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SANDIA REPORT

The State-of the-Art Port of Entry Workshop

Brad Godfrey

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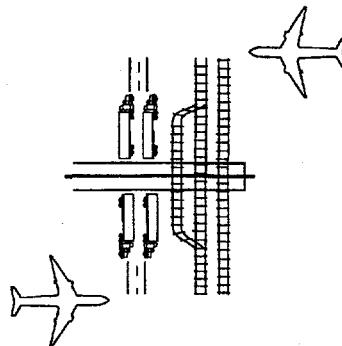
The State-of-the-Art Port of Entry Workshop

Albuquerque, New Mexico
July 14–15, 1994

Sandia National Laboratories
Federal Highway Administration
New Mexico State Highway & Transportation Department
Science Applications International Corporation
Alliance for Transportation Research

Abstract

The increased demand for freight movements through international ports of entry and the signing of the North American Free Trade Agreement (NAFTA) have increased freight traffic at border ports of entry. The State-of-the-Art Port of Entry Workshop initiated a dialogue among technologists and stakeholders to explore the potential uses of technology at border crossings and to set development priorities. International ports of entry are both information and labor intensive, and there are many promising technologies that could be used to provide timely information and optimize inspection resources. Participants universally held that integration of technologies and operations is critical to improving port services. A series of Next Steps was developed to address stakeholder issues and national priorities, such as the National Transportation Policy and National Drug Policy. This report documents the views of the various stakeholders and technologists present at the workshop and outlines future directions of study.

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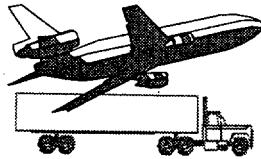
EXECUTIVE SUMMARY

Purpose of Workshop

The increased demand for freight movements through international ports of entry and the signing of the North American Free Trade Agreement (NAFTA) have increased freight traffic at border ports of entry. State-of-the-art technologies offer the possibility of reduced delay time while maintaining inspection requirements. The State-of-the-Art Port of Entry Workshop initiated a dialogue among international port-of-entry stakeholders and technologists to explore potential uses of technology at border crossings and to set development priorities. While some of these technologies can be useful at interstate ports of entry, this workshop focused on international border crossings.

As a result of the workshop, stakeholders were acquainted with the possible technology improvements, and technologists were informed about port-of-entry problems.

Results

The most obvious outcome of the workshop is the high level of interest in making international ports of entry both efficient and effective. A wide variety of stakeholders were represented at the workshop, from federal and state agencies to private interests. Stakeholders noted that they are working under increasing constraints (increasing freight movements, decreasing manpower, more regulations, and increasing time criticality) in the face of increasing demand. Users and operators recognize the basic tension between inspection thoroughness and expediting freight movement. There can be tension between federal and state agencies but great gains can be made through cooperative efforts. It was noted that NAFTA will have significant impact on both federal and state operations with commercial vehicles. The result is that stakeholders are willing to work as a team to improve performance.

Ports of entry are both information and labor intensive, and there are many promising technologies that could be used to provide timely information and optimize the effectiveness of inspection resources. However, any technologies introduced must enhance operations at a reasonable cost.

Next Steps

Post-workshop surveys were sent to all participants to elicit their views on next steps. Their comments suggest the following guidelines for the next meeting:

- Take a team approach.

- Include data processing and information systems.

- Analyze interagency and federal/state operations.

- Focus on both enforcement and facilitation.

- Focus on port operations first, then define opportunities for technology introduction.

- Address state operations at border crossings in relation to federal efforts.

These criteria can be satisfied by collecting information from participating agencies in both Mexico and the U.S. and analyzing interrelationships to prepare for the workshop. A focused analysis can be achieved by examining a specific port that is as representative as possible. The following program would accomplish these objectives:

- Identify agencies and requirements, including mission statements, information sources, databases used, agency interactions, and performance measures.

- Map and model the current process of freight movement through the ports for road, rail, and air modes.

- Analyze opportunities for performance improvement, using the process model and small planning groups.

- Conduct a workshop to evaluate the feasibility of implementing the improvements and to suggest others, and reach a consensus on a plan for the selected port, if possible.

- Transfer the process used to other ports in both the U.S. and Mexico, at their request.

Taking these steps offers opportunities to address several national priorities. National Transportation Policy is enhanced by the use of intermodal transportation systems that result in greater efficiency, mobility, and accessibility. Advanced inspection technologies support National Drug Policy with improved defenses against narcotics entering the U.S.

Other benefits of implementing advanced technologies at the border include innovation of port-of-entry design and operation, including interagency cooperation (National Performance Review—Reinventing Government). Public/private funding serves both government and commercial interests (Cost Reduction), and development of dual-use technologies required for national security can continue by using them to support border needs as well (Defense Conversion and Dual Use Technology). Air quality problems are improved by faster movement of vehicles (Clean Air Act Amendments/Border Environmental Cooperation Commission). New border facilities enhance U.S./Mexico trade opportunities (NAFTA/U.S. Trade Representative), and jobs are created by a facility that is attractive to shippers, consignees, brokers, suppliers, and industrial developers (Enterprise Zones).

A number of critical national priorities are addressed by border crossing improvements.

Implementation of this program could address these national objectives *and* achieve tangible improvements in local operations in a single project, a rare opportunity.

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FIGURES

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NOMENCLATURE

ABI	Automated Broker Interface
ACS	Automated Commercial System
AEI	Automatic Equipment Identification
ARPA	Advanced Research Projects Agency
ATM	Asynchronous Transfer Mode (communications)
AVC	Automatic Vehicle Classification
AVI	Automatic Vehicle Identification
BCR	Background Commodity Research
despacho previo	Prior clearance and payment on railways
DOT	Department of Transportation
EDI	Electronic Data Interchange
FNM	Ferrocarrilles de Nacionale México (railway)
GIS	Geographic Information System
HAZMAT	Hazardous Materials
HDTV	High definition television
HELP	Heavy-Vehicle Electronic License Plate, Incorporated
HF	High Frequency
INS	Immigration and Naturalization Service
IMT	Institute of Mexican Transportation
IRD	International Road Dynamics, Incorporated
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITS	Intelligent Transportation Systems
JIT	Just-In-Time (manufacturing process)
LAN	Local Area Network
NAFTA	North American Free Trade Agreement
PFNA	Pulsed Fast Neutron Activation
POE	Port of Entry
RF	Radio Frequency
SAIC	Science Applications International Corporation
SCT	Secretariat of Communications and Transportation (Secretaria de Comunicaciones y Transportes)
SMDS	Switched multi-megabit data service
SNL	Sandia National Laboratories
SONET	Synchronized Optical Network
STARBASE	System Tracking and Response Base
TPASS	Toll Plaza Application Simulation System
USDA	United States Department of Agriculture
VHF	Very High Frequency
WAN	Wide Area Network
WIM	Weigh-in-motion
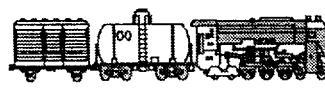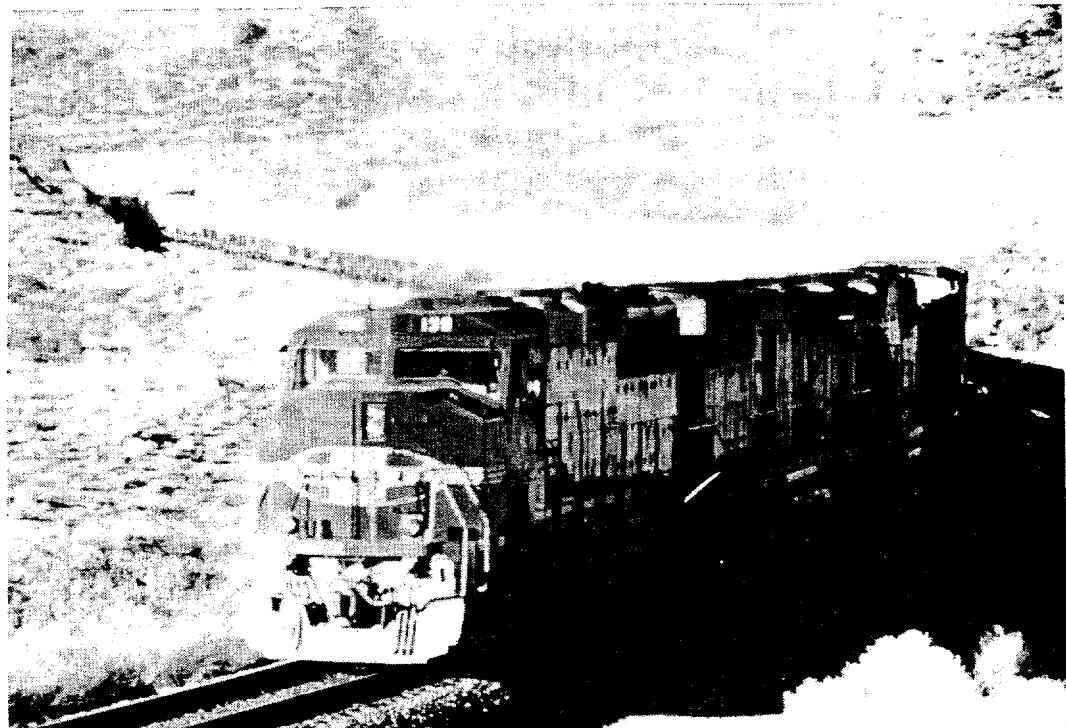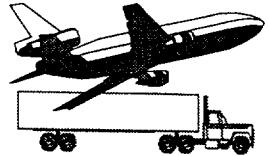
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THE STATE-OF-THE-ART
PORT OF ENTRY WORKSHOP

INTRODUCTION

The growth of the U.S. economy depends on the efficient movement of
people and goods across the international borders with Canada and
Mexico. Although the North American Free Trade Agreement (NAFTA)
may increase trade with both Mexico and Canada, the promise of NAFTA
can be realized only if the international ports of entry through which that
trade must flow can handle the increase. Given the volume of this trade,
even small investments in port-of-entry efficiency can yield enormous
returns. As the pattern of government research and development
changes from military to civilian projects, the investment of funds in
technologies to increase port-of-entry efficiency stands out as a way to
reduce transportation costs, enhance the security of border crossings,
provide additional protection from the risks of transporting hazardous
materials, and increase U.S. competitiveness in the international
marketplace.

THE WORKSHOP

A port of entry involves complex interactions of state, local, and federal governments, and private-sector interests on both sides of the border. All of these must be considered in planning and coordinating technological improvements to new or retrofitted ports of entry to meet growing demand. The State-of-the-Art Port of Entry Workshop, held at the Albuquerque Hilton on July 14 and 15, 1994, brought a broad selection of these diverse international interests together with technology providers for the first time to consider technological options that address common problems facing ports of entry, particularly those on the U.S./Mexico border.

Users	Technologists
U.S. Customs	Sandia National Laboratories
U.S. Dept. of Agriculture	Science Applications Int'l Corp.
U.S. Immigration and Naturalization Service	BDM
U.S. Dept. of Transportation	HELP Inc.
Federal Highway Administration	Lockheed
Secretaria de Comunicaciones y	Los Alamos National Laboratory
Transportes	Advanced Research Projects Agency
Border State Departments of Transportation	Alliance for Transportation Research
Southern Pacific Railroad	Wilson and Company
Atchison Topeka & Santa Fe Railway	Bohannan-Huston
Customs Brokers	International Road Dynamics
New Mexico Motor Carriers Association	Alex Mills Development
Instituto Mexicano del Transporte	Scientific Atlanta
Grupo Summa	Syntonic

Figure 1. Participating Organizations
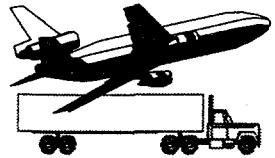
This workshop was basically a starting point; no technical detail or specific new projects were recommended because of the need for further analysis. The two-day schedule allowed only glimpses into the issues and possible technical solutions, and the participants, although representative of border interests, did not include all stakeholder groups. Therefore, this workshop should be viewed as a preliminary scoping of the problems, a top-level review of how technologies might improve port-of-entry processes.

