COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION

BUREAU OF MAINTENANCE AND OPERATIONS

RESEARCH PROJECT 94-30

TRANZIT *XPRESS:* HAZARDOUS MATERIAL FLEET MANAGEMENT AND MONITORING SYSTEM

EVALUATION REPORT

JULY 1997

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PENNSTATE

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Prepared for

Commonwealth of Pennsylvania
Department of Transportation
Bureau of Maintenance and Operations

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CENTER FOR INTELLIGENT TRANSPORTATION SYSTEM

The Center for Intelligent Transportation Systems (CITranS) was established in January 1994 to provide a means for Penn State to take a more active part in Intelligent Transportation Systems (ITS) research. CITranS is a multidisciplinary research initiative administered through the Pennsylvania Transportation Institute (PTI), which is a Intercollegiate Research Center and encompasses all forms of surface transportation-including highways, railroads, and transit-and serves as a focal point for advanced technologies research at Penn State.

In addition to coordinating the University's broad interdisciplinary ITS research efforts, CITranS provides guidance in four critical ITS-related research area: human factors and safety; large vehicle dynamics; transportation planning and demand management; and systems architecture, modeling, and integration. Two of the center's main objectives are: (1) to create a synergy at the University by acting as a point of contact for researchers at Penn State and as an information source for promoting University's capabilities to the ITS community and potential research sponsors, and (2) to actively foster professional development in ITS subject matter through university-level course work and technology transfer activities.

CITranS is affiliated with several Penn State research areas, including the College of Engineering, which has designated CITranS as one of its Centers of Excellence; the Mid-Atlantic Universities Transportation Center (MAUTC); the AppIied Research Laboratory (ARL); the Gerontology Center; the Center on Aging and Health in Rural America; and The Smeal College of Business Administration.

This project is part of the transportation planning and demand management activities at the center. It is representative of a program on commercial vehicle operations and demand forecasting research.

ABSTRACT

In this report the evaluation performed on the first phase of the Tranzit ***XPress*** system is presented. The system comprises of a traffic/safety control center, motor vehicle instrumentation, and a variety of off vehicle tools that communicate with each other. These include electronic tags for cargo components, radar guns, cellular communication, etc. The system was evaluated by involving motor carrier operators and incident responders. The overall perception of the draft system configuration (at the time there was no complete functional system) is positive and it is a significant improvement over existing systems. The system appears, however, to need tailoring to the needs of each actor involved, and should be complemented by other systems such as CHEMTREC, CAMEO, etc. In addition, perception and intention of use is different between the two groups examined in this evaluation. In addition, this report is unable to present detailed institutional issues faced by Tranzit *Xpress* because there has been no input provided on this either by NIER or PAR. In the report, however, a broader analysis on this is provided.

In terms of the evaluation procedure future work needs to involve larger sample sizes of potential users, careful tracking of the "population" from which the sample is drawn should be defined, and planning and survey execution need to be planned with much longer lead times. In addition, the pre-exposure, post-exposure survey format provides unprecedented insights in terms of response reliability and it should be used in future evaluations.

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1. FIELD TEST INTRODUCTION

The Tranzit *XPress* Operational Test Evaluation Report discusses the strategy and methodology observed as the technical evaluation was performed. This chapter provides a synopsis of the purpose, partnership, organization, test goals and objectives.

1.1. PURPOSE OF THE OPERATIONAL TEST

The Intelligent Transportation System (ITS) National Program Plan defines operational tests as bridging the gap between research and development activities and full-scale deployment of proven technologies. Furthermore, it states that the emphasis of operational tests is on integrated systems and services. Operational tests are conducted under real world conditions in the transportation domain. Although many of the technologies are being transferred from the defense industry, the application in the transportation community still needs to be explored. Therefore, the evaluation of these operational tests is critical to provide information on viability of technologies and systems as potential ITS applications. The Tranzit *XPRESS* operational test will further the knowledge on the feasibility of application of ITS technologies to promote HazMat transportation safety.

1.2. OPERATIONAL TEST PARTNERSHIP

One of the most critical elements for a successful operational test and its subsequent evaluation is the definition of the roles of all partners and the organization. Figure 1 - 1 illustrates the respective areas of involvement to which the partners have agreed during the initial planning process. The FHWA role includes the support of their Operational Test and Evaluation Support Contractor, Booz-Allen & Hamilton (BA&H).

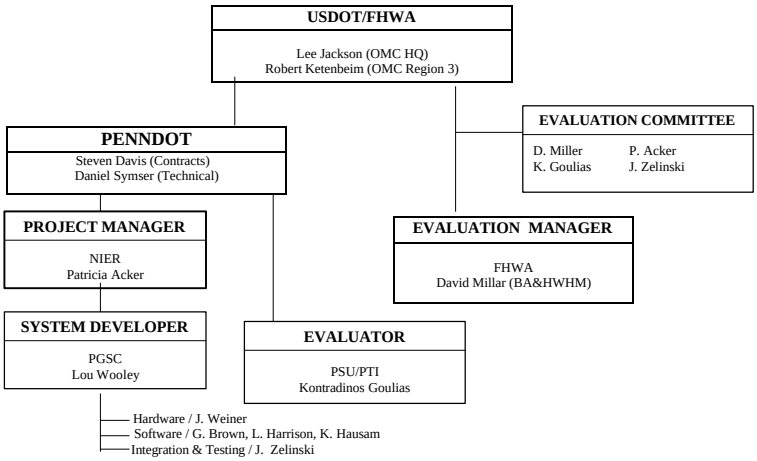
Figure 1-1
Team Partners and Roles

MEMBERS	Evaluation	System Design	System Development	Implementational O&M	Program Management	Software	Outreach/Training	Policy
FHWA	■							■
PENNDOT	■							■
NIER	■	■	■	■	■	■	■	■
PAR	■	■	■	■	■	■	■	■
BA&H	■							
PENN STATE / PTI	■							

1.3. PROJECT ORGANIZATION

The Tranzit *XPress* project is a system of hardware and software designed for use by parties involved in HazMat transportation. The design and implementation of Tranzit *XPress* is done by MER and PAR. Other work on this project is carried out by a group of university staff, consultants, and industry representatives. One person from each partner is designated as a member of the Evaluation Committee, which is created to oversee the evaluation tasks performed by the independent Evaluation Team, from CITranS a center in the Pennsylvania Transportation Institute at the Pennsylvania State University (PSU). The System Developer is PAR Government Systems Corporation (PAR), and Federal Highway Administration (FHWA) is the evaluation manager. National Institute for Environmental Renewal (NIER) is the project manager. Guidance on the evaluation is provided by Booz-Allen & Hamilton (BA&H). Figure l-2 depicts the general structure.

Figure 1-2
Project Organization



1.4. OPERATIONAL TEST GOALS AND OBJECTIVES

The primary goal of the Tranzit Press Operational Test is to demonstrate the potential to reduce response time to hazardous material incidents by combining existing information technologies into a HazMat fleet monitoring and data management system. The objectives developed to support this goal are as follows:

a. Develop a comprehensive and coordinated use of ITS technologies to promote HazMat transportation safety.

b. Demonstrate the feasibility of computerized emergency response information technologies, including telecommunications technologies, to:

- Identify contents of shipments of hazardous materials transported by motor carriers;
- Link systems that identify, store and allow retrieval of data for emergency response to incidents and accidents involving transportation of hazardous materials by motor carriers;
- Provide information to facilitate responses to accidents involving hazardous materials shipments by motor carriers either directly or through links with other systems.

c. To aggressively implement the directives of the Congressional language through rapid prototyping and the leveraging of:

- Installed and planned communications capabilities of targeted shippers and carriers;
- Ongoing ITS projects;
- National Institute for Environmental Renewal (NIER) and industry team investment and ongoing projects;
- Existing and emerging technologies relating to ITS solutions.

1.5. OPERATIONAL, TEST OVERVIEW

The Tranzit *XPress* project is intended to demonstrate a vehicle fleet management and data monitoring system using multiple, coordinated ITS technologies to improve hazardous material transportation safety and industry productivity. The following section describes the Tranzit *XPress* System as envisioned by the developers.

- The Tranzit *XPress* system will demonstrate the feasibility of automated emergency response information technologies to:

  - Identify HazMat contents of motor carrier shipments

  - Link systems that identify, store, and allow retrieval of data for emergency response to incident involving HazMat transportation

  - Provide information, either directly or through links to other systems, to facilitate responses to incidents involving motor carrier HazMat shipments (crisis management)

- The Tranzit *XPress* system will:

  - Gather and sell information on HazMat being transported

  - Provide one-time data entry for electronic shipping papers

  - Provide vehicle and cargo location, status, and theft indication

- Potential benefits of the system include:

  - Improved response to HazMat incidents by providing proactive notice to first responders

  - Reduced costs to shippers, carriers, and recipients through reduced paperwork, data entry, fines, insurance, lost time, and incident cleanup

- The project is implemented according to a 12 month phased task approach (four cycles of development) to achieve early and incremental success

. The project is conducted in northeastern Pennsylvania along and around the I-8 1 corridor between Binghamton, NY and Harrisburg, PA.