STAKEHOLDER PARTICIPANTS

The international port-of-entry stakeholders at the workshop came from a variety of public and private entities, with about 90 individuals attending. Federal transportation and inspection agencies contributed important insight to the panels. Public agencies and private interests from the U.S. border states were represented, and a number of technology providers were present.

Inspection Agencies

Workshop participants came from a variety of federal inspection agencies, including the U.S. Customs Service, the Immigration and Naturalization Service (INS), and the U.S. Department of Agriculture (USDA).

The focal point for U.S. inspections is the Customs Service at approximately 250 U.S. ports of entry. Customs is responsible for enforcing all 400 or so laws on goods entering and exiting the U.S. The inspection agencies identify people and freight at border crossings, and inspectors can use a broad variety of means to examine whatever conveyance is passing through their port. The difficult job of the inspection agencies is to balance law enforcement efforts against commodity movement. Key to this is the concept of focusing on probable offenders through historical evidence and pre-clearance of legal traffic. Improved inspection technologies are clearly an ongoing interest of these agencies.

Besides their concerns for detecting illegal drugs and safety infractions, inspection agencies are also concerned about hazardous material (HAZMAT). Also, inspectors are required to ensure that infectious livestock and plant life do not cross international borders, endangering indigenous species.

Agricultural inspections by the USDA are very labor intensive and can involve lengthy delays because little technology has been developed to identify plant and animal diseases automatically. The USDA also X-rays bus cargo to ensure that it is disease free. The USDA performs background commodity research, called a BCR, looking back five years for histories of pest problems and similar concerns. Using these data coupled with a risk analysis, USDA focuses its inspection efforts on those shipments with the highest likelihood of having problems.

U.S. Transportation Interests

Departments of transportation from the U.S. border states and the New Mexico Taxation and Revenue Department were present at the workshop. The border states are likely to share increased revenues generated by increased border traffic, but they will also bear some of the burden of providing infrastructure improvements. Private stakeholders were represented by the railways, the New Mexico Motor Carriers Association, customs brokers, and shippers. Two railroads with international connections were present: the Atchison Topeka & Santa Fe and the Southern Pacific. These private-sector businesses are interested in the potential use of technology to make border crossings more efficient and less costly.

Mexican Interests

Because 70% of Mexican commerce involves the U.S./Mexico border, Mexico is very interested in improving already congested conditions at the border. The Mexican government was represented by the Secretaria de Comunicaciones y Transportes (SCT) and the Instituto Mexicano del Transporte (IMT). The IMT is researching many areas, including how to promote industrial development through transportation improvements. The IMT works with universities and research laboratories on
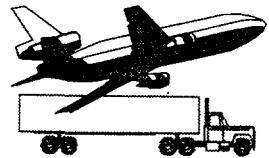
infrastructure optimization and on specifications for the transport sector. The SCT is conducting feasibility studies to support projects for improving port-of-entry efficiencies.

Technologists and Designers

Technology providers from both government and private industry attended. Government technologists were the Department of Defense's Advanced Research Projects Agency (ARPA), Sandia National Laboratories (SNL), Los Alamos National Laboratory, and the Alliance for Transportation Research, a consortium of New Mexico universities, national laboratories, and the state transportation department. Large private firms in attendance were BDM Federal, Lockheed, Science Applications International Corporation (SAIC), and its subsidiary, Syntonic. Smaller firms at the workshop were HELP (Heavy-Vehicle Electronic License Plate), Incorporated; International Road Dynamics (IRD); and Alex Mills Development. Architecture and engineering firms in attendance were Bohannan-Huston and Wilson & Company.

WORKSHOP APPROACH

This workshop was developed to bring a disparate set of parties (border-crossing stakeholders and technologists) together. They began thinking about how to solve a common issue: the application of technology to improve port-of-entry inspection activities and freight movement. Overviews from the perspective of Mexico and U.S. transportation agencies were given at the beginning of the workshop. There were also presentations on port-of-entry design and typical operations at border crossings. (See Appendix B, Agenda.)

The workshop brought together international port-of-entry stakeholders and technologists to begin a dialogue on possible technical improvements, particularly at the U.S./Mexico border crossings. It became clear that many attendees were unfamiliar with each other's work.

To help the technologists understand the needs at border crossings, there were plenary briefings from the user community (U.S. and Mexican transportation agencies, inspection agencies, and shippers, including customs brokers). There were also briefings on technologies and applications to help the port-of-entry users understand the available and developing technologies.

A user/technology team sorted through the issues that arose in the user briefings and assigned them to the port-of-entry functions (as defined in Chapter 3). The team reformulated and added to these issues for use in the facilitated workshop sessions. Each workshop had a mix of border-crossing stakeholders and technologists that went through the specific list of issues. They then decided which technologies applied to a particular port-of-entry function (such as tariff and fee collection) and which areas needed help beyond what technologies could offer.

A final session briefed participants on the results of each of the facilitated workshops and showed some potential impacts of workshop recommendations on port-of-entry design and operations. After the workshop, evaluation forms were sent to each attendee to obtain consensus on the topics for future workshops.
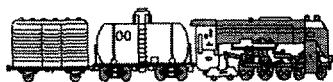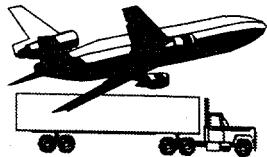
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BACKGROUND

RELATED PROJECTS

Because border transportation issues are becoming more pressing national concerns, a number of state and federal agencies have formed interagency organizations to take a broad look at the impact of increased trade on port-of-entry infrastructure.

Task Force on Border Infrastructure and Facilitation

The federal interagency Task Force on Border Infrastructure and Facilitation was formed in January 1994 to examine the nature of traffic congestion at major international U.S. land border crossings. The principal objective of the recommendations of this group is to achieve coordinated short- and long-term changes in border planning, management, and financing (affecting both operations and infrastructure). This activity will facilitate efficient, cost-effective movement of people and goods while maintaining safety and security.

Task Force recommendations address many of the issues raised at the workshop. They include the following:

- Set a standard that defines "border efficiency."

- Improve coordination of Customs Service and INS operations.

- User tolls, user fees, and private sector funding.

- Expand and standardize the use of electronic data interchange.

- Use pilot programs to test innovative concepts and new technologies for border-wide benefits.

Membership includes officials of the National Economic Council, Department of Transportation, State Department, the General Services Administration, Customs Service, Immigration and Naturalization Service, Department of Agriculture, Department of Commerce, Office of Management and Budget, Environmental Protection Agency, U.S. Trade Representative's Office, and Council of Economic Advisers, with participation by the Interstate Commerce Commission.

- Develop a regional planning approach for new and expanded border crossings and related infrastructure.

- Utilize and coordinate FHWA early deployment on priority corridors.

Although the Task Force has a short life, appropriate member agencies will be charged with implementing the recommendations that are approved by the Administration. A summary of workshop results was sent to the Task Force.

Intermodal Surface Transportation Efficiency Act of 1991

The Federal Highway Administration of the U.S. Department of Transportation has completed the Report to Congress required by Sections 1089 and 6015 of the Act. The report, *Assessment of Border Crossings and Transportation Corridors for North American Trade*, addresses the problem of border station congestion and recommends "the use of new technologies for facilitating the movement of people, cargo, and vehicles through major border crossings." Also, the report recommends utilizing and coordinating Intelligent Transportation System (ITS) field operational test project results.

Southwest Border Transportation Alliance

A request for developing performance measures at ports was submitted to the Alliance on behalf of State-of-the-Art Port of Entry Workshop participants.

The Southwest Border Transportation Alliance is an organization of state transportation planning agencies from the four states bordering Mexico. Members of the Alliance are currently taking steps toward a major binational study that would include participation by the six Mexican border states. This organization offers the opportunity, and perhaps some resources, for addressing problems of federal-state cooperation at ports of entry in both countries.

Other Projects

Several other related projects are under way. They include a research and development program for drug detection being conducted by ARPA, a project to share information among drug enforcement agencies being conducted by the Defense Information Systems Agency; the development
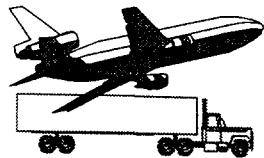
of detailed process maps by Customs and INS to improve coordination; mobility improvement for Niagara International Transport through the use of advanced technology, and participation in binational and trinational forums such as the newly established joint Working Committee on Border Transportation Planning.

CURRENT OPERATIONS

Many of the present international ports of entry separate commercial from noncommercial traffic. Noncommercial border crossings have a primary (quick) inspection area. Individuals who do not pass this inspection proceed to a more intensive secondary inspection area. Those that fail the secondary inspection are sent to the impoundment lot. Those that pass inspections go to the toll booths before exiting the facility. The commercial ports of entry also have quick release booths, followed by a secondary inspection dock where the commercial vehicle unloads, and finally an impoundment lot for those failing inspections or a toll booth for those that pass.

A 1979 Texas Transportation Institute study reported that the capacity of a noncommercial lane is about 100 to 150 vehicles per hour.

In 1992, 20,000 rail cars per month crossed the border at Laredo, and 5,000 rail cars crossed per month at El Paso [Table 1]. One rail car can have up to ten double-stacked containers. From the time when a train arrives to when it departs is approximately one to two days at the larger crossings, and it can take three or more days in Laredo. It takes about two hours (three to eight hours at Laredo) for U.S. Customs to check a train without inspecting its load. U.S. inspections can take up to 24 hours at the discretion of the inspector. Mexican inspectors have a random red light/green light system for selecting rail cars for inspection. If one of the containers is unloaded for inspection, the other containers on the same car are held up also. A method called *despacho previo* allows bonding before the train arrives at the border. All railroad cars in interchange service were required to be equipped with Automatic Equipment Identification (AEI) tags by January 1, 1995, to automate processing.

Table 1. Ports of Entry for Rail Between Mexico and U.S.		
Port	Volume (1992)	Avg Time for Customs Checks (without inspection of load)
Laredo, TX	20,000 Railcars/Month	3-5 Hours
El Paso, TX	5,000 (est.)	2 Hours
Nogales, AZ	2,500	2-3 Hours *
Eagle Pass, TX	2,500	2 Hours
Brownsville, TX	3,500	1 Hour
Presidio, TX	—	—
Tijuana, MX	—	—
Calexico, CA	700	—

From arrival at border yard until across the border is 1-2 days. Inspection may slow crossing by 24 hours.

* 6-15 hours during perishable season   Source: Workshop presentation

CHANGING NEEDS OF SHIPPERS AND CARRIERS

The Big Three automobile makers need a pipeline of products; however, if parts do not arrive and the assembly line has to shut down, a plant could lose $2 million per day in production.

A major change in recent freight transport comes from companies receiving Just-in-Time (JIT) deliveries from producers, in effect using the conveyance as a rolling warehouse of stock. This is especially evident in the *maquiladora* twin-plant international manufacturing process. The traffic requirements for the JIT process not only require rapid freight movement but also predictability and reliability of freight arrival.

Containers and trailers moving in and out of Mexico by rail come from the U.S. domestic pool; even the racks that freight is moved in must be returned to the U.S. pool. The U.S. railways co-schedule rail traffic with Ferrocarriles de Nacionale México (FNM—the Mexican national railroad). There is a domestic bill of lading from the origin to the border, where freight must be rebilled to go from the border to its destination. One improvement being developed is a through bill of lading from origin to destination across the border. A growing amount of freight is shipped via intermodal carriers where better service is expected to offset the additional cost. The carriers essentially sell service, and it is important to avoid congestion at borders and other delays that may hamper their service.

As an example of current international rail freight movements, commodities moving from Long Beach to Mexico City via rail will spend about 32 hours from Long Beach to El Paso and another 60 hours from Juarez to Mexico City. However, freight can spend two to four days at the border; a guaranteed 24-hour delay would fit the transportation providers' needs much better. Most of the delays are from lack of documentation by the initial seller (who may reside outside the North American continent), and as noted earlier, inspection problems can hold up a partial load.

The railways have begun implementing *despacho previo* with Mexican customs to allow prior clearance and duty payments before the train reaches the border. However, the train is still subject to the red light/green light process. The development of electronic data interchange (EDI) will allow shippers to log onto a computer database to locate and determine the status of their shipments.

However, these solutions do not deal with a basic problem: there are a large number of players that interact with the railways at the border, including U.S. and Mexican customs, customs brokers, immigration services, agriculture inspection agencies, and freight forwarders. All these agencies and firms have their own procedures and documentation. The one-stop shopping concept, that is, having a single multinational agency as a point of contact for all border crossing issues, may be useful here.

As JIT manufacturing becomes more popular, the number of trucks servicing small businesses and remote areas will increase, as will traffic through border crossings. To expedite freight traffic, inspection agencies can focus on stopping carriers that are not in compliance and let the carriers in compliance bypass lengthy examinations. Truckers that are in compliance need not bear the brunt of inspection fees either. The goal of truckers in compliance is to cross borders as easily and with as little delay as passenger vehicles.

The customs brokers are the interface between the inspection agencies and the transportation providers. They are the legal representation for importers and exporters, and they facilitate movement of shipments. They provide information to all the agencies, typically through the

Given the cost of engine crews, track space, switching, and car hire, total costs of border delays to a railway company can go as high as $1000 per car per day, not counting the cost of disgruntled customers.

One of the main needs for trucking firms is to reduce the duplicative paperwork. Often a 6-inch stack of documentation is required for a truck to go through an interstate port of entry.

automated broker interface (ABI) of the automated commercial system (ACS). A key need in the broker's job is the ability to access information on-line about any shipment, from origin to destination. Brokers also need to be able to locate shipments and identify reasons for delay. In this way, brokers can quickly locate problems at the border and apply release procedures appropriate for the commodity, importer, or shipper. Other major needs of customs brokers are the ability to track commodity movements after their leaving customs and to link the conveyance with the shipment. Methods and technologies that can reduce human data entry error and validate stored information are also important.
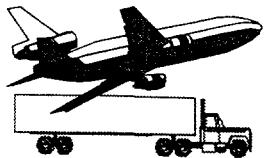
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FUNCTIONAL ISSUES

An international port of entry is very complex, and a wide variety of stakeholders discussed an even broader range of issues. A port of entry can be viewed several ways. One way is by the transportation aspect of interest, whether it is the vehicle, its driver, or its cargo. There are regulations for each aspect that focus on different port-of-entry operations.

The other way is by enforcement agency. There are federal, state, and possibly municipal and third-party interests for both Mexico and the U.S. These interests can easily compete or conflict because so many agencies are involved. Thus, many issues raised in the facilitated workshops could not be solved only by incorporating state-of-the-art technologies. Often organizational concerns are a greater problem. For this reason, the workshops were not restricted to associating technologies with issues, but were allowed to address issues that also need administrative attention. These are covered in Chapter 4, Management Issues. The functional issues examined in this chapter are listed in Figure 2.

Appendix C, Technologies, contains a more detailed explanation of the technologies.

While this workshop is only a first step in improving international ports of entry, some key themes came out of the discussions. First, a high level of interest exists in improving both the efficiency (expediting freight) and

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ISSUES

- Fee and Tariff Collection
- Inspection
- Information and Communications
- Access Control and Security
- Systems Integration

Figure 2. Port-of-Entry Functions

effectiveness (having thorough inspections) of border crossings. Keys to obtaining both goals are (1) standardization and simplification of processes and documentation and (2) capability to target vehicles and pedestrians for inspection selectively.

The key to making any of these technologies useful is ascertaining what functions need to be accomplished at an international port of entry. With a given set of requirements, systems integrators can blend these technologies for maximum impact on operations while planning for upgrades as more sophisticated equipment becomes available.

Standardization and simplification easily come from computer-based tools because information is the focus of many port-of-entry processes. Technologies and procedures that have common user interfaces and automate many of the redundant information checks will facilitate traffic flow through border crossings. An example of these technologies is the electronic data interchange (EDI), which standardizes interaction with computer databases.

Inspection selectivity also comes from computer tools such as classification methods and historical databases. Tools that will be the most effective allow operators to focus on what humans do best, such as making visual assessments, and let the computer do the intensive data searches and comparisons. An example of these technologies is automatic vehicle identification (AVI), which takes sensor or transponder information and compares it to records kept in a computer database.

Pre-clearance of freight (in terms of electronic credentials, on-board monitoring, automatic roadside inspection, and HAZMAT identification and tracking) can expedite legal traffic and focus inspection efforts.

FEE AND TARIFF COLLECTION

A port of entry has a revenue-producing function that needs to be considered. First, not only are fees being assessed, but tariffs and sometimes penalties or fines are also collected at border crossings. These may be prepaid, collected as cash or noncash, or waived. Also, there are annual and one-time fees, and per-use fees. Revenue is collected for passage of the cargo, the driver, and/or the vehicle through the port. Because of the cash involved, toll systems have a dollar loss of 20 to 30%.
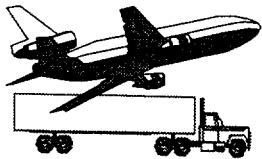
Federal agencies are concerned with customs duties (usually paid in a noncash manner) on the cargo. The duty is assessed according to cargo classification and intrinsic value. The INS performs credential checks on the vehicle drivers. State agencies require that moneys for state corporation commission stamps are collected according to cargo classification. State agencies also perform a driver credential check, collect fees for highway use, and assess fines for overweight loads.

Federal agencies collect user fees on vehicles that may be per-trip fees (paid in cash) or an annual prepaid fee. State agencies issue trip permits to vehicles by the vehicle's weight and the expected distance to be traversed by collecting cash payment. If the vehicle is too large, the state collects a penalty paid by cash or credit. For vehicles carrying HAZMAT, the state collects both per-trip (paid with cash) and annual prepaid fees. In the future, states may wish to collect fines for vehicles that fail air quality assessments. Municipalities or another third party may collect fees for trucks crossing international bridges, assessing fees by the number of axles and accepting payment by cash or credit. Also, private concerns may sell insurance for the vehicle.

Technologies could facilitate truck freight movement through ports of entry and still effectively assess and collect revenue. These technologies would need to collect information on the tractors, trailers, and cargo separately. Information about tractor physical characteristics and operating data (such as odometer readings), trailer physical characteristics, cargo characteristics, and shipper history could be put into transponders, that is, radio devices that would automatically convey pertinent information to border facilities. The transponder attached to the tractor would communicate all the information from the tractor, trailer, and cargo, and the data could be compared to data from a bill of lading or other shipping documents. This setup would require transponders, portable readers, stationary or fixed readers, and a central database to manage data access and management functions.

Transponders, tags, and seals store information and relay it across a communication link to the port of entry. Their data may be permanent, or may be reprogrammable. They may also contain computers to assess and report sensor data.

Present transponders may be inadequate to handle the load of information transferred at international borders. The driver's personal credentials and trip information (including company history) may need to be put on transponders to be quickly read into port-of-entry computers and compared with regional database information.

These transponders would also need to handle information relating to on-board cargo monitoring and support roadside safety and emission inspection services.

Many benefits would result from this sort of automation. International customs agencies would have increased compliance from the automated validation and would improve their record of correctly assessed commodity tariffs. Their operation would be more efficient, permitting faster traffic flow, and would promote more secure transfer of revenues collected. In turn, the government would have more effective utilization of port operators and facilities, which should translate into lower costs over the long run and more secure transfers of revenues collected.

Private vehicles mixed with freight traffic could have expedited clearance under this system. Shippers can also be given expedited clearance and a better ability to track the movement of goods, facilitating their scheduling ability with an automated, accessible system. Shippers would have the financial benefits of less wear and tear on vehicles because delays would be minimized at the port of entry and more conveyances would be rolling at any given moment. Automated movement of funds would be more efficient and more secure, given modern auditing software packages. Finally, automated information collection and analysis could give the shippers more information for correcting any problems occurring en route.

INSPECTION

There are various reasons for inspections at border crossings: to detect contraband and illegal aliens, for safety, and to weigh the vehicle.

In particular, contraband inspection is expensive because it is labor intensive, and the agencies are increasingly short on manpower. However, the costs of failing to find contraband during inspections can be even greater. Deaths and employee absence and ineffectiveness from illegally imported drugs are two examples of these costs, and black market imports cost jobs. Risk analyses are performed to determine
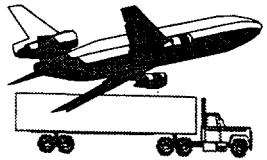
where diminishing returns exist in the inspection process so that agencies do not overallocate resources.

A main issue for the inspection community is how to focus limited resources onto specific criminal activity. Inspectors realize that only a small percentage of port users are real problems, and holding up traffic to inspect every vehicle is counterproductive. Inspectors would be more effective rigorously inspecting the subset of the traffic that contains the criminal element.

More effective inspection depends on the effective selection of those inspected. Some agencies (such as the INS) may have a 100% inspection rate. Other agencies (such as Customs and the USDA) may have inspections at the point of origin for the commodity combined with random inspection at the border crossing. Effective use of selection technologies would greatly improve inspection thoroughness.

More point-of-origin inspections will directly reduce the congestion at border crossings and increase the thoroughness of inspections. However, once the inspection has taken place outside the port of entry, container seals must remain intact with high integrity throughout the trip if these items are to pass through the border crossing without a second inspection.

Today's electronic tagging and seal technologies are a good match to the problem of assuring freight integrity after inspection at the point of origin. Because proprietary information needs to be stored on the electronic tags and seals, they need to be secure. The data should be accessible only by parties with the proper need to know. Additionally, it may make sense to use seals that emit an alarm when the tag or its protected cargo has been tampered with or damaged, and that can aid in locating lost containers. On-board cargo monitoring, security, stability, emissions, and other environmental factors could be logged on the tag and reported later.

Information access and processing are integral to the inspection operation. Inspection is information intensive because not only the present status of each shipment is important, but also the history of the driver, shipper, and receiver. These are keys to selecting the appropriate

vehicles on which to concentrate inspection resources. This historical information needs to be available and easily accessible at more than one port of entry, even though some of the information may be private or proprietary. One focal point is at intermodal connections where tags for container identification could eliminate confusion during mode changes.

INFORMATION AND COMMUNICATIONS

Information processing and dissemination are central to most port-of-entry functions, and workshop participants approached this function as a series of process improvements, such as dissemination of information to appropriate parties. This process can otherwise be described as allowing the information to be retrieved by a wide variety of users, but limiting full access to those with the proper need to know.

Allowing shippers, as well as port-of-entry personnel, access to status and location data for cargo at border crossings would aid in scheduling freight passing through the ports. Cargo could be tracked as it moves through border inspections, and regulatory agents could track shipments and keep an electronic audit trail after inspections to ensure that the shipment is moved legally. There are other stakeholders, such as customs brokers and government record keeping and statistics agencies, that would benefit from easier access to border crossing data appropriate to their functions. Many of these information customers and many of the data to be collected are remote to the ports of entry, requiring reliable, high-information-rate communications with the facilities.

Besides facilitating shipping operations, improved information and communication services would also aid border inspection and enforcement agencies. Retaining and passing historical information about the drivers, transportation companies, and cargo origins would allow Customs and other agencies to be more selective in their inspections. For example, Customs could require more comprehensive inspections on goods associated with companies having a history of inspection and documentation problems. At the same time, Customs could do less thorough inspections or even bypass freight coming from

companies with good histories. This would focus inspection efforts on the "bad guys." Also, this would give port-of-entry customers a strong incentive to keep a clean record and good documentation because their service would be expedited as a result.

Another improvement needed at ports of entry is the ability to quickly stop "runners," criminals that try to run through the port without submitting to inspections and fee collections. Once a runner is detected, a delay apparatus needs to be activated. Because runner actions span a very short time, an automated system would aid greatly in solving this problem.

Communication technologies for improving these processes include wireless two-way communications between port-of-entry operators and vehicle drivers. This could be a cheap and useful way for sending bypass information directly to the driver. This would allow the port-of-entry operator to assess driver competency based on slurred speech and incoherence, indicating intoxication. More sophisticated communication between port computers and the tags on the cargo and vehicle could provide automated validation of pre-cleared shipments and permit rerouting of cleared vehicles to bypass lanes.