1.6. RELATION TO NATIONAL GOALS AND OBJECTIVES

The 1995 Congressional Appropriation Bill directed the U.S. Department of Transportation and Federal Highway Administration to make available $1.5 million to develop a comprehensive and coordinated use of Intelligent Vehicle Highway System (Intelligent Transportation System) technologies to promote hazardous materials transportation safety. The Appropriation Bill includes the guidance cited above in "Objectives".

The relationship of Tranzit ***XPress*** and National Goals can be summarized as follows:

Primary: Improve safety of nation's surface transportation system.

Secondary: Reduce energy and environmental costs. Create an environment in which development and deployment of ITS can flourish.

Tertiary: Increase operational efficiency and capacity of surface transportation. Enhance present and future productivity.

No Relation: Personal mobility and convenience and comfort of surface transportation system.

1.7. RELATION TO STATE GOALS AND OBJECTIVES

To enhance the safety, efficiency, and management of Pennsylvania's transportation system the major transportation agency of the Commonwealth, Pennsylvania Department of Transportation (PennDOT), is in the process of development and deployment of intelligent transportation strategies. The 1995 ITS Strategic Plan by PennDOT outlines the goals and supporting objectives. The goals address transportation safety, efficiency and reliability as well as the organization, funding, partnership, policy and outreach necessary for success.

The relationship between the State Goals and Tranzit *XPress* is briefly summarized as follows:

Primary: Improve safety, efficiency, and reliability of the Commonwealth's Transportation system using Intelligent Transportation Systems (ITS) strategies.

No Relation: Heighten awareness of Intelligent Transportation Systems (ITS) among customers and stakeholders.

No Relation: Establish a broad-based multidisciplinary organizational structure to facilitate the planning, design, deployment, operations and maintenance of Intelligent Transportation Systems (ITS) services.

No Relation: Address key legislative, regulatory and policy issues to expedite Intelligent Transportation Systems (ITS) service delivery.

No Relation: Foster and encourage public, private, and academic partnerships to implement and operate Intelligent Transportation Systems (ITS).

No Relation: Allocate appropriate funding commensurate with program commitments and seek alternative financial mechanisms to manage and implement Pennsylvania's Intelligent Transportation Systems (ITS) program.

1.8. PURPOSE OF THE OPERATIONAL TEST EVALUATION

The Intelligent Transportation System (ITS) National Program Plan defines operational tests as bridging the gap between research and development activities and full-scale deployment of proven technologies. Furthermore, it states that the emphasis of operational tests is on integrated systems and services. Operational tests are conducted under real world conditions in the transportation domain. Although many of the technologies are being transferred from other industries (e.g., the defense industry), the application in the transportation community still needs to be explored. Therefore, the

evaluation of these operational tests is critical to provide information on viability of technologies and systems as potential ITS applications,

At the National level, evaluations help support further development of ITS system architectures, public sector policy development, private sector product/service development, and decisions to continue, modify, or suspend operational testing. The purpose of this operational test evaluation is to assess potential perceived benefits and impacts (positive and negative) of the systems and services being tested.

1.9. EVALUATION GOALS AND OBJECTIVES

During the period of January 1996 to May 1996 the project evaluation committee worked on the goals and objectives of the Tranzit ***XPress*** Operational Test Evaluation. Five primary goals were selected for the evaluation. These goals, and their associated objectives, were then further reduced to meet the evaluation budgetary constraints. The next step was the development of basic items of information that, for the purpose of this evaluation, are generally called “evaluation measures”. Evaluation measures are quantifiable or measurable parameters that attempt to validate the intended impacts or physical functions required of the object/feature to be deployed and used in a realistic environment. Each evaluation objective is linked to one or more evaluation measures as shown in Figure l-3.

These goals, objectives and measures were finalized during the period of May 1996 to July 1996, and were presented in the Tranzit *XPress* Evaluation Plan, Document #9610.XPRS.00. As shown later in this report, these evaluation measures provide the basis for the hypothesis statements that were developed to test the system.

Figure I-3
Evaluation goals, objectives and measures

Goal	*Objective*	*Measures*
1. Determine the feasibility that Tranzit ***XPress*** will improve HazMat Incident Management	1.1. Assess the Tranzit *XPress'* ability to decrease HazMat incident response and recovery time	1.1.1. For typical accidents, amount of decrease in incident recovery time by first responders based on staged incidents (When information is conveyed directly by the driver)
		1.1.2. For typical accidents, amount of decrease in incident response and recovery time when information is generated and routed through Operations Center, based on accident scenarios
	1.2. Assess the Tranzit *XPress'* ability to improve the accuracy of HazMat cargo identification	1.2.1. Perception of likelihood for improvement in placard information based on each user group responses
		1.2.2. Perception of likelihood for more accurate shipping papers reflecting HazMat on board, based on each user group responses
		1.2.3. Perception of likelihood to avoid legislative loop holes (e.g., herbicides, minimum toxic quantities, and toxic combinations) based on regulatory and enforcement agency responses
	I.3. Assess the Tranzit *XPress'* ability to improve HazMat incident emergency response (strategy) selection	1.3.1. Perception of likelihood to design optimal incident recovery strategy using Tranzit ***XPress*** based on emergency agency and motor carrier responses
	1.4. Assess the Tranzit ***XPress'*** ability to improve Motor Carrier and Shipper compliance with HazMat regulations*	1.4.1. Perception of potential for Motor Carrier and Shipper compliance using Tranzit ***XPress*** based on regulatory/enforcement authority and motor carrier responses
	1.5. Assess the Tranzit *XPress'* ability to provide information to facilitate responses to accidents and incidents through links with other systems	15.1. User perception of the Tranzit ***XPress'*** ability to provide information to facilitate responses to accidents and incidents through links with other systems based on user responses
2 Evaluate user acceptance and perception (as they relate to the use of Tranzit ***XPress)***	2.1. Assess the Tranzit *XPress'* ability to meet for each user group their stated needs	2.1.1. List of needs for each user group (as they relate to HazMat Transportation) based on user responses
	needs	2.1.2. Perception of Tranzit ***XPress'*** ability to meet specific stated needs based on user responses
	2.2. Assess for each group perceptions of Tranzit *XPress* and its components	2.2.1. Expected benefits for each user group of Tranzit ***XPress*** based on user responses
		2.2.2. Expected benefits for each user group of components of Tranzit ***XPress*** based on user responses
	2.3. Assess for each group stated intention to use Tranzit ***XPress***	2.3.1. Expected use of Tranzit ***XPress*** based on user responses
	2.4. Assess for each group stated intention to use individual components of Tranzit XPress	2.4.l. Expected use of individual componcnts of Tranzit ***XPress*** based on user responses'
	2.5. Assess for each group stated intention to use information generated and/or routed through Tranzit ***XPress***	2.5.1. Expected use of information generated and routed through Tranzit ***XPress*** based on user responses
. Document and assess the effect of institutional and legal issues on the Tranzit	5.1. Identify all institutional and legal issues encountered and appraise the extent of their impact for future deplovment	5.1.1. A list of institutional and legal issues encountered and an appraisal of their impact on future deploymen
	5.2. Identify any institutional and legal lesson learned	5.2.1. A list of institutional and legal lessons learned
	5.3. Assess a state agency, federal agency and first responder position on	5.3.1. State agency's likelihood of deploying Tranzit ***XPress*** emerging from agency responses

Figure 1-3 (Continued)
Evaluation goals, objectives and measures

Goal	Objective	Measures
XPress operational test and future deployment	deployment of Tranzit *XPress*	53.2. Federal agency's likelihood of deploying Tranzit *XPress* emerging from agency responses
		5.3.3. First responder's likelihood of deploying Tranzit *XPress* emerging from first responder responses
	5.4. Assess shipper, carrier, and recipient positions on deployment of Tranzit XPress	5.4.1. Shipper's likelihood of deploying Tranzit *XPress* emerging from shipper's responses
		5.4.2. Carrier's likelihood of deploying Tranzit *XPress* emerging from carrier responses
		5.4.3. Recipient's likelihood of deploying Tranzit *XPress* emerging from recipient responses
	5.5. Collect and maintain a library of contracts, agreements, working papers, and reports from key participants describing the impact of institutional and legal issues on proiect development	5.5.1. A list of all institutional and legal issues on project development and a library of contracts, agreements, working papers, and reports from key participants

1.10. STRUCTURE OF THIS REPORT

The Tranzit ***XPress*** Evaluation Report describes in detail, the frame work and strategies followed in conducting the Tranzit ***XPress*** Operational Test technical evaluation, and also discusses the outcome of the tests and provides summary of the results. Following this introduction, this report is organized into the following 5 chapters:

- **Cbapter** 2-General description of the new system, examples of operational scenarios and information flow using the system components.
- **Chapter** 3-Evaluation design and test conduct methodology followed during the evaluation.
- **Chapter** 4-Data processing and management schemes, and statistical analysis of the survey responses.
- **Chapter** 5-Detailed test schedule.
- **Chapter** 6-Documentation of institutional and legal issues encountered.