Some multimedia technologies are commercially available to support international border crossing services. Other communication systems under development could also aid in disseminating port-of-entry information. A multimedia communication system as part of the border crossing computer network would have the ability to send photographs scanned into the system across the whole network. The asynchronous transfer mode (ATM) technology allows for rapid dissemination of large amounts of data, such as photos. Development of wireless ATM will allow a mobile system to have the same transmission and network capabilities as the port of entry. Broadband encrypted communication systems would allow operators to disseminate data over wide areas while maintaining information security. Many of these technologies are part of the HELP project and are being considered as part of a development effort for a private, commercial transportation information network.

Vehicle barriers are available that can stop a truck in motion. Sticky foam can be dispensed at criminals running security blocks, instantly binding them to their surroundings.

Transponder tag data could include arrival and departure times, report on intermediate shipment locations, control access, provide yard inventory, automatically collect tariffs, and provide automated identification.

The communications systems may be tied in directly to other equipment at the port of entry. Wire and wireless communication systems allow a stand-alone computer at a border crossing to be part of a regional or even global information network, given satellite communication technology. Sensors and scanners at the border crossing, as well as remote sensors and transponders, can send information directly to the facility's main computer system for automatic processing.

Systems can be designed so that instead of overloading port operators with data from various sensors, computers could filter data, noting which vehicles need special attention. If the port's security systems were tied into a communication system, port operators could actuate barriers remotely. Having sensors, transponders, and security systems communicate with a central computer system at the border crossing allows automatic actuation of security measures when problems are sensed, such as obvious gate runners.

Continuing development of portable workstations and HDTV displays will focus on making low-cost rugged equipment for use at remote locations.

Many technologies are being developed that would be useful in the port-of-entry computer operations room. Given the amount of information coming in through communication lines, high definition television (HDTV) technology may be worth pursuing. HDTV would allow operators to display whole sets of data rather than paging or panning through several screens of data. Since information is a key commodity at a port of entry, databases that store this information are the focal point of many operations. Two database technologies that may at first seem competitive are actually similar in function: integrated and distributed databases.

Integrated databases link information obtained and stored by disparate agencies into a master catalog of data. This technology would be useful at border crossings because there are so many stakeholders (such as various inspection agencies, brokers, and revenue collection agencies) that need reliable information about the vehicles and cargo passing through the facility. Traditionally, this information is stored in individual repositories that are maintained separately, increasing not only the workload of information processing, but also increasing the probability of inconsistencies across databases. Integrating the data into a secure, linked database would allow individual agencies to maintain control over
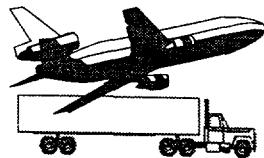
their data responsibilities while reducing duplication of efforts and associated data inconsistencies.

Distributed databases take the linking process a step further by allowing each information manager to maintain control over his database while allowing simple data retrievals over a large network. This technology would be useful in distributing the data responsibilities across all the ports of entry, instead of centralizing all the data into one mainframe. Centralization may have some of the advantages of integrated databases. However, one disadvantage is that there is a single point of failure (i.e., "the main computer is down"). Another problem is that those who have the most knowledge about the data are remote and, therefore, tend to lose control of data maintenance. Research in distributed database technology is heading toward maintaining databases locally while allowing simple nationwide access. This would allow each port to have its own data in integrated databases but to be linked to distributed databases at other border crossings.

Many of the data access problems can be solved by having a standardized EDI through which data are retrieved. Much of the technology is available now; standardization, however, requires administrative resolution and control over the various data formats. If the interfaces can be standardized, the following step allows for electronic documentation. It may appear that electronic documents are more ephemeral than paper documents. However, they provide rapid consistency and fraud checks because much of the information can be automatically accessed by a computer network.

Vehicle, driver, and cargo data consistency checks can be more sophisticated, catching a higher percentage of fraud and error, using computer-based techniques under development. Mathematical algorithms and software, such as neural nets, can quickly and accurately classify vehicles, given minimal sensor data (time periods between truck wheels crossing highway traffic tubes). With access to other sensor data and historical information in an integrated-distributed database, these technologies will be able to identify vehicles quickly and check consistency with their electronic documentation. Classification/identification data can be fed into modern risk analysis routines automatically so that operators can have real-time information on each carrier. Thus, inspection

agencies can spend more resources on carriers who have been problems.

Many aspects of these information and communication systems are commercially available. Other technologies are ready for field testing. Some technologists feel that additional studies and analyses will only delay deployment of these services.

Port-of-entry automation will be challenged by commercial vehicles that can carry, maintain, and transmit on-board electronic credentials while monitoring results and changes in travel plans. Current vehicle tags will need to be replaced by those with in-vehicle processing units to support all of the services for commercial vehicles. A commercial vehicle information exchange network will be needed to support a state-of-the-art port of entry.

ACCESS CONTROL AND SECURITY

Several issues were raised in the workshop that related to security at ports of entry and controlling access to data, equipment, and facility personnel. The basic access control issue is facilitating movement of legal traffic through border crossings while simultaneously limiting unauthorized access to any part of the same facility. Legal traffic movement can be expedited by keeping unnecessary contact with port-of-entry personnel to a minimum. This is basically the selection/bypass process mentioned in earlier sections. Limiting unauthorized access means ensuring that port-of-entry personnel and equipment are physically protected from intruders. Access control also includes disallowing unnecessary access to private and proprietary data stored at the facility.

An even more intriguing problem is control at a multi-use facility where state and federal entities co-exist. Port-of-entry security involves validating that vehicles, personnel, and cargo have proper accreditation for being on the premises. Many problems with quickly identifying illegal people and items on port-of-entry property may be solved with rapid background checks. Consequently, maintaining and accessing historical
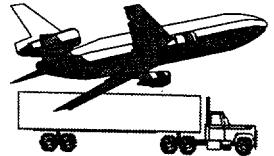
records are important. Once intruders are detected, there needs to be a method for stopping them without interfering with operations. This is the "runner" problem mentioned earlier in which an individual or vehicle needs to be stopped with minimal interruption to the main traffic flow.

Again, technologies that apply directly to access control and security include both communication and information tools. Physical barriers for vehicles and pedestrians (such as hydraulically actuated barriers for stopping vehicles and dispensed foams for disabling people) limit access internally or externally to a border crossing.

Two-way communications between port operators and vehicle drivers can facilitate traffic movement by limiting direct contact to only what the port operator deems essential (e.g., visual sobriety checks). AVI and automatic vehicle classification (AVC) technologies can give port operators information prior to vehicle arrival. This can help expedite passage or focus inspection efforts, either way segregating legal traffic from those who need more attention. Sensor systems placed at border crossing entrances and remote to the facility would be part of the AVI/AVC system along with an automatic assessment system in the facility computers (or possibly embedded in the sensors). This system could be integrated with facility security systems to activate bypass switches or barriers automatically, whichever may be needed.

Syntonic's TPASS simulation shows that manual toll collection can handle 300–500 cars per hour, while an AVI/transponder system has a through-put of 1400–1700 vehicles per hour.

Automated traffic control sensors inside the border station could determine where long queues exist downline and reroute traffic inside the facility accordingly. Pre-inspected loads might be deemed a low enough security risk at these times to allow complete bypass of inspections or only a small percentage of the pre-cleared traffic could be routed into the main inspection lines.

The data in the AVI/AVC system could be considered proprietary by its owners. Even though several operators at the port might need access to the whole classification database, portions may need to be inaccessible to the outside world. Database technology has allowed multilevel access for several years and research is continuing in this area. Modern database technology allows sophisticated control of who has access to certain parts or all of a given database and methods are being developed to prevent access by hackers. This technology would allow ports to

accumulate commodity and transportation data into a central (or distributed) database, but access would be limited to only the parts essential to a particular job.

Port operators should have a reliable and simple communication system with response teams in case of HAZMAT spills, law enforcement problems, and other emergency needs. Touch-screen computers with autodial capabilities can help an operator in an emergency situation contact the appropriate emergency response team.

SYSTEMS INTEGRATION

These proceedings have already mentioned that many of the technologies useful to border crossings can work synergistically. An example of this is a computer system that can communicate with sensors and traffic control equipment to route specific vehicles according to their classification and carrier history automatically. The capabilities of the individual components of a system like this are, for the most part, already available. However, these capabilities alone do not ensure a sound, workable design for port-of-entry operations. The key to getting the expected synergy is systems integration, making the components fit together.

For successful system design, care needs to be taken to include concerns of government enforcement functions as well as facilitating private sector operations. Both public and private concerns can be important to all stakeholders. Thorough government inspections resulting in apprehension of those transporting illegal goods reduce international crime. This improves the overall economy (fewer dollars spent on health care related to illegal drugs, fewer jobs lost to black market operations). Expedited freight and vehicle movement reduces wear and tear on international bridges and other border infrastructure and reduces pollution from idling vehicles. This reduces costs and problems borne by government agencies.
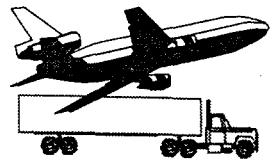
One-stop shopping for border inspections may expedite traffic through ports of entry and is another reason for joint federal/state inspections. Also, conducting commodity inspections at the point of origin (or other remote stations) and pre-clearing goods may relieve congestion at the border facilities. However, it is crucial not to compromise inspection standards just to expedite freight transportation.

Facilities should be designed so that the appropriate information is readily available to the port operators. Extraneous information merely confuses and slows down operations, while incomplete or tardy information causes the operator to spend more time obtaining the information needed to make appropriate decisions. An important system-wide effort should be made to standardize processes and documentation reasonably, thus minimizing confusion among drivers moving freight through the port. This requires extensive dialogue between all border-crossing stakeholders.

Workshop discussions illustrated that it is important that one agency take the lead in systems integration. However, different groups suggested that the U.S. Department of Transportation (DOT), U.S. Customs, and even SNL should take the lead role. Whatever agency takes the lead must organize forums for all stakeholders to discuss their needs so that perceived improvements at border crossings do not make conditions worse. It would also be useful to have a process to improve border crossings from a regional perspective, not just a local view.

An across-the-board look at border-crossing processes should occur before attempting to implement the new technologies. This functional analysis should examine each agency's goals to determine areas of overlap and to ensure that all functions are encompassed in the integrated design. It is also important to document lessons learned, yielding a database of past experiences so that bad experiences are not repeated.

Lessons learned from interstate ports of entry should be integrated into international border crossing designs. In the same way, state ports of entry ought to implement the best ideas that apply from international border crossings. As an example, all ports of entry with inspections may

The HELP system uses truck-mounted transponders to transmit information to the port of entry. SNL's STARBASE system tracks vehicles continuously using a Geographic Information System.

The focus of the system integration workgroups should be on the port-of-entry needs (requirement pull), not on gadgetry (technology push).

benefit from technologies such as AVI and weigh-in-motion (WIM). These technologies could automatically divert some traffic to bypass lanes.

AVI could also serve as a key into the EDI, linking the conveyance to the transportation network. EDI should be made available to all stakeholders. This means that the interface should have bilingual (and eventually multilingual) information, be standardized, use international protocols, and have security mechanisms limiting access to only the data needed by the user. Inspection outcomes should be logged into the database.

The systems integration work group should use these technologies to deliver information that is appropriately formatted for the analysts. As stated previously, information is the focal point of ports of entry. All information collected and presented, therefore, should be in a usable form even though it may be coded for internal storage.

TECHNOLOGY OPPORTUNITIES

As mentioned earlier, it is important to first understand the entire border crossing process before implementing any particular technologies. Workshop participants were quick to point out that technologies should not be showcased without all parties clearly understanding why they were needed. However, several broad technological opportunities clearly emerged out of the workshop discussions and it is important that users and stakeholders be aware of potential technology improvements to port operations.

Since one of the main issues concerning border crossings is maintaining and disseminating valid information, data processing technologies developed for these purposes will be high-leverage items. EDI and standardized data formats will make port-of-entry information much more accessible to more users. Technology is maturing in these areas, and further discussion from all stakeholders is needed to define the details of standardization.

Computer communications systems need to be designed for wide but secure dissemination of the data collected at the border crossing. Other

communications will be necessary for remote activation of sensors and controllers.