2. TRANZIT XPRESS SYSTEM

2.1. SYSTEM DESCRIPTION

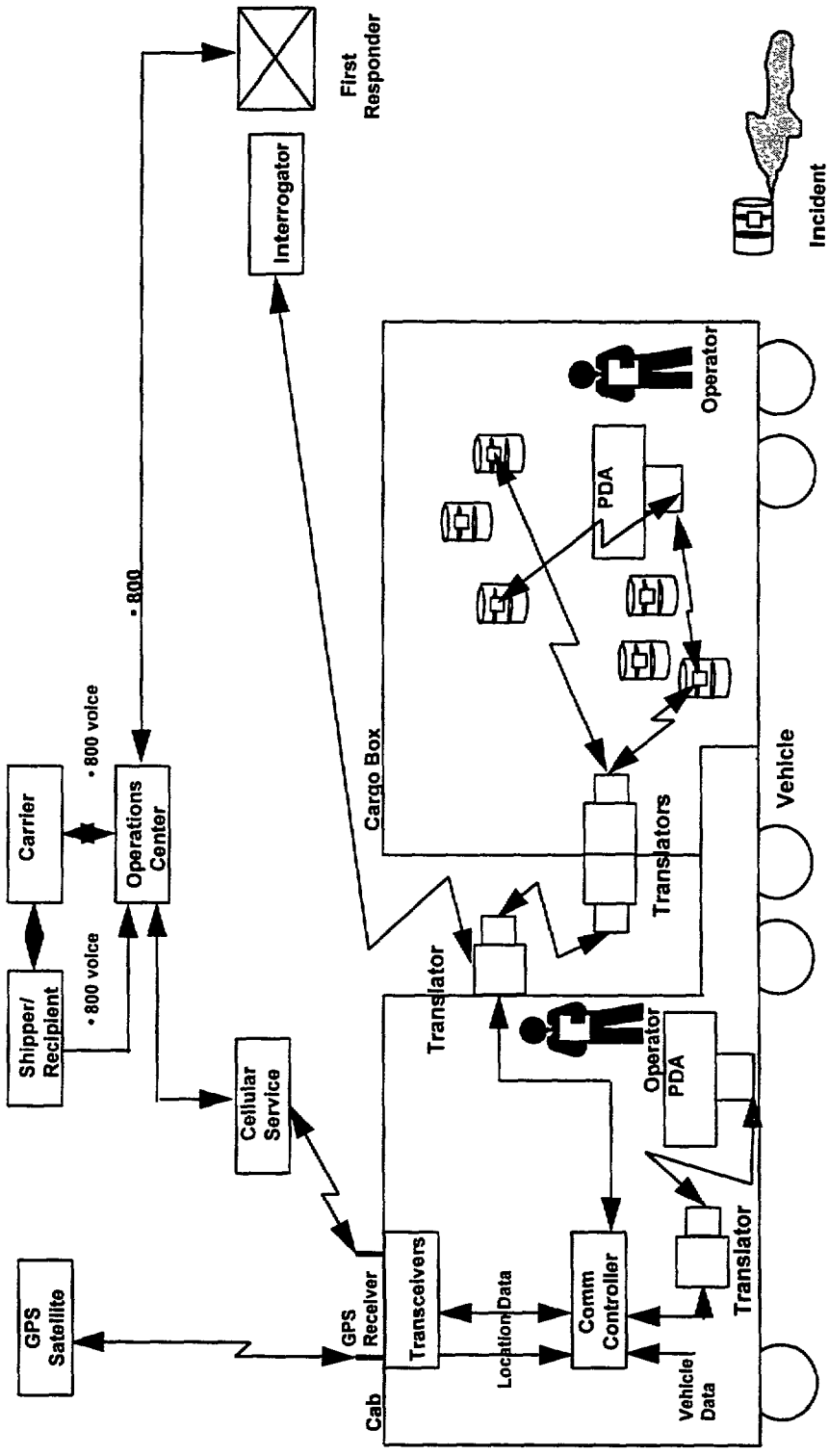
The Tranzit ***XPress*** system , according to its developers, is intended to provide a user-friendly, reliable, computerized information system that will collect and provide more accurate and timely information about hazardous material shipments, enabling participating agencies to act more effectively and efficiently in case of incidents. The system may be categorized into three distinct parts-the Information Dispatching/ Operations Center, the on-Vehicle Electronics system, and a battery of off vehicle devices such as an interrogator. Although interrogators are not, strictly speaking, a part of the system, they are also briefly described due to their importance in the operation of Tranzit ***XPress*** system. Figure 2-1 illustrates the interconnections of the system components. The system is further described in greater detail below.

2.1.1. Operations Center

The principal function of the Information Dispatching/ Operations Center is to collect information from the shipper of materials and move this information to where it is currently needed in the system. In addition, information regarding the current content of the vehicle, contained in the Vehicle Electronics, is returned to the operations center, and it can be made available to the clients. The Operations Center has four software packages resident on a Pentium PC; the Gateway, OpCenter, a relational database with a database interface, and a map visualization product.

The Gateway application is designed to communicate with the vehicles through a cellular modem to transfer shipping orders and to maintain status information. The OpCenter application allows the operator to activate a set of shipping orders for a particular truck and to view the locations of vehicles that are actively processing shipping orders. The vehicle locations are overlayed onto a map visualization product. The database serves as a repository for customer, stop, bill of lading, and material data. Information is loaded into and updated through a database interface package.

Figure 2-1
Layout of Tranzit *XPress* System



Prototype Operations Center exist at NIER and PGSC. A mobile Operations Center is also developed for testing purposes intermediate versions of which have been used in this evaluation.

2.1.2. Vehicle Electronics System

This part of the system consists of the electronic components based in the vehicle and/or provided to the driver/operator. This system is composed of two subsystems-the Tractor Electronics, and the Trailer Electronics.

2. 1. 2. 1. Tractor Electronics

Tractor Electronics includes the Driver Pack (Personal Digital Assistant and Power Pack), Interrogate and Respond Module, vehicle communications controller, trailer wireless communicator, Global Positioning System (GPS) receiver and antenna, cellular communications transceiver and antenna plus modem, roof mounted fixture and enclosure, and necessary cable and wireless links.

The Personal Digital Assistant (PDA) is a mobile, wireless, and programmable Newton type system (hand-held personal computer). It is one of the two areas in the system where manual input is required. HazMat transportation related information such as schedules, routes, stops, vehicle location, cargo status, and incidents can be transmitted from or to the driver through the PDA to or from the Operations Center. Furthermore, it can be used for checking contents and integrity of the cargo, assigning tags to shipping units and periodically updating the location/ time/status of a vehicle during transit. Since the PDA is intended for relatively untrained users the software design aims at a user friendly and interactive communication. PAR reports that "when complete with necessary programming, it requires minimal training and it is attempting to be consistent with the current driver practices."

The Newton carrying case, located in the truck cabin, provides a padded holder for the Newton PDA in cabs, and provides wireless communications and a means for recharging the Newton and communicator batteries. The communications controller is based on a personal computer platform. It

communicates with a translator on the tractor roof, GPS receiver and a cellular transceiver, and necessary interface equipment.

Interrogate and Respond Module is an externally powered device. Through an RF translator on the trailer, it maintains a summary of cargo information (up to 1000 characters) and in case of an incident this information is provided to the incident responders. It may be interrogated by X, Ku, Ka band or laser stimulation and provides interrogation reply at VHF (synthesized voice at 155.475 MHz, the Nationwide/Statewide emergency communication frequency or at 154.665 Mhz, 154.905 Mhz, or 155.445 Mhz state police communication frequencies) followed by a modem data stream.

2.1.2.2. Trailer Electronics

The Trailer Electronics consists of wireless communication devices (RF translators) and Asset tags.

Two RF translators, placed on the front wall of trailer (one inside and the other one outside the trailer) provide communication between the Asset Tags and the Tractor Electronics. The translator inside the trailer “talks” to the tags and gets necessary cargo information, that is then transmitted to the outside translator through a cable link. The outside translator transmits the information to Tractor Electronics and Interrogate and Respond Module.

Attached to cargo shipment, Asset Tags are small reprogrammable electronic devices intended to contain shipment data. These tags can be programmed by the driver using the PDA.

2.1.3. Interrogator

Through this system, in case of incident, police and/or first responders are able to get relevant information about the material from the helper-tags using a radar gun and a radio. Generally X, Ku, Ka band or laser radar is envisioned to be used for HazMat interrogation with the reply broadcast by the helper tag on a police radio channel using synthesized voice and modem format data

describing the cargo. In this phase, the system development concentrates on state police on interstate highways that have a radar gun.

2.2. SYSTEM OPERATION SCENARIOS

Based on the information provided by PGSC on July 18, 1996 system operations are briefly illustrated in this section. Figure l-2 and Figure l-3 outline the procedure followed by the Tranzit ***XPress*** system during routine non-emergency and emergency situations respectively.

2.3. TYPICAL INCIDENTS INVOLVING HAZMAT

In this section "typical" incidents involving hazardous material are described and are based on a review of administrative records provided by the U.S. DOT.