Classification technologies, such as WIM and AVI, used in concert with bypass lanes, can help border crossings pursue the dual goals of efficient and effective operation. Future classification technologies (such as neural networks) integrated with historical databases may greatly improve the selection mechanism trained to recognize carriers that are habitual or potential border crossing problems.

Tags, seals, and transponders can be used to allow containers inspected at their point of origin to bypass further inspections. Future versions of these technologies will actively denote the status of the vehicle, driver, and cargo to alert port operators of potentially illegal or dangerous situations. Automated security systems can be designed to contain these vehicles or pedestrians with minimal interruption of regular traffic flow.

As smugglers become more sophisticated and traffic increases at the border, the need for sensors to supplement human and dog inspections also increases. While there are many more sensors and scanners that can inspect luggage nonintrusively, a need remains for large-scale scanning of containers and conveyances. One labor-intensive area where scanners traditionally have not been used is agricultural inspection. A device that could automatically scan freight for disease and infection would aid the USDA immensely.

The key to implementing useful technologies at ports of entry is thinking through the entire function of the port carefully. Opportunities for technological enhancement will be wasted if products are developed in isolation, without an overarching guide stating what needs to be accomplished. Systems integration of these technologies is the key to having an effective and efficient border crossing system that does not become obsolete with equipment change.

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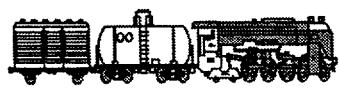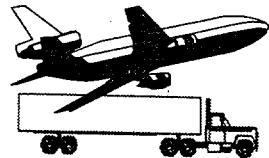
MANAGEMENT ISSUES

CROSSCUTTING AND GENERAL ISSUES

The concluding sessions of the workshop addressed several topics that included 1) cooperation among the several agencies involved, 2) information sharing, 3) enforcement vs. facilitation, 4) establishment of performance baselines, 5) funding, and 6) leadership. The contents of the sessions are summarized below.

Agency cooperation has been discussed elsewhere, and the concept of rationalizing the process was raised again. Such a rational process would prioritize entrance (and exit) requirements based on the consequences of noncompliance. Interagency agreements could then be formulated for sharing responsibilities for initial identification of problems. The agency identifying the potentially offending vehicle or container could then refer the problem to agency specialists for further examination. The development of a process to define agency interactions and exploit opportunities for cooperation was strongly recommended.

It is a great waste of scarce resources if an inspected truck is refused entrance to a state because it is overweight or does not meet safety requirements.

Information sharing was a recurrent theme in efforts to improve this information-intensive process. Independent documentation is needed for cargo, vehicle, driver, shipper, and receiver for federal, state, and local agencies in both the U.S. and Mexico. The type and valuation of cargo are of interest to Customs, Agriculture, and insurance companies. Compliance records of shippers and transportation companies are very important in the development of inspection strategies. International origin and destination data are needed by federal statistical agencies and transportation facilities planners.

A plan for information standardization and sharing, with proper confidentiality safeguards, was widely endorsed.

The balance between the conflicting port-of-entry goals of enforcement of numerous regulations versus facilitation of freight movement was raised

as a fundamental problem early in the conference and continued to be pervasive. The technologies discussed offer the promise of improved performance in both areas. However, participants urged that implementation be designed to supplement more streamlined and shared processes.

The first step in evaluating potential technologies is establishing a baseline measuring the current performance of ports. Increased performance offered by proposals for improvement could then be compared with current operations to estimate benefits that would then be compared with costs. A broad definition of benefits and cost was encouraged because the benefits of more confidence in the integrity of shipments would accrue not only to inspection and revenue collection agencies, but also to victims of drug use and theft of intellectual property. The benefits of faster processing would accrue not only to shippers, receivers, customs brokers, transportation companies, and consumers, but also to the economies of both countries in the form of increased international competitiveness.

Thoughts on funding attempted to match payments to beneficiaries. Because the broad base of beneficiaries of improved inspection reflects national populations as a whole, the public sector, through its relevant agencies, was the most logical candidate. Since the immediate benefits of faster processing are largely felt in the private sector, costs could logically be recovered through user fees. However, fees paid should be commensurate with savings. Because many technology options can provide both improved inspection and time savings, public-private partnerships also emerged as logical entities to pay the bills.

Thoughts on leadership ranged widely. The U.S. Customs Service has traditionally taken the lead at most ports and has been the principal customer of the General Services Administration, which designs, constructs, and maintains them. However, interagency and international cooperation is imperative if significant performance improvements are to be achieved. The DOT was suggested as an agency with a mission to facilitate freight movements. This department is currently supporting the interagency Task Force on Border Infrastructure and Facilitation, which has many of the same objectives and recommendations as the workshop. This Task Force includes a representative from the National

Economic Council in the Executive Office of the President with interdepartmental responsibilities that might be useful in achieving coordination. Leadership should also come from the local level, perhaps from one of the four regional offices of the federal inspection agencies along the border. The Department of State was suggested since it is responsible for international port-of-entry operations. SNL was also suggested as an organization with both the technical competence and objectivity needed to lead an interagency program.

The Port of the Future: Design and Operational Impact

The meeting began with a physical description of a typical port of entry designed for truck and automobile traffic and a presentation on current operations and technologies in use. The meeting concluded with several implications for facility design and operations to accommodate new technologies.

Special bypass lanes could be constructed for trucks equipped with transponders containing information about pre-clearance of the cargo by Customs officials at remote locations, the integrity of the seal, the condition of the cargo, the credentials of the driver, any deviations from the planned route, an indicator of the level of risk based on historical violation data, the status of user fee and tariff accounts, and the vehicle's compliance with safety and environmental regulations. The transponder could be interrogated electronically as it approached the port. The information could be simultaneously transmitted to inspection officials on the other side of the border. Trucks meeting all requirements would not be required to stop. Trucks not meeting all requirements or those subject to random inspections could be diverted to inspection areas. These areas would be designed to accommodate facilities housing X-ray and pulsed fast neutron activation equipment for contraband detection. Biological and chemical sensors could be used to detect noncompliance with agricultural requirements.

If intermodal facilities were available at the port, pre-cleared containers with transponders could be tracked as they moved between truck and rail modes as well as to and from temporary storage and inspection

areas. Rail cars could have the same kind of transponder data as trucks. Facilities would be provided for interrogating rail-car transponders at greater distances from the port than trucks. This system would permit trains to enter switching yards to detach cars and off-load containers that did not meet all requirements. The remaining cars could continue without further delay.

Facilities would need to be designed to house inspectors from various agencies, perhaps in a single room that contained display consoles presenting appropriate transponder data for evaluation. Automated data evaluation could include decision rules for acceptability and deviations from those rules. When field inspections were needed, data from inspection equipment could also be evaluated from a central location. Agents in inspection areas could have mobile video equipment, making it possible for field inspections to be monitored from a central location. The close proximity of inspection officials from several agencies, and perhaps the U.S. and Mexico, would permit immediate communications among inspectors as decisions about the disposition of noncompliant cargo were reached. The possibility of achieving multiple, simultaneous evaluations would also permit a more efficient organization of port operations.

Physical design features could place the control room with inspection agency computer consoles in a tower, permitting visual confirmation of the flow of trucks, trains, and containers. The tower would also be useful for confirming information from access-control sensors and systems for controlling the operation of physical barriers that could be used to stop runners. Other physical features would include wiring, fiber-optic lines, antenna locations, and power supplies to support information and communications systems.
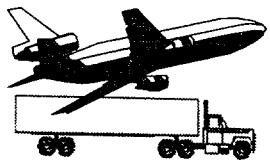
Conclusions

It was apparent from the user speeches and further discussions in the workshop sessions that port-of-entry stakeholders are under pressure from several directions. Because of the signing of NAFTA, freight movement across the Mexico/U.S. border is expected to increase. At the same time, many manufacturers have moved to JIT operation, which minimizes warehouse usage by requiring timely transportation of assembled parts from remote locations, including across the border. However, resources at the border are already strained, and all indications are that manpower will be reduced and regulations will increase. The net effect of these events is that there will be increased congestion at the border facilities unless operations are improved.

One recurring theme of the workshop was that a focus is needed on how to improve the functionality of ports of entry, not just on how to get technologies out of development and into operation.

Standardization and simplification were deemed as keys to success of improving border crossings. A lead agency needs to be assigned so that a careful, integrated effort takes place instead of having a disjointed collection of technologies installed at the various border ports. The DOT may be in the best position to lead multi-agency discussions and work through international and industry protocols. Historical data should be used to derive lessons learned from past efforts. The product of this work would be a roadmap to technology implementation that takes into account the entire border-crossing process, including recommendations on administrative procedures.

Information is central to many port-of-entry inspections and can be the key to selecting which conveyances passing through the facility need the most thorough inspections. Timely data on vehicle, driver, and cargo allow manufacturers and transportation providers to schedule their resources appropriately, reducing transportation overhead costs. These data are essential to customs brokers who are charged with expediting and resolving problems with freight passage. Also, information needs to be available to stakeholders on both sides of the border in a format that can easily be understood by all parties.

In terms of the port-of-entry functions identified for this workshop, information is vital to each operation. Fee and tariff collection requires the port operator to have validated information on the driver,

conveyance, and cargo. Inspectors can be more selective on what is searched if there is information on the credibility of the carrier and on the nature of the goods before the conveyance reaches the port. Status of inspections needs to be available to many parties, such as other inspection agencies at that border crossing, agencies at other border crossings (for future reference), and customs brokers. Facility security personnel need to know which drivers or pedestrians are probable runners while they can still stop them, not after the fact.

Besides current data on the driver, conveyance, and cargo, it is also important that historical records be kept on port-of-entry transactions. As stated above, a record of past changes and resulting net effects would be useful in designing future border facilities. The cost of installing data collecting tools is offset by the knowledge that this information can be used in keeping designers from re-implementing known mistakes.

One method for reducing congestion at the ports is to have inspections remote from the border crossing. An obvious inspection point for freight is at the commodity point of origin, the manufacturing facility. After the freight leaves the facility, inspectors need a way to assure that the freight container has not been breached and, if it has been breached, to determine what the container status is at the border.

Promising technological solutions to these problems are available today; however, this does not mean that all problems will be solved tomorrow. There are still issues that need to be resolved, such as who will pay for technology implementation and where can it be most effective.

If one wants to implement technologies, the best place is at operational facilities or at those in the design phase. Implementing prototype technologies at an operational site runs the risk of increasing congestion while "the bugs are being worked out." It appears obvious that the best place to try out a new technology would be at a new facility that has a small, growing amount of traffic. However, new facilities are a very small percentage of ports of entry and are, therefore, unrepresentative of the overall border operation. Prototype technologies are probably best tested at the new facilities, but designers need to remember that integration into existing facilities should receive first priority after they are tested.
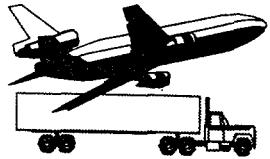
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RECOMMENDATIONS

NEXT STEPS

As stated earlier, this workshop was essentially a prelude to a more
ambitious set of work that needs to be done to address port-of-entry
improvements with advanced technologies. Post-workshop surveys were
sent to all participants to elicit their interpretation of future workshop
focus. Although response was low, about 25% of the participants, all the
major stakeholder groups (inspection agencies, state and federal
transportation agencies, Mexican interests, private sector,
transportation providers, and technologists) were represented. About
half the respondents were technologists; most of the other stakeholder
groups had two participants responding.

*See Appendix D,
Survey Materials,
for the survey
questionnaire.*

To evaluate the results of the rating system quantitatively, we translated
low, medium, and high scores into values of 1, 2, and 3, respectively.
Forms that had both medium and low marked were averaged, giving a
net score of 1.5. Averages were taken of the marked forms by individual
workshop, issue, and technology. This method assures that even though
some forms were not completely filled out, no values were automatically
assumed; the scores represent the true average of the responses.
Standard deviation shows the level of agreement about the average
score. Higher values for standard deviation mean less consensus. For
example, if all the respondents that rated an issue gave it a medium
priority, the average would be 2, and the standard deviation would be 0.