2.3.1. Incident Type-l: Leak with no vehicle accident

1. a) Truck driver discovers a leak from the trailer (typically at a rest/truck stop or the delivery location) - or -

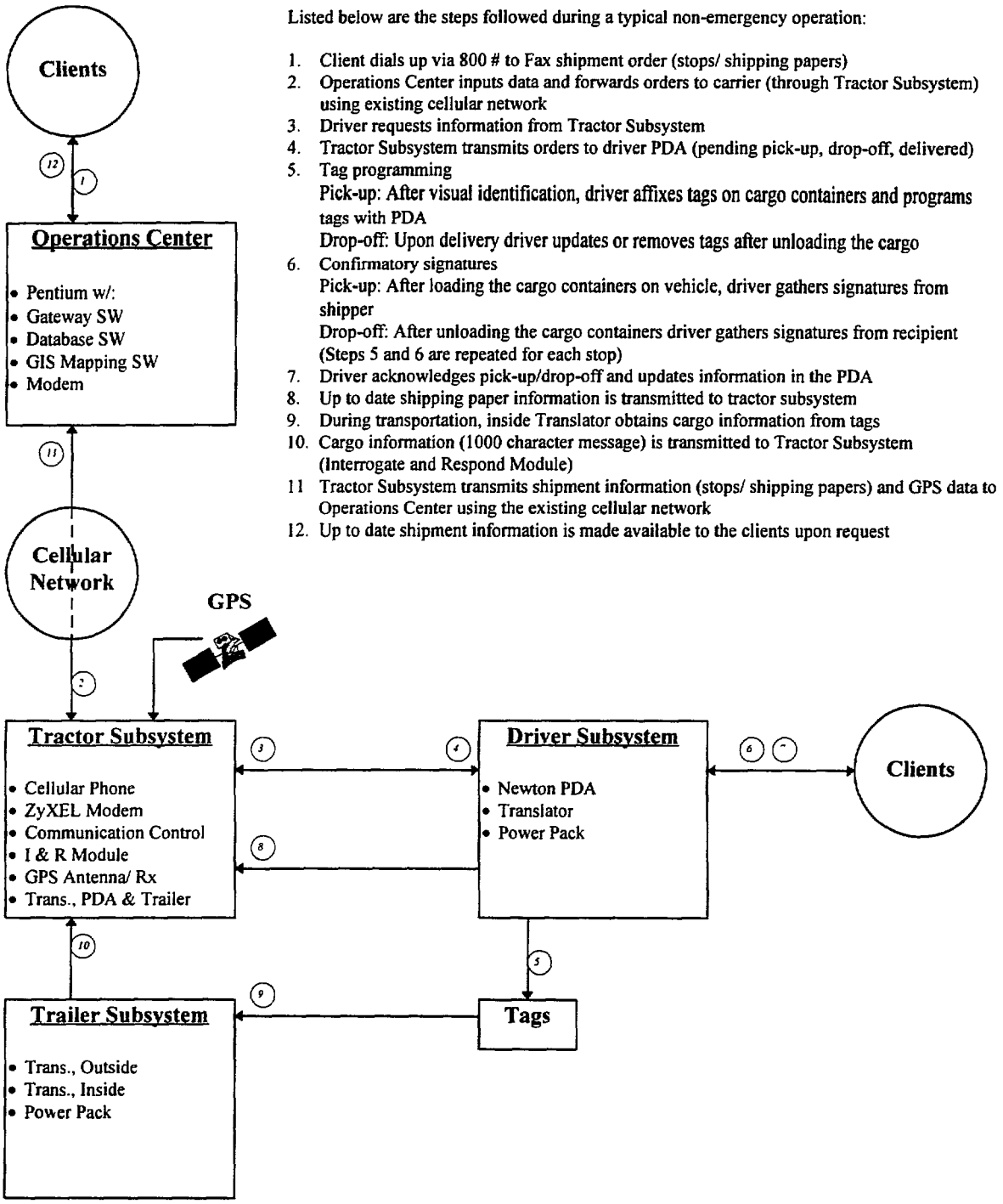
   b) Leak from trailer is detected by a motorist who notifies the truck driver and/or police.

2. a) Truck driver calls trucking company (for minor spills, this occurs most often) - or -

   b) Truck driver calls 911 or state police, depending on the incident location.

Note: In Pennsylvania, 911 centers dispatch local police and fire departments to respond to emergencies in the towns they serve. State police are dispatched from their own headquarters and respond to emergencies on major highways and in areas where no local police is available.

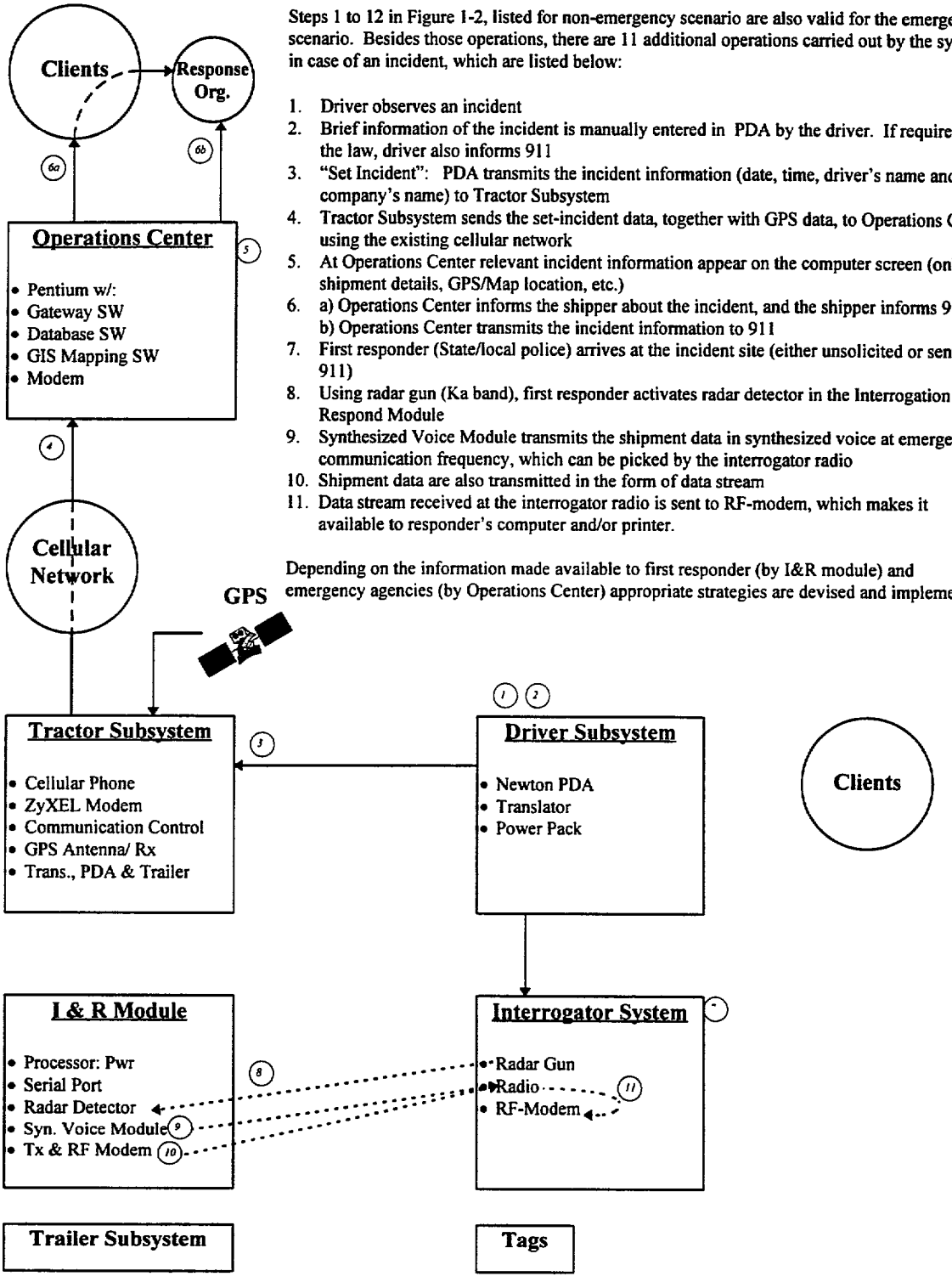
FIGURE 1-2
System Operations: Non-emergency Scenario (Routine Operation)



Listed below are the steps followed during a typical non-emergency operation:

1. Client dials up via 800 # to Fax shipment order (stops/ shipping papers)
2. Operations Center inputs data and forwards orders to carrier (through Tractor Subsystem) using existing cellular network
3. Driver requests information from Tractor Subsystem
4. Tractor Subsystem transmits orders to driver PDA (pending pick-up, drop-off, delivered)
5. Tag programming
   Pick-up: After visual identification, driver affixes tags on cargo containers and programs tags with PDA
   Drop-off: Upon delivery driver updates or removes tags after unloading the cargo
6. Confirmatory signatures
   Pick-up: After loading the cargo containers on vehicle, driver gathers signatures from shipper
   Drop-off: After unloading the cargo containers driver gathers signatures from recipient
   (Steps 5 and 6 are repeated for each stop)
7. Driver acknowledges pick-up/drop-off and updates information in the PDA
8. Up to date shipping paper information is transmitted to tractor subsystem
9. During transportation, inside Translator obtains cargo information from tags
10. Cargo information (1000 character message) is transmitted to Tractor Subsystem (Interrogate and Respond Module)
11. Tractor Subsystem transmits shipment information (stops/ shipping papers) and GPS data to Operations Center using the existing cellular network
12. Up to date shipment information is made available to the clients upon request