From the responses on the survey forms, apparently the respondents
were eager to participate in future workshops. The ratings of future port-
of-entry workshop priorities are shown in Figure 3. Generally, there is a
high level of interest in the suggested workshops. The port-of-entry
systems integration workshop had the highest priority and the highest

level of consensus. Access Control and Security has a notably lower priority and a relatively high standard deviation. This means that even though most of the participants that did respond felt that this was the lowest priority, there is a constituency that is very interested in security improvements. One additional workshop suggested dealing with state issues so that the state taxation and revenue department, motor carriers, transportation department, and others could work through issues such as operations, electronic and interactive communications, and so on.

Another workshop on joint federal/state ports was suggested that would address issues such as port integration and harmonization, joint operations, problem resolution, and future trends.
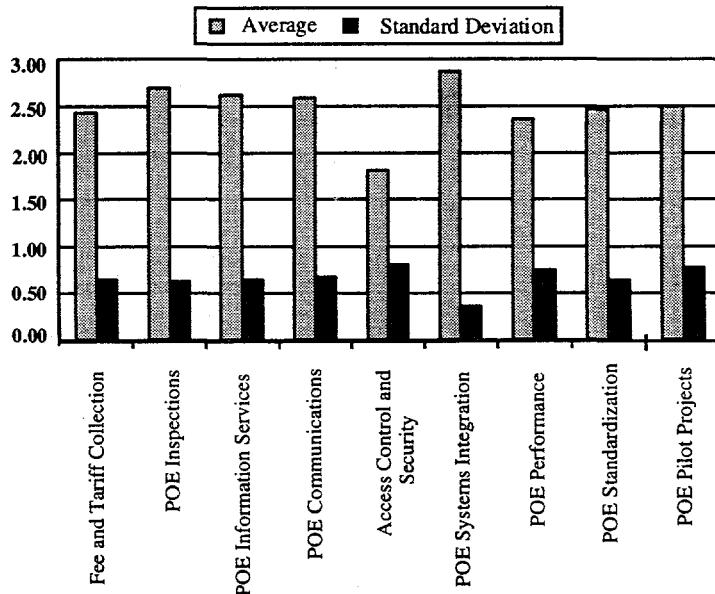
Figure 3. Future Port-of-Entry Workshops

There was also a positive outlook on the nature of the workshops in bringing about changes. Nearly all the respondents believed this particular workshop would be useful in their job and that the suggested workshops would impact future port-of-entry operations. Most believed that the focus of the workshops should remain on the port-of-entry functions because a team approach is needed, but some believed that
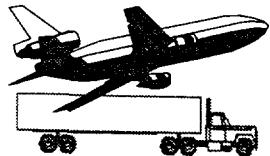
the focus should be on individual agencies and then focus on the functions later. Also, most believed that holding some of these workshops near an international port of entry, depending on the workshop focus, would help the participants see the problems firsthand. Others were not sure that this would be much help and suggested that holding future workshops near the agencies might be more useful. There were suggestions to include state agency operations more adequately in future meetings.

Although some respondents thought the format used in this workshop would be good for future workshops, several improvements were suggested. There were suggestions to reduce the focus on hardware and spend more time on port-of-entry operation specifics from the inspection agencies and users. As to the size of workshops, there were suggestions to have an open forum, to limit the number of organizations and people, and to expand the scope of the workshop to include state agencies (to improve traffic flow in and out of the facility). However, it was suggested that the first step to future workshops needs to be defining the lead agency. Also, it was suggested that technology application should come after defining each agency's requirements.

The results from the survey on what issues need to be addressed on both sides of the border can be seen in Figure 4. Again, the respondents saw most of these issues as high priority. On the average, the highest rated issues dealt with cooperation among agencies, standardization/simplification, and reducing the time freight spends at the ports of entry. This was not surprising because these were key themes mentioned throughout the workshop, with speakers alluding to the necessity of teamwork and compatibility. The lowest scores went to consolidation of federal inspections and universal selective access to border-crossing information. This may be more because of skepticism about administrative concerns than barriers. There was a suggestion that automating inspection services should focus on operator interactivity.

Participants also suggested some additional issues that need to be addressed. Defining port-of-entry requirements is essential to discerning the base needs of border ports. The private sector needs to be involved in the planning to ensure federal agency cooperation with private sector users. A more direct issue is separation of freight from other traffic.

Figure 5 shows the survey results on prioritization of technology improvements. There were not any major distinctions in the survey results between priorities for the near term (two or less years) and the long term (three or more years), so only the near-term chart is presented here. On the average, the respondents saw the technologies as lower priorities than the issues. The highest priority items were data processing (information is central to port-of-entry operations) and systems integration (how to improve operations, not just implementing technology). Improving barrier technology was seen as the lowest priority for enhancing border crossings and that correlates with the low priority given for the Access Control and Security Workshop. Apparently, most of the respondents were more interested in high-level issues than the more specific security issues.
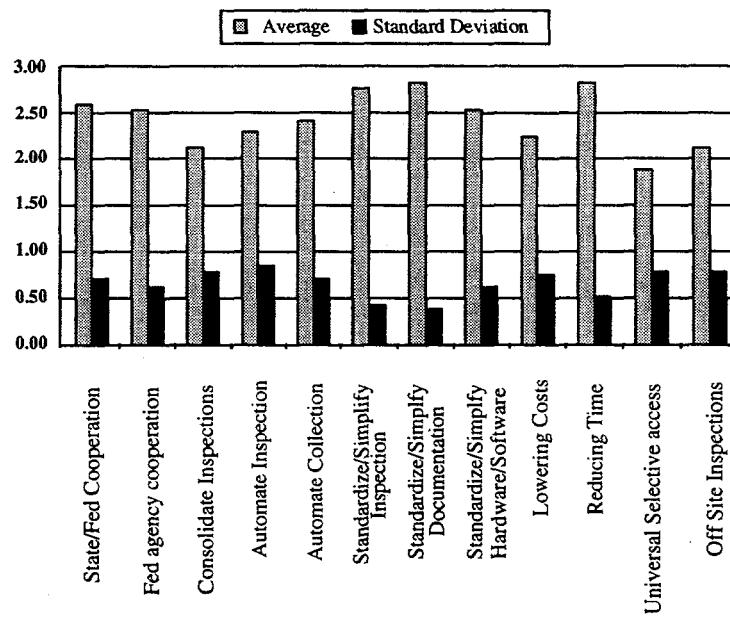
Figure 4. Port-of-Entry Issues Evaluation
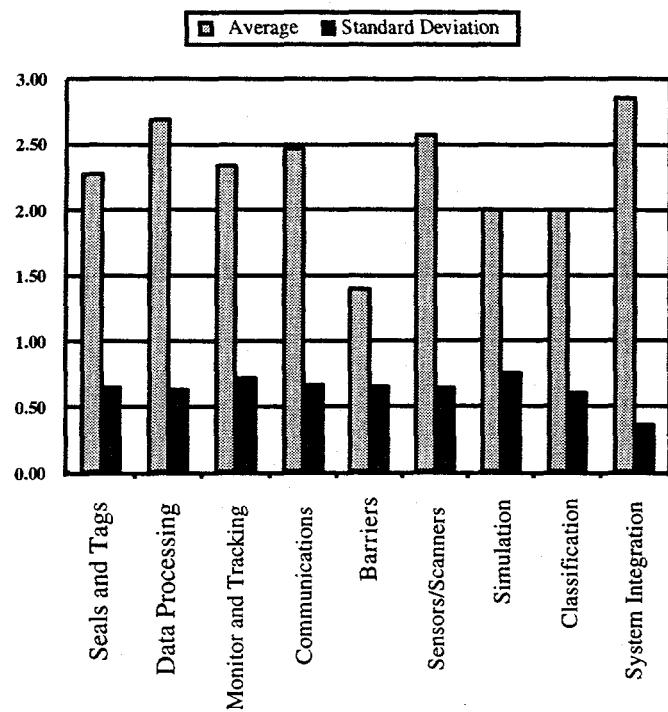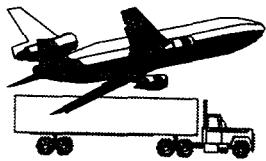
Figure 5. Port-of-Entry Technology Evaluation

OBJECTIVES

Based on the survey results, the criteria for next workshop should include the following:

■ Take a team approach.

■ Include data processing and information systems.

■ Analyze interagency and federal/state operations.

■ Focus on both enforcement and facilitation.

■ Focus on port operations first. Then define opportunities for technology introduction.

■ Address state operations at border crossings in relation to federal efforts.

Meeting these criteria can be accomplished by collecting information from participating agencies and analyzing interrelationships to prepare for the workshop. More focus can be achieved by examining a specific port that is as representative as possible.

Work Plan

1. Identify agencies and requirements.

Conduct a telephone survey and field interviews with the federal and state inspection officials, both U.S. and Mexico, at the selected port. Information collected would include mission statements, information sources, databases used, technologies used, information needs, interactions with other agencies, and performance measures.

2. Map and model the current process.

Define the sequence of events as freight moves through the ports for road, rail, and air modes. Take advantage of ongoing projects conducted by U.S. Customs and the INS. Develop a model of the process.

3. Analyze opportunities for performance improvement.

Use the model and small planning groups to propose alternative procedures and technologies that offer the potential for performance improvements in both enforcement of regulations and facilitation of movement.

4. Conduct workshop.

Design and conduct a structured workshop involving representatives from all stakeholder groups in both countries to evaluate the feasibility of implementing the improvements and to suggest others. Participants would be supplied with the information developed during the mapping and modeling process. They would be expected to prepare for the workshop by reviewing the material and discussing it with operators and policy makers in their organizations. Reach a consensus on a plan for the selected port, if possible.

5. Transfer the process used to other ports.

Since all ports are different, the process used, complete with its inventory of alternative operational innovations and technologies, would be conducted for other ports, in both the U.S. and Mexico, at their request.

BENEFITS

These workshops offer opportunities to address several national priorities:

- We can "reinvent" port-of-entry design and operations through effective use of redesigned processes that use technology appropriately and incorporate interagency cooperation [**National Performance Review – Reinventing Government**].

- We can address air quality problems at some of the current border crossings by moving vehicles through ports more quickly [**Clean Air Act Amendments/Border Environmental Cooperation Commission**].

■ We can provide facilities that will encourage and enhance trade opportunities for both the U.S. and Mexico and make both countries more competitive in international trade by reducing transportation costs (**NAFTA/U.S. Trade Representative**).

■ We can capitalize on dual-use technologies that need continued development to support national security interests but can be leveraged to support port-of-entry needs—e.g., sensors; nonintrusive inspection; wireless communication, identification, and classification; intelligent agents; information systems, etc. (**Defense Conversion and Dual Use Technology**).

■ We can stimulate job creation by creating a service-oriented climate at the port that is attractive to shippers, consignees, brokers, suppliers, and industrial developers (**Enterprise Zones**).

■ We can provide an improved defense against narcotics and other illegal substances through advanced technology inspection systems that reduce the possibility of penetrating the U.S. borders (**National Drug Policy**).

■ We can promote use of intermodal transportation systems that result in greater efficiency, mobility, and accessibility (**National Transportation Policy**).

■ We can leverage government investments by taking advantage of innovative financing mechanisms that bring the synergy of public/private partnerships to funding infrastructure investments that serve both government and commercial interests (**Cost Reduction**).

Implementation of this program could address the national objectives listed above and achieve tangible improvements in local operations in a single project, a rare opportunity.

APPENDIX A. WORKSHOP PARTICIPANTS
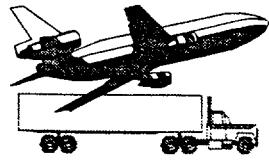
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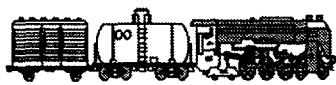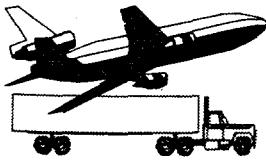
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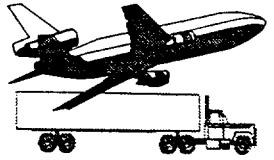
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APPENDIX B. AGENDA

Thursday July 14, 1994

Albuquerque Hilton - New Mexico South Room

7:15 Registration and Continental Breakfast

8:00 *Introduction Panel Moderator - James Kelsey, Sandia National Labs*
Gerry Yonas, Sandia National Labs
Noah Rifkin, Department of Transportation
Benjamin Montiel Espinosa, SCT
Dave Thompson, Wilson & Company
Steve Dick, Wilson & Company
Mike Smith, Science Applications International Corp.