FIGURE 1-3
System Operations: Emergency Scenario (Incident)



Steps 1 to 12 in Figure 1-2, listed for non-emergency scenario are also valid for the emergency scenario. Besides those operations, there are 11 additional operations carried out by the system in case of an incident, which are listed below:

1. Driver observes an incident
2. Brief information of the incident is manually entered in PDA by the driver. If required by the law, driver also informs 911
3. "Set Incident": PDA transmits the incident information (date, time, driver's name and company's name) to Tractor Subsystem
4. Tractor Subsystem sends the set-incident data, together with GPS data, to Operations Center using the existing cellular network
5. At Operations Center relevant incident information appear on the computer screen (onboard shipment details, GPS/Map location, etc.)
6. a) Operations Center informs the shipper about the incident, and the shipper informs 911
   b) Operations Center transmits the incident information to 911
7. First responder (State/local police) arrives at the incident site (either unsolicited or sent by 911)
8. Using radar gun (Ka band), first responder activates radar detector in the Interrogation and Respond Module
9. Synthesized Voice Module transmits the shipment data in synthesized voice at emergency communication frequency, which can be picked by the interrogator radio
10. Shipment data are also transmitted in the form of data stream
11. Data stream received at the interrogator radio is sent to RF-modem, which makes it available to responder's computer and/or printer.

Depending on the information made available to first responder (by I&R module) and emergency agencies (by Operations Center) appropriate strategies are devised and implemented.

3. If trucking company is the first to be notified:

   a) Trucking company contacts 911 or state police - or -

   b) Trucking company contacts privately contracted recovery team to re-pack material and cleanup spill. (Note: In Pennsylvania it is required for 911 to be notified of any HazMat spill, but this rarely occurs for minor spills)

4. Call is received in 911 center.

   a) If a significant amount of hazardous material is known to be present, the HazMat team is dispatched immediately via paging from the 911 center. The 9 11 center notifies the local Emergency Management Agency (EMA), which notifies the PA Department of Environmental Protection (DEP).

   b) If a significant amount of hazardous material is not known to be present, police officers are dispatched to evaluate the situation and determine the need for fire/rescue/HazMat response.

5. A police officer arrives on the scene and attempts to determine if hazardous materials are present. Fire personnel and the HazMat team are requested by the police through the 911 center if a significant amount of material is leaking and one or more of the following conditions are met:

   - The driver is incapacitated.
   - The driver knows or suspects that he was carrying hazardous materials.
   - The shipping papers are available and list hazardous materials on board.
   - Placards are visible and indicate the presence of hazardous materials.
   - Hazardous materials are suspected due to smoke, fumes, etc. from the leaking container.

6. Police clears the immediate area of bystanders and makes a passive attempt to identify the cargo. These steps include asking the driver (if available) for information about the cargo and looking for placard numbers without approaching the vehicle.

a) If the shipping papers are available, the Emergency Response Telephone Number on the papers is forwarded by the first responders to the 911 center. The 911 center then contacts this number to obtain critical information about the dangers specific to the material involved and relays this information back to the incident site.

b) If the shipping papers are unavailable but the type of material can be identified, the police will relay this information to the 911 center. The 911 center will then assist in determining the first steps to be taken (i.e., determine evacuation distances) based on data from the North American Emergency Response Guidebook (NAERG), CEMA and PennDOT computers, and contact with emergency information hot-lines such as CHEMTREC.

c) If the type of material cannot be identified, the area will be cleared for 50 to 100 meters in all directions until the HazMat team arrives. If the spill is large and threatens to spread into waterways or storm drains, the fire department will dig ditches or build dikes to contain the spill, but will not actively attempt to approach the vehicle or stop the leak.

7. HazMat Response Team arrives at the incident site.

a) The first step is to determine if any material is leaking and what the material is, or, at least, what type of immediate dangers it poses to rescue workers (i.e., whether the material is explosive, toxic, caustic, corrosive, etc.) If this information cannot be determined from the shipping papers, driver, placards, or the shipping company, then the HazMat team will dispatch a 2-member reconnaissance team with protective suits and attempt to determine the identity of the material from container labels or by using special tests.

b) After determining (to the extent possible) the specific dangers that the material poses and obtaining the protective equipment necessary to ensure the safety of rescue workers, the HazMat team will send in another 2-person team to attempt to rescue any persons affected by the spill. The incident commander will simultaneously coordinate with CEMA and PEMA to begin any necessary evacuations and obtain additional and/or special equipment necessary for containment.

c) After the area has been cleared of any nonessential personnel, the HazMat team will send in additional teams with protective suits to attempt to determine which container is leaking and the best way to stop the leak. This may involve the unloading of some of the cargo in order to gain access to the leaking container. The leak is then contained by repairing or repackaging the container and using booms, ditches, or sand/dirt dikes to contain any material that has spilled on the ground or pavement.

8. Cleanup

a) Once the leak has been stopped and the spilled material is contained, the responsibility for cleanup of the incident site shifts from the HazMat team to the motor carrier. Most carriers of hazardous materials have contracts with specialized environmental cleanup companies to perform these duties. In Pennsylvania, all cleanup companies must be approved by and operate under the supervision of the DEP. The cleanup may involve the removal of spilled liquid and any contaminated soil as well as remediation of the affected area.

2.3.2. Incident Type-2: Vehicle accident with or without a leak

1. a) Vehicle accident is reported to 911 or state police by motorists or bystanders.

b) Vehicle accident is reported to 911 or state police by truck driver.

c) Vehicle accident is reported to trucking company by truck driver; company contacts state police or 911.

2. The 911 center dispatches local police and, if the accident is serious, the local fire department.

a) If HazMat is known to be present, the HazMat team is dispatched immediately via paging from the 911 center. The 911 center notifies the local Emergency Management Agency (EMA), which notifies the PA Department of Environmental Protection (DEP).

b) If HazMat is not known to be present, police and/or fire crews will evaluate the accident scene to determine the need for a HazMat team response.

3. Police and/or fire crews arrive on the scene and attempt to determine if hazardous materials are present. The HazMat team is requested by the police through the 911 center if one or more of the following conditions are met:

   a) An unidentifiable material is leaking from the vehicle and:

      - The driver knows or suspects that he is carrying hazardous materials.
      - The shipping papers are available and list hazardous materials on board.
      - Placards are visible and indicate the presence of hazardous materials.
      - A vehicle fire prohibits access to the driver, placards, and/or shipping papers.

   b) Hazardous materials are suspected due to smoke, fumes, etc. from the vehicle.

4. See Incident Type 1, Step 6.

Note: For significant incidents involving the transportation of hazardous materials, motor carriers must immediately notify the U.S. Coast Guard's National Response Center (NRC) via a toll-free telephone number. The NRC will then notify any concerned federal agencies including, when appropriate, the modal administrations, RSPA, EPA, CHEMTREC, and the NTSB.

A significant hazardous material incident is defined by the USDOT as an "incident involving death, property damage in excess of $50,000, an evacuation, the closure of a major transportation artery or facility, the alteration of the operational flight pattern or routine of an aircraft, the release of a radioactive material or etiologic agent, or a situation which is judged by the carrier to merit notification even though it does not meet the specified criteria."

The evaluation design that follows takes into account the incident scenarios offered here by attempting to follow (e.g., in the survey) the stages of a typical

incident and the roles played or not played by the Tranzit ***XPress*** system in each stage.

3. EVALUATION DESIGN AND TEST CONDUCT

3.1. EVALUATION SCHEME

The broad nature of evaluation goals, as indicated by the diverse objectives, require the segregation of test activities into three distinct focus areas:

- System Impacts and Performance
- User Acceptance
- System Deployability

Information regarding the specific data collection methods used for each area is provided in subsequent sections of this report. Collection of information and data pursuant to each of these focus areas was done through a combination of information collection methods:

- Research-Collection of historical data from motor carrier and state agency files and records.

- Surveys-Structured questionnaires to collect user perceptions, opinions, and preferences.

- Interviews-Follow-up discussion with some of the test participants to clarify and expand upon survey responses, and collect additional information. These were also used to gather information about the existing systems.

3.1.1. System Impacts and Performance

The purpose of this portion of the test is to determine the changes in the HazMat incident response carriers and incident responders may realize through the use of the Tranzit ***XPress*** system. The users are queried about the ability of the Tranzit ***XPress*** system to effectively decrease the incident response and recovery time, improve cargo identification, improve incident response

strategy, improve motor carrier compliance with regulations, and provide necessary information about HazMat incidents.

There are five areas addressed during this portion of the test, consistent with the following five objectives:

- Objective 1.1-Assess the Tranzit ***XPress'*** ability to decrease HazMat incident response and recovery time

- Objective 1.2-Assess the Tranzit ***XPress'*** ability to improve the accuracy of HazMat cargo identification

- Objective 1.3-Assess the Tranzit ***XPress'*** ability to improve HazMat incident emergency response (strategy) selection

- Objective 1.4-Assess the Tranzit ***XPress'*** ability to improve Motor Carrier and Shipper compliance with HazMat regulations

- Objective 1.5-Assess the Tranzit ***XPress'*** ability to provide information to facilitate responses to accidents and incidents through links with other systems

3.1.2. User Acceptance

The goal of this portion of the tests is to determine the extent to which the Tranzit ***XPress*** system satisfies the requirements and suits the preferences of the system users. Structured surveys, and interviews, with system users involved in the transportation of HazMat are used to collect the information necessary to address the following objectives:

- Objective 2.1-Assess the Tranzit ***XPress'*** ability to meet for each user group their stated needs

- Objective 2.2-Assess for each group perceptions of Tranzit ***XPress*** and its components

- Objective 2.3-Assess for each group stated intention to use Tranzit ***XPress***

- Objective 2.4---Assess for each group stated intention to use individual components of Tranzit ***XPress***

- Objective 2.5---Assess for each group stated intention to use information generated and/or routed through Tranzit ***Xpress***

3.1.3. System Deployability

The goal of this portion of the tests is to assess the degree to which the Tranzit ***XPress*** system provides a viable platform for the deployment of a nationwide HazMat transportation emergency system. Data gathered during research, and through surveys and interviews of and with motor carrier and incident responder personnel are used to address the following objectives:

- Objective 5. l-Identify all institutional and legal issues encountered and appraise the extent of their impact for future deployment

- Objective 5.2-Identify any institutional and legal lesson learned

- Objective 5.3—Assess a state agency, federal agency, and first responder's position on deployment of Tranzit ***XPress***

- Objective 5.4-Assess shipper, carrier, and recipient positions on deployment of Tranzit ***XPress***

- Objective 5.5-Collect and maintain a library of contracts, agreements, working papers, and reports from key participants describing the impact of institutional and legal issues on project development

3.2. HYPOTHESES AND ASSUMPTIONS

To further define the methods necessary to address the test objectives, hypotheses and assumptions were developed, where feasible, for each evaluation objective and measure. Hypotheses were formulated for those objectives for which it was deemed appropriate to provide a means of proving or disproving some change from the status quo, or the attainment or non-

attainment of a prescribed performance objective. In a strict statistical sense, the hypotheses presented here may be considered the alternative hypotheses. Some assumptions were also formulated to provide guidelines for the investigation. These assumptions are the maintained hypotheses that cannot be tested within the resources of this test. These hypotheses and assumptions for incident responders and motor carriers are given in Figure 3-l and Figure 3-2 respectively.

3.3. DATA REQUIREMENTS

In order to define the data requirements for this test, the goals, objectives, and measures listed in the Evaluation Plan were carefully reviewed, and the specific data elements necessary to adequately address them were identified. The resulting data elements are provided in Figure 3-3, listed with the corresponding measures.

3.4. DATA COLLECTION SCHEME

A key feature of this study, like many other system evaluation studies, is the understanding of user perception of the Tranzit ***Xpress*** system to assess its capabilities. The effectiveness of evaluation process is directly related to the quality of the data available. This study relies on self completing surveys for most of its data requirements. Interviewers, however, were present at all system demonstrations and surveys to aid with any clarification questions and to guide the development team in their presentation of the system components.

The conduct of a survey is a formal procedure, following a series of interconnected steps, including preliminary planning, selection and design of survey method, and selection and design of sample. In designing a survey, many factors have to be considered and numerous decisions need to be made. The essence of a good survey design is to be able to make trade-offs between the competing demands of good design practice in several areas, such as sample design, survey instrument design and conduct of survey, so as to arrive at the most cost effective high quality survey which meets the data requirements within budget constraints. The decisions range from the size of the sample down to the detail of the type of paper used for producing survey documents. The total

Figure 3-1
Test objectives, measures, hypotheses, and assumptions
Incident Responder group

Objective	Measures	*Hypothesis (H)/Assumption (A)/Content*
1.1. Assess the Tranzit ***XPress'*** ability to decrease HazMat incident response and recovery time	1.1.1. For typical accidents. amount of decrease in incident recovery time by first responders baaed on staged incident. (When information is conveyed directly by the driver)	H 1.1.1. Use of the Tranzit ***XPress*** will result in a reduction in the average amount of lime between when a HazMat incident occurs, and when the first responder reaches site, when compared to the current system
	1.1.2. For typical accidents, amount of decrease in incident response and recovery time when information is generated and routed through Operations Center, based on accident scenarios	H 1.1.2a H 1.1.2b. **Difficult to infer from the Demo/staged incident.**
1 2 Assess the Tranzit ***XPress'*** ability to improve the accuracy of HazMat cargo identification	1.2.1. Perception of likelihood for improvement in placard information based on each user group responses	H 1.2.1. Agency personnel involved in HazMat transportation will perceive that the Tmnzit ***XPress*** system improves placard information
	12.2. Perception of likelihood for more accurate shipping papers reflecting HazMat on board, based on each user group responses	H 1.2.2. Agency personnel involved in HazMat transportation will perceive that the Tmnzit ***XPress*** system improves the accuracy of shipping papers
	12.3. Perception of likehhood to avoid legislative loop-holes (e.g., herbicides, minimum toxic quantities, and toxic combinations) baaed on regulatory and enforcement agency responses	H 1.2.3. Agency personnel involved in HazMat transportation will perceive that the Tranzit ***XPress*** system helps in avoiding legislative loopholes
1.3. Assess the Tmnzit ***Xpress'*** ability to improve HazMat incident emergency response (strategy) selection	1.3.1. Perception of likelihood to design optimal incident recovery strategy using Tranzit ***XPress*** based on emergency agency and motor carrier responses	H 1.3.1. Agency personnel involved in HazMat transportation will perceive that the Tranzit ***XPress*** system helps in improved incident recovery
1.4. Assess the Tranzit ***Xpress'*** ability to improve Motor Carrier and Shipper compliance with HazMat regulations*	1.4.1. Perception of potential for Motor Carrier and Shipper compliance using Tranzit ***XPress*** based on regulatory/enforcement authority and motor carrier responses	H 1.4.1. Agency personnel involved in HazMat transportation will perceive that the Tranzit ***XPress*** system helps in Motor Carrier and Shipper compliance A 1.4.1. If motor carriers are helped in meeting the regulatory requirements their compliance will improve
1.5. Assess the Tranzit ***XPress'*** ability to provide information to facilitate responses to accidents and incidents through links with other systems	1.51. User perception of the Tranzit ***XPress'*** ability to provide information to facilitate responses to accidents and incidents through links with other systems based on user responses	H 1.5.1. Agency personnel invoived in HazMat transportation will perceive that the Tranzit ***XPress*** system facilitates responses to accidents and incidents through links with other systems
2 I. Assess the Tranzit ***XPress'*** ability to meet for each user group their stated needs	2.1.1. List of needs for each user group (as they relate to HazMat Transportation) based on user responses	H 2. I. 1. Perception of needs agency personnel will not change with exposure to Tmnzit ***Xpress*** system
	2.1.2. Perception of Tranzit ***XPress'*** ability to meet specific stated needs based on -responses	H 2.1.2. Agency personnel involved in HazMat transportation will perceive that the Tranzit ***XPress*** system meets specific stated needs

Figure 3-1 (continued)
Test objectives, measures, hypotheses, and assumptions
Incident Responder group

Objective	Measures	Hypothesis (H)/ Assumption (A)/ Content
2.2. Assess for each group perceptions of Tmnzit ***XPress*** and its components	2.2.1. Expected benefits stated by each user group of Tranzit ***XPress*** baaed on user responses	List
	2.2.2. Expected benefits stated by each user group of components of Tmnzit ***XPress*** based on user responses	List
2.3. Assess for each group stated intention to use Tmnzit ***XPress***	2.3.1, Expected use of Tmnzit ***XPress*** baaed on user responses	H 2.3.1. Agency personnel involved in HazMat transportation will find the Tranzit ***XPress*** system useful
2.4. Assess for each group stated intention to use individual components of Tranzit ***XPress***	2.4.1. Expected use of individual components of Tranzit ***XPress*** baaed on user responses	H 2.4.1. Agency personnel involved in HazMat transportation will find individual components the Tranzit ***XPress*** system useful
2.5. Assess for each group stated intention to use information generated and/or routed through Tranzit ***XPress***	2.5.1. Expected use of information generated and routed through Tranzit ***XPress*** baaed on user responses	H 2.5.1. Agency personnel involved in HazMat transportation will fmd the information generated and routed through the Tranzit ***XPress system*** useful
5.1. Identify all institutional and legal issues encountered and appraise the extent of their impact for future deployment	5.1.1. A list of institutional and legal issues encountered and an appraisal of their impact on future deployment	List
5.2. Identify any institutional and legal lesson learned	5.2. I. A list of institutional and legal lessons learned	List
5.3. Assess a state agency, federal agency, and first responder's position on deployment of Tranzit ***XPress***	5.3.1. State agency's likelihood of deploying Tmnzit ***XPress*** emerging from agency responses	Analysis
	5.3.2. Federal agency's likelihood of deploying Tranzit ***XPress*** emerging from agency responses	Analysis
	5.3.3. First responder's likelihood of deploying Tranzit ***XPress*** emerging from first responder responses	Analysis
5.4. Assess shipper. carrier, and recipient positions on deployment of Tranzit ***XPress***	5.4.1. Shipper's likelihood of deploying Tranzit ***XPress*** emerging from shipper's responses	N/A
	5.4.2. Carrier's likelihood of deploying Tranzit ***XPress*** emerging from carrier responses	N/A
	5.4.3. Recipient's likelihood of deploying Tranzit ***XPress*** emerging from recipient responses	N/A
5.5. Collect and maintain a library of contracts, agreements, working papers, and reports from key participants describing the impact of institutional and legal issues on project development	5.5.1. A list of all institutional and legal issues on project development and a library of contracts, agreements, working papers, and reports from key participants	List