9:30 *Port of Entry User Panel Moderator - Dan Payton, SAIC*
Arthur Pitts, US Customs
John Vigil, US Department of Agriculture

10:00 Break

10:30 John Puffer, Southern Pacific Lines
Steve Griego, Santa Fe Railway
Vic Sheppard, NM Motor Carrier Association
Fernando Velasquez, Institute of Mexican Transportation
Raul Gomez, Rudolph Miles & Sons

11:45 Lunch Buffet

12:45 *Technology Panel Moderator - David Albright, ATR*
John Pennella, Advenced Research Projects Agency
Ernie Mercier, US Customs
Gary Ruegg, Science Applications International Corp.
Roger Johnson, Science Applications Int'l Technologies
Dave Swahlan, Sandia National Labs
John Naegle, Sandia National Labs
Ed Davidson, Syntonic
Laverne Ronnesberg, Sandia National Labs
Ernie Edwards, BDM Federal

3:00 Break

Thursday July 14, 1994

3:30 *Applications Panel - John Wagner, SAIC*
Jim Gentner, HELP Inc
Pat Shea, Science Applications International Corp.
Jim Elliott, Los Alamos National Labs
Larry Luzynski, Science Application Int'l Corp.
Jayne Williams, Sandia National Labs

4:45 Workshop Announcement - Bob Rea, SAIC

6:00 User/Technology Team Meeting and Dinner

Friday July 15, 1994

Albuquerque Hilton - New Mexico South Room

7:15 Continental Breakfast

Albuquerque Hilton - Designated Rooms

8:00 Facilitated Workshops in Designated Rooms

Albuquerque Hilton - New Mexico South Room

12:00 Lunch Buffet

1:00 *Facilitator Outbriefs of Morning Sessions*
Jessica Glicken, Sandia National Labs
Pat Shea, Science Application International Corp.
Don Garcia, Department of Energy
Mike Moulton, Sandia/ATR
Tim Karpoff, University of New Mexico
Gregory Lay, Alliance for Transportation Research

2:30 Break

3:00 Impact on Facility Operations - Mike Smith,SAIC
Impact on Facility Design - Steve Dick,Wilson & Co.
Workshop Wrap up - Bob Rea,SAIC / Mike Moulton,ATR
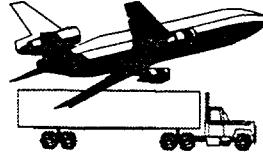
POE Workshop Lists - Friday July 15, 1994

Tariff & Fee Collection	Inspection	Information & Communication	Access Control & Security	System Integration
Jessica Glicken/SNL	**Pat Shea/SAIC**	**Don Garcia/DOE**	**Mike Moulton/SNL**	**Tim Karpoff/UNM**
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Ed Davidson/Syntonic	Brian Beranek/IRD	Roger Johnson/SAIT	Dave Swahlan/SNL	Verne Romesberg/SNL
Jim Gentner/HELP	Mike Smith/SAIC	Mike Sjulin/SNL	John Weiss/SNL	Ernie Edwards/BDM
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APPENDIX C. TECHNOLOGIES
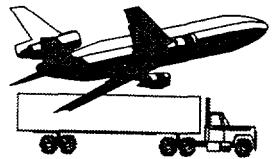
APPENDIX C

TECHNOLOGIES

SENSORS AND SCANNERS

In addition to illegal drugs, inspectors are trying to detect hazardous materials and leakage, illegal armament, and any other misrepresentation of cargo crossing international borders. These misrepresentations can be quite subtle, such as trying to avoid higher tariffs by falsifying the country of origin of the goods or improperly classifying the type of commodity. At present much of the inspection is carried out visually and with intrusive probes, which is very labor intensive.

Scanners and sensors can revolutionize inspections at ports of entry. These devices can search cargo non-intrusively as opposed to having a human visually inspect container contents. These devices detect items that would elude a human inspector, such as illegal drugs hidden in a grain boxcar or liquid propane tanker.

A well-known scanning technology is X-ray radiation, such as used to scan the human body. X-ray technology being developed can scan a rail container in two minutes compared to the human analysis time of 15 minutes. The radiation is such that if a person were hidden in the container, they would receive the equivalent dose of only two chest X-rays.

Other scanning technologies include pulsed fast neutron activation (PFNA), ultrasound, tomography, and electromagnetic detection. These scanners operate at different frequencies to give the inspector non-intrusive pictures of the interior of the container. These pictures visually note changes in interior composition that can cue the inspector to items

that may be hidden in the container. Most of these technologies are currently able to examine only luggage-size containers.

Dogs are the main sensors used at border facilities. Their acute sense of smell works quite well in detecting chemical vapors emanating from illegal substances. However, conditions at the U.S./Mexico border ports on very hot summer days with even hotter pavement impede the operating capability of the dog. In its place, sensors sometimes known as "sniffers" can detect and identify chemical vapors. The micro gas chromatograph is a hand-held device that separates and classifies gases that are in the vapor; detection time for a selected substance is from five to ten seconds. Gamma backscatter, as well as hydrogen detection and laser range-finders, can be used to examine voids and detect hidden compartments.

There are testbeds and models of many of these technologies to determine what impact they should have on border inspections. While these technologies are costly, their use may be the only way to compensate for inspection manpower shortages without compromising thoroughness of inspections. Another benefit of these devices performing their particular inspection regime on cargo quickly is that vehicle and freight throughput should increase accordingly.

Transponders, Tags, and Seals

Transponders, tags, and seals are technologies used to store information and relay the stored information across a communications link. In the past, these technologies were distinct. Tags and seals were clipped to and stuck on containers as labels and to ensure that the contents had not been disturbed. Transponders were essentially little one-way radios attached to containers used for remote identification. As these technologies have matured, their distinctions have blurred and now many tags and seals contain transponders.

There are three main types of transponder tags: read-only, read/write, and computer off-load. The read-only transponders traditionally have been used to identify mobile equipment for inventory control electronically. These transponders are permanently programmed, and they save labor and reduce the possibility of error by allowing information

to be read electronically. Read/write transponders additionally allow data to be written to the transponder so that information can be added or changed as the status of the vehicle or freight changes. Computer off-loaded transponders have computers on board the transponder that can make status assessments from sensor data and log data history or report conditions to operators.

Current read-only tags include information on cargo identification and container physical dimensions in a standardized format for rail cargo. These tags are mounted on the front bumper of trucks or on the sides of rail cars. These tags are read from fixed antenna systems by the rail or roadbed and by hand-held readers that can upload information from the tag and download it to a printer or another computer. As these data are disseminated to a wide set of customers, transponder tag data could be used to gather arrival and departure times, report on intermediate shipment locations, control access, provide yard inventory information, automatically collect tariffs, and automatically identify equipment.

Communications

The previous technologies were developed to acquire and store information; communications technologies were developed to pass information between points. The type of communications needed is determined by the type of information that needs to be passed and the required transfer time. The higher the frequency bandwidth (or transmission speed for wire systems), the more information can be transferred in the same amount of time. As the data requirements have increased from transmitting voice, to sending computer data, to sending high fidelity computer graphics and photographs in real time, communications bandwidths have increased.

Communications can be classified into two types: wireless systems (like radios) and wire systems (like telephones). The wireless systems comprise four main types: local area networks (or LANs), optical systems, radio frequency (RF) systems, and satellite communications.

Wireless LANs are currently broadcast over short distances and can handle moderate transmission speeds (up to 10 megabits, or about 250 pages of text per second). Future LANs will use high frequency bandwidth

ATM to pass voice, data, and video. Optical communications are also used in LANs, headsets, and storage tags using source modulation and in bar code readers using reflection modulation.

RF systems include high frequency/very high frequency (HF/VHF) radio, cellular telephone and radios, personal communication systems, and microwave communications. The first two systems are low speed, limited range systems best used for local voice transmission; personal communications systems have similar qualities but also may be used for constant two-way tracking. Microwave transmissions have a medium to high speed transmission and a range up to 50 miles between repeaters or end nodes.

Satellite communications systems can be used for data and telephony transmission. There are many satellite systems being designed to supplement the services provided by MRSat, ORBCOM, and QUALCOM, and the proposed Motorola Iridium system. GPS/GVLS can provide one-way communication or tracking, if needed.

Wire systems, also known as physical communications, include LANs, telephone, and other telecommunications. Current LAN technologies can handle high transmission speeds, up to 100 megabits per second, using fiber optics or certain wire systems. Follow-on LAN technologies will eventually be superseded by ATM when it is deployed, increasing speeds beyond 600 megabits per second. Telephone technology is low speed, inexpensive, and easy to use. Leased T1 lines and fractional T1 provide low to medium speed (to 1.5 megabits per second) across dedicated lines for a moderate price, while leased T3 lines provide more bandwidth at a higher cost.

Current telecommunication services include frame relay, providing medium speeds to 1.5 megabits per second, and switched multi-megabit data service (SMDS) with data rates to 32 megabits per second. Transparent LAN service is low cost and has simple connections, but is limited to a metropolitan area. Future telecommunications technology improvements include the synchronous optical network (SONET) with high data rates that will replace T1 and T2 lines. Also, ATM will become a communication standard for LANs and wide area networks (WANs). There are international standards coming out in the next few years that should enhance data transmittal just as future networks turn global.
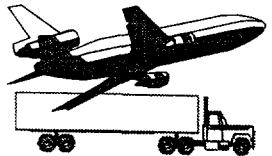
As more private or proprietary information is transmitted between points, communication security becomes an issue. There are several methods to protect data being transmitted, including data encryption, modulation, and media control. Encryption technologies send messages in a format that is unreadable without decryption equipment or software so that intercepted messages appear to be random garbage. Modulation techniques such as frequency hopping and spread spectrum transmission deny an interceptor's obtaining information by merely tapping into a single channel. Media control does not allow an interceptor physical access to the transmission media (secure, dedicated communication lines). Media control may use protocols, such as passwords or secure ID cards, to deny unauthorized access to computer network resources.

Data Processing

The technologies associated with data processing include both computer hardware and software. Some aspects of these technologies will be covered in the following sections.

Computer Hardware

It is assumed that major ports of entry or some centralized office will have a stationary computer operation where transactions are processed. Remote facilities and remote parts of large border crossings may have small, mobile workstations that can be tied into these mainframes as a WAN. Information will be passed into the WAN via radio, landline, or satellite link.

Hand-held and pen-based computers can use a spread spectrum radio link to connect to one of these portable workstations. These workstations can in turn act as a worksite server for a remote LAN. This client/server system could relay data taken from the field (including audio, video, photographs from electronic cameras, graphics, text, and telemetry data) back to the main office for further processing and dissemination.

In concert with these developments are technologies such as high definition flat panels. High density flat panel displays can show high

resolution images from the field either on the remote workstations or at central processing sites. Continuing development of portable workstations and high density flat panel displays will focus on making low-cost, rugged equipment for use at remote locations. These capabilities, currently under development, will enhance human operation at remote sites.

Computer Software

Once the data are communicated to a central processing office in the port, much data processing can be done. Classification software, such as neural nets, can quickly and accurately classify vehicles, given very simple sensor data (time measurements between truck wheels crossing highway traffic tubes). Current research shows that of twelve classes of vehicles (from motorcycle to multi-trailer trucks), neural nets can accurately classify 96 to 97% of the Class II and III vehicles (cars and pickups, with and without trailers) and 60% of the Class V vehicles (two-axle trucks). The results of this probabilistic technology compare to the 90% accurate classification requirement in the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) for Class II and III vehicles and the 30% accurate classification of Class V vehicles using fielded technology. Given access to more sensor data, classification software should be able to identify vehicles and perform consistency checks quickly.