Figure 3-2
Test objectives, measures, hypotheses, and assumptions
Motor Carrier group

Objective	Measures	Hypothesis (H)/ Assumption (A)/ Content
1.1. Assess the Tranzit ***XPress'*** ability to decrease HazMat incident response and recovery time	1.1.1. For typical accidents, amount of decrease in incident recovery tune by first responders based on staged incident (When information is conveyed directly by the driver)	**H 1.1.1. Use of the Tranzit *XPress* will result in a** perceived reduction in the **average** amount of time between when a HazMat incident occurs, and when the first responder reaches site, when compared to the current system
	1.1.2. For typical accidents, amount of decrease in incident response and recovery time when information is generated and routed through Operations Center, baaed on accident scenarios	H 1.1.2a. H 1.1.2b. **Difficult to infer from the Demo/staged incident.**
1.2. Assess the Tranzit ***Xpress'*** ability to improve the accuracy of HazMat cargo identification	1.2.1. Perception of likelihood for improvement in placard information based on each user group responses	H 12.1. Motor carrier personnel involved in HazMat transportation will perceive that the Tranzit ***XPress*** system improves placard information
	1.2.2. Perception of likelihood for more accurate shipping papers reflecting HazMat on board, based on each user group responses	H 1.2.2. Motor carrier personnel involved in HazMat transportation will perceive that the Tranzit ***XPress*** system improves the accuracy of shipping Papers
	1.2.3. Perception of likelihood to avoid legislative loop-holes (e.g., herbicides, minimum toxic quantities, and toxic combinations) based on regulatory and enforcement agency responses	**N/A**
1.3. Assess the Tranzit ***XPress'*** ability to improve HazMat incident emergency response (strategy) selection	1.3.1. Perception of likelihood to design optimal incident recovery strategy using Tranzit ***XPress*** baaed on emergency agency and motor carrier responses	H 1.3.1. Motor carrier personnel involved in HazMat transportation will perceive that the Tranzit ***XPress*** system will allow optimal incident recovery strategy.
1.4. Assess the Tranzit ***XPress'*** ability to improve Motor Carrier and Shipper compliance with HazMat regulations*	1.4.1. Perception of potential for Motor Carrier and Shipper compliance using Tranzit ***XPress*** baaed on regulatory/enforcement authority and motor carrier responses	**H** 1.4. l. Motor carrier personnel involved in HazMat transportation will perceive that the Tranzit ***XPress*** system will help in meeting the regulatory requirements. A 1.4.1. If motor carriers are helped in meeting the regulatory requirements their compliance will improve
1.5. Assess the Tranzit ***XPress'*** ability to provide information to facilitate responses to accidents and incidents through links with other systems	1.5.1. User perception of the Tranzit ***XPress'*** ability to provide information to facilitate responses to accidents and incidents through links with other systems based on user responses	H 1.5.1. Motor carrier personnel involved in HazMat transportation will perceive that the Tranzit ***XPress*** system facilitates responses to accidents and incidents through links with ***other systems***
2.1. Assess the Tranzit ***XPress'*** ability to meet for each user group their stated needs	2.1.1. List of needs for each user group (as they relate to HazMat Transportation) based on user responses	**H2.1.1.** Percentionofneedsofmotorcarrier personnel will not change with exposure to Tranzit ***XPress*** system
	2.12. Perception of Tranzit ***XPress'*** ability to meet specific stated needs baaed on user responses	H 2.1.2. Motor carrier personnel involved in HazMat transportation will perceive that the Tranzit ***XPress*** system meets specific stated needs

Figure 3-2 (continued)
Test objectives, measures, hypotheses, and assumptions
Motor Carrier group

Objective	Measures	Hypothesis (H)/ Assumption (A)/ Content
2.2. Assess for each group perceptions of Tranzit *XPress* and its components	2.2.1. Expected benefits stated by each user group of Tranzit *XPress* based on user responses	List
	2.2.2. Expected benefits stated by each user group of components of Tranzit *XPress* based on user responses	List
2.3. Assess for each group stated intention to use Tranzit *XPress*	2.3.1. Expected use of Tranzit *XPress* based on user responses	H 2.3.1. Motor carrier personnel involved in HazMat transportation will perceive the Tranzit *XPress* system beneficial
2.4 Assess for each group stated intention to use individual components of Tranzit *XPress*	2.4. 1. Expected use of individual components of Tranzit *XPress* baaed on user responses	H 2.4.1. Motor carrier personnel involved in HazMat transportation will perceive individual components of Tranzit *XPress* system beneficial
2.5. Assess for each group stated intention to use information generated and/or routed through Tranzit *XPress*	2.5. I. Expected use of information generated and routed through Tranzit *XPress* based on user responses	H 2.5.1. Motor carrier personnel involved in HazMat transportation will perceive information generated and routed through Tranzit *XPress* system beneficial
5.1. Identify all institutional and legal issues encountered and appraise the extent of their impact for future deployment	5.1. I. A list of institutional and legal issues encountered and an appraisal of their impact on future deployment	List
5.2. Identify any institutional and legal lesson learned	5.2.1. A list of institutional and legal lessons learned	List
5.3. Assess a state agency, federal agency, and first responder's position on deployment of Tranzit *XPress*	5.3.1. State agency's likelihood of deploying Tranzit *XPress* emerging from agency responses	*N/A*
	5.3.2. Federal agency's likelihood of deploying Tranzit *XPress* emerging from agency responses	*N/A*
	5.3.3. First responder's likelihood of deploying Tranzit *XPress* emerging from first responder responses	N/A
5.4. Assess shipper, carrier, and recipient positions on deployment of Tranzit *XPress*	5.4. I. Shipper's likelihood of deploying Tranzit Press emerging from shipper's responses	N/A
	5.4.2. Carrier's likelihood of deploying Tranzit *XPress* emerging from carrier responses	Analysis
	5.4.3. Recipient's likelihood of deploying Tranzit *XPress* emerging from recipient responses	N/A
5.5. Collect and maintain a library of contracts, agreements, working papers, and reports from key participants describing the impact of institutional and legal issues on project development	5.5.1. A list of all institutional and legal issues on project development and a library of contracts, agreements, working papers, and reports from key participants	List

Figure 3-3
Data Requirements

Measures	Type of Data Required	Data Source	
		Motor Carrier	Incident Responder
1.1.1. For typical accidents, amount of decrease in incident recovery time by first responders based on staged incident. (When information is conveyed directly by the driver)	• Continuous data on different time • Continuous data on diffe segments involved in the process	• Demo[1] - Survey - Research	• Demo[1] - Survey - Research
1.1.2. For typical accidents, amount of decrease in incident response and recovery time when information is generated and routed through Operations Center, based on accident scenarios	• Continuous data on different time segments involved in the process	*Difficult to ina from the Demo/staged incident.*	
1.2.1. Perception of likelihood for improvement in placard information based on each user group responses	• Discrete data on perception of user groups	- Survey[1] - Interview	- Survey[1] - Interview
I .2.2 Perception of likelihood for more accurate shipping papers reflecting HazMat on board, based on each user group responses	• Discrete data on perception of user groups	- Survey[1] - Interview	- Survey[1] - Interview
1.2.3. Perception of likelihood to avoid legislative loop-holes (e.g., herbicides, minimum toxic quantities, and toxic combinations) based on regulatory and enforcement agency responses	• Discrete data on perception of regulatory and enforcement agency responses	- Survey[1] - Interview	- Survey[1] - Interview
I .3.1 Perception of likelihood to design optimal incident recovery strategy using Tranzit *XPress* based on emergency agency and motor carrier responses	• Discrete data on perception of emergency agency responses	- Survey[1] - Interview	- Survey[1] - Interview
I .4.1 Perception of potential for Motor Carrier and Shipper compliance using Tranzit *XPress* based on regulatoty/enforcement authority and motor carrier responses	• Discrete data on perception of regulatory and enforcement agency responses	- Survey[1] - Interview	- Survey[1] - Interview
1 .5. 1. User perception of the Tranzit *XPress'* ability to provide information to facilitate responses to accidents and incidents through links with other systems based on user responses	• Discrete data on perception of user groups	- Survey[1] - Interview	- Survey[1] - Interview
2.1.1. List of needs for each user group (as they relate to HazMat Transportation) based on user responses	• Open ended lexicographic data	- Survey[1] - Interview	- Survey[1] - Interview
2.1.2. Perception of Tranzit *XPress'* ability to meet specific stated needs based on user responses	• Discrete data on perception of responders	- Survey[1] - Interview	- Survey[1] - Interview
2.2.1. Expected benefits stated by each user group of Tranzit *XPress* based on user responses	• Open ended lexicographic data	- Survey[1] - Interview	- Survey[1] - Interview
2.2.2. Expected benefits stated by each user group of components of Tranzit *XPress* based on -responses	• Open ended lexicographic data	- Survey[1] - Interview	- Survey[1] - Interview
2.3.1. Expected use of Tranzit *XPress* based on user responses	• Discrete data on perception of user groups	- Survey[1] -Interview	- Survey[1] - Interview