Simulation technology can be used to enhance border crossing operations. The Toll Plaza Application Simulation System (TPASS) developed at Syntonic gives a visual display of anticipated traffic queuing in a border crossing. This type of model can be used to compare different technologies that might be introduced at a port of entry to expedite traffic. As an example, vehicles equipped with an RF transponder can be validated with an AVC system. This system can have the carrier's credit card automatically debited so that the vehicle could be directed to a bypass lane instead of going through a manual toll booth. The TPASS simulation shows that manual-only toll collection can handle 350 to 500 cars per hour while an AVI/transponder system has a throughput of 1400 to 1700 vehicles per hour. TPASS can also estimate the total number of queued vehicles by time of day before and after implementing electronic toll collection. Data of this type can be used in a cost-benefit analysis to determine the utility of installing an AVI
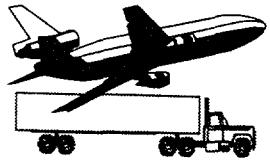
system at a given port. Also, computer models of sensor and scanner technologies can be used to optimize design of the technology prior to introduction at a border crossing. These simulations are typically calibrated against real data to refine the internal model for future applications.

Barriers

Barriers give a distinct legal boundary, such as with a perimeter barrier, and delay or deny access to certain areas until intruders can be contained. Barrier access delay time must be greater than the time it takes to detect and assess that there are intruders plus the time it takes to dispatch a response team to the scene.

Some drivers try to run their vehicles through the port without stopping to avoid inspection and paying tolls. While simple fences, posts, and gates cannot guarantee stopping a truck, vehicle barriers are available that can stop a truck in motion. Vehicle barriers are available with a two-second cycle time and can be operated remotely. These barriers remain in the "up" position and are lowered when vehicle drivers pay their tolls or pass inspection and can be set to stop tailgaters trying to sneak through the port. Security turnstiles are available with electronic controls to regulate pedestrian traffic, allowing passage of authorized personnel only.

Less-than-lethal technology can be used to stop criminals without having to shoot at them. Sticky foam can be dispensed at criminals trying to run through security blocks. This foam essentially bonds people instantly to their surroundings. Special measures are required to release them. Aqueous foam is about 99% air but totally obscures visual cues, thereby disorienting people surrounded by it. This foam is so inexpensive it could fill a corridor or bypass ditch every night as an intrusion precaution. Both foams can be ejected from fixed dispensers or portable dispensers that have a range from twenty to fifty feet.

Systems Integration

Each of the technologies previously mentioned can improve border crossing operations. However, if the technology is incompatible, inflexible, or intolerant to user needs, more harm than good can come from its introduction into an existing facility. Conversely, technologies may be integrated such that the outcome is much more useful to the operators than the stand-alone version. An example of this would be complex technologies that may make burdensome requirements on the operator, but when integrated with a computer-based controller that has a friendly interface, the system may actually reduce the operator's workload. Unfortunately, integrating diverse technologies into a logical system is not a trivial effort, but the discipline of systems integration has precisely this goal.

In the case of the diverse technologies that might be put into a port-of-entry system, there are processes that have already been designed by manufacturers and shippers such as automated inventory and tracking systems. These systems could be integrated into a state-of-the-art border crossing. However, the first issue that needs to be determined is what a port of entry should do. What are the port's objectives, and where does a port's responsibility end and another entity's begin? Do we want to make the border crossing the focus of activity, or do we want to decentralize functions such as inspections to relieve border congestion? Is the port's basic goal to have a border that is transparent to legal freight movement and impermeable to illegal goods? These questions need to be answered before trying to integrate more technologies into border crossings.

A basic principle of design is that the system should serve everyone's needs in the production-to-consumption chain of manufacturing transportation. An example of this principle is that allowances are needed for manual processing by operators and carriers that do not wish to automate immediately, so a design is required that has separate processing facilities for those not willing to automate. A good systems design will produce greater efficiencies across all port operations by reducing the amount of repetitive activity such as multiple entries of the same carrier data. An upgradable design can be based on an open

systems architecture and would require an understanding of all technologies and their associated availability timelines.

The basic methodology used by the systems integrator is to determine the objectives first, then design a prototype system, and evaluate and refine until all requirements are met. In determining the objectives, the integrator will characterize the facility, such as identifying what should be kept from crossing the border. In designing the prototype, the integrator will develop an initial system that uses complementary components to meet the design goals. The integrator will develop a system model that will be used to aid in designing the prototype and later to pre-test refinements to the system. In the evaluation, the integrator will identify shortcomings, such as system vulnerabilities, and refine the design using a balanced approach to accomplishing the objectives.

An example of an integrated system is the HELP program under development. This is a proposed fee-for-service system that can be used to expedite freight traffic through interstate ports of entry. HELP combines several technologies: AVC, WIM, transponders, communication beacons, centralized databases, and automated toll collection readers.

The HELP system will have transponders mounted on trucks that will respond to communication beacons set up some distance from the ports of entry. The transponder will have information, such as the current odometer reading and interstate registrations, which can be used for automatic credential verification of the truck, the driver and the cargo. These credentials can be used to process the truck for taxes (weight-distance tax, fuel tax, etc.) and pre-clear the truck for HAZMAT, emissions, and safety inspections through a centralized database. The state can still stop processed trucks for random inspections, but generally the truck would not be required to stop.

Another example is the system tracking and response base, STARBASE, a system SNL developed for the Department of Energy. STARBASE integrates transponders, communications equipment, and data processing software and hardware into a system used to continuously track vehicles. Vehicle tracks are displayed real time on a Geographic

Information System (GIS) using off-the-shelf technology in this operational system.

Redundant high frequency (HF) and satellite communications ensure that STARBASE operators can remain in contact with vehicles anywhere in the U.S. 24 hours a day. Measures have been taken to ensure that communications and data remain secure during operation. Besides the GIS display screen the operators have several other screens on the STARBASE console, any of which can be used to display information pertaining to the vehicles, the shipments, and the health of STARBASE.

As an example of human factors engineering, if an emergency occurs, STARBASE software allows the user to step rapidly through standard procedures using touch screens. In this way, an operator in a crisis situation has all the information at hand. The computer will even dial the emergency response team's phone number. STARBASE developers maintain a testbed system that mirrors the operational system so that new hardware and software can be tested off-line before introduction into an operational environment. Computers used in STARBASE are designed using an open architecture so that upgrades will not be precluded.

These systems, along with others mentioned previously, give an idea how advanced technologies can be integrated. Again, much care must be exercised to ensure that systems operate as intended and are designed to have easy upgrade paths so that they do not become obsolete. The systems integrator needs to be the link between what is available now and how new technologies are introduced.

APPENDIX D. SURVEY MATERIALS
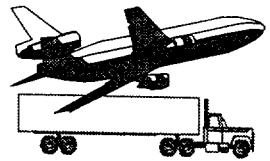
I. Future Workshops

Please evaluate the priority of these workshops and suggest an appropriate attendee/org.:

A. Fee and Tariff Collection   Low   Med   High   _____

B. POE Inspections   Low   Med   High   _____

C. POE Information Services   Low   Med   High   _____

D. POE Communications   Low   Med   High   _____

E. Access Control & Security   Low   Med   High   _____

F. POE Systems Integration   Low   Med   High   _____

G. Measuring POE Performance   Low   Med   High   _____

H. POE Standardization   Low   Med   High   _____

I. POE Pilot Projects   Low   Med   High   _____

J. _____   Low   Med   High   _____

II. Quality Issues

A. Will your workshop experience help you in your job?   No   Yes

B. Will these workshops have impact on future POE operations?   No   Yes

C. Should workshops focus on inspection agencies instead of POE functions?   No   Yes

D. Should future workshops be held at or near Ports of Entry?   No   Yes

E. How would you improve workshop format and content?

III. Issue Prioritization:

What is the priority of <u>addressing</u> the following issues, for both US and Mexico:

A. Increasing cooperation between state and federal agencies	Low	Med	High
B. Increasing cooperation among federal agencies	Low	Med	High
C. Consolidating federal inspections	Low	Med	High
D. Automating inspection services	Low	Med	High
E. Automating fee and tariff collection	Low	Med	High
F. Standardizing/Simplifying inspection processes	Low	Med	High
G. Standardizing/Simplifying documentation	Low	Med	High
H. Standardizing/Simplifying POE hardware/software	Low	Med	High
I. Lowering costs associated with POEs	Low	Med	High
J. Reducing time spent by freight at POEs	Low	Med	High
K. Allowing universal selective access to POE information	Low	Med	High
L. Increasing portion of off-site inspections	Low	Med	High
M. Other:	Low	Med	High

IV. Technology Prioritization

What do you see as the priority for <u>improving</u> the following technologies:

	Near Term (< 2 years)			Far Term (3+ years)		
A. Seals and Tags	Low	Med	High	Low	Med	High
B. Data Processing (e.g., EDI)	Low	Med	High	Low	Med	High
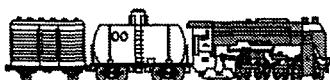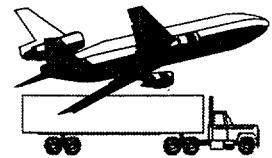
C. Monitoring and Tracking	Low	Med	High	Low	Med	High
D. Communications	Low	Med	High	Low	Med	High
E. Barriers	Low	Med	High	Low	Med	High
F. Sensors/Scanners (e.g., X-ray)	Low	Med	High	Low	Med	High
G. Simulation	Low	Med	High	Low	Med	High
H. Classification	Low	Med	High	Low	Med	High
I. System Integration	Low	Med	High	Low	Med	High
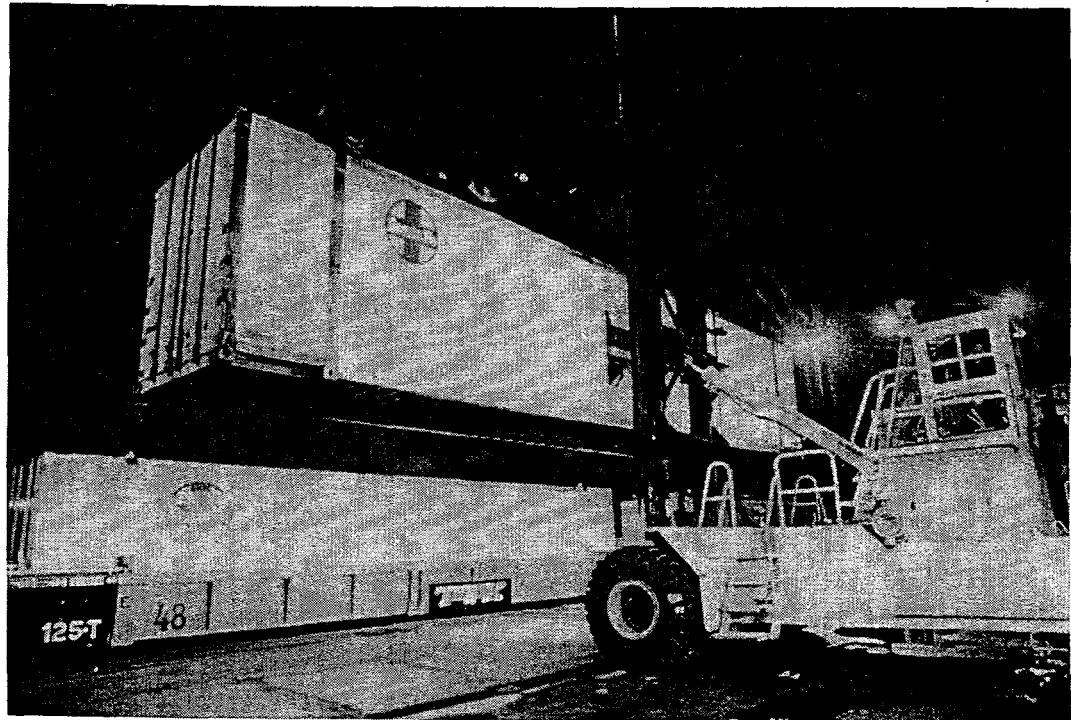
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1	MS 0767	Steve Roehrig
1	MS 0775	Suzanne Rountree
1	MS 0783	Dave Swahlan
1	MS 0807	John Naegle
1	MS 0619	Print Media, 12615
5	MS 0899	Print Media, 13414
1	MS 9018	Central Technical Files, 8523-2
150	MS 0763	Brad Godfrey