Figure 3-3 (Continued)
Data Requirements

Measures	Type of Data Required	Data Source	
		Motor Carrier	Incident Responder
2.4.1. Expected use of individual components of Tranzit ***XPress*** based on user responses	• Discrete data on perception of user groups	• Survey[1] -Interview	• Survey[1] - Interview
2.51 Expected use of information generated and routed through Tranzit ***XPress*** based on user responses	. Discrete data on perception of user groups	- Survey[1] - Interview	. Survey[1] . Interview
5.1.1 A list of institutional and legal issues encountered and an appraisal of their impact on future deployment	. Qualitative data	- Research[2] · Interview[4]	- Research[2] - Interview[4]
5.2.1. A list of institutional and legal lessons learned	. Qualitative data	- Research[2] - Interview[4]	- Research[2] - Interview[4]
5.3.1. State agency's likelihood of deploying Tranzit ***XPress*** emerging from agency responses	. Emerges from data analysis (unknown at this time)	- Survey[1] - Interview - Research	- Survey[1] - Interview - Research
5.3.2. Federal agency's likelihood of deploying Tranzit ***XPress*** emerging from agency responses	. Emerges from data analysis (unknown at this time)	- Survey[1] - Interview - Research	- Survey[1] - Interview - Research
5.3.3. First responder's likelihood of deploying Tranzit ***XPress*** emerging from first responder responses	. Emerges from data analysis (unknown at this time)	- Survey[1] - Interview	- Survey[1] · Interview
5.3.4. Enforcer's likelihood of deploying Tranzit ***XPress*** emerging from enforcer's responses	. Emerges from data analysis (unknown at this time)	. Survey[1] . Interview	. Survey[1] . Interview
5.4.1. Shipper's likelihood of deploying Tranzit ***XPress*** emerging from shipper's responses	. Emerges from data analysis (unknown at this time)	- Survey[1] -Interview	Survey[1] - Interview
5.4.2. Carrier's likelihood of deploying Tranzit ***XPress*** emerging from carrier responses	. Emerges from data analysis (unknown at this time)	- Survey[1] - Interview	- Survey[1] - Interview
5.4.3. Recipient's likelihood of deploying Tranzit ***XPress*** emerging from recipient responses	· Emerges from data analysis (unknown at this time)	- Survey[1] . Interview	- Survey[1] . Interview
5.5.1. A list of all institutional and legal issues on project development and a library of contracts, agreements, working papers, and reports from key participants	. Qualitative data	. Research[2] . Interview[4]	. Research[2] · Interview[4]

1 Primary Data Source
2 Identification and documentation of all legal and institutional issues encountered in the operational test was carried out by NIER and PGSC.
3 Discrete data are binary responses due to sample size limitations and related data analysis requirements.
4 Interviews will PGSC, NIER, and public agencies to capture the first hand information about institutional and legal issues.

methodological design of a survey to provide data for analysis, understanding and modeling of user perception of the system is addressed in the following sections.

3.4.1. Preliminary Planning

3.4.1.1. Objectives

Information is needed to allow us to relate user characteristics and occupational background to individual perceptional responses-relationships that will be the foundation for predicting user perception of the Tranzit ***XPress*** system.

To achieve the goals of study, following objectives are formulated for this data collection scheme:

- To develop an effective data collection instrument for recording user perception.

. To collect classification information about the study participants.

- To ensure that the data reflect the population's perception of the existing systems.

. To collect data that will enable comparison of the existing systems with the Tranzit ***XPress.***

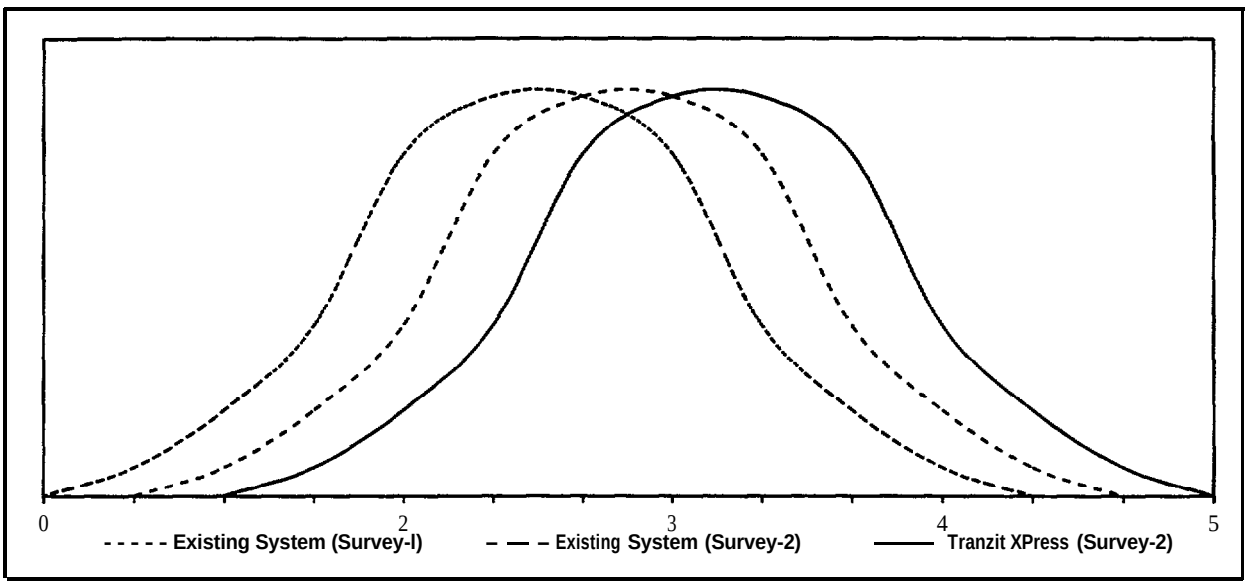
In any survey there is a trade-off between the quantity, quality and cost of the data This survey is aimed at obtaining good quality data while minimizing the overall cost, inevitably resulting in some decrease in the amount of information asked from the participants.

3.4.1.2. Survey Method

The objective of this study is to assess the benefits and impacts of the system and services provided by Tranzit ***XPress*** through the perception of intended users participating in the Operational Test. Therefore, a simple, cost effective data collection scheme is necessary to not only record the user perception of the existing and the Tranzit ***XPress*** systems, but also to capture the shift in user perceptions over time, which is an indicator of response reliability. It is anticipated that as the participants are exposed to the new technologies

employed in the Tranzit ***XPress,*** their opinion about the existing systems might change. In addition, when returning back into their every day work the most reliable responses given will not change whereas the most unreliable will present a significant shift in opinions stated. This trend is graphically represented in Figure 3-4. It should also be noted the participants may also show a genuine change in their opinion about the Tranzit ***XPress,*** once they are given sufficient time to absorb the information provided to them during the system demonstration.

Figure 3-4
Evaluation Survey Approach for Tranzit *XPress*



Keeping this in mind, the user perception, behavior and preference data was collected through three surveys developed specifically for this test. The first survey asks the participants to rate the existing system based on their experience before any exposure to the new technology. The second survey asks the participants to once again rate the existing system and also rate the Tranzit ***XPress*** system shown in the system demonstration. Through the third survey-similar in format to the first and second surveys-the participants are asked to again record their perception of the systems, several weeks after the demonstration. The type of information collected through these surveys is summarized in Figure 3-5.

3.4.2. Sample Design

Any survey has to be preceded by a well planned and well executed selection of a proper sample. Sample can be defined as a collection of units which is

Figure 3-5
Information collected through surveys

Survey	Questionnaire Content		
	Classification Data	Existing System Rating	Tranzit *XPress* Rating
1	√	√	x
2	x	√	√
3	x	√	√

some part of a larger population and which is specially selected to represent the whole population. It is understandable that if data are secured from only a small fraction of the population, expenditures are smaller than if the whole population is included. The object of sampling is to obtain a small sample from an entire population such that the sample is representative of the entire population. This process deals with the sample units, study population, sample size, and the sampling method involved in the survey.

3.4.3. Target Population

Target population is the complete group about which the survey we would like to collect information. In case of Tranzit ***XPress,*** the definition of the target population for the survey follows directly from the user groups targeted by the system.

These user groups for this study are systematically different from each other with respect to the roles played by them before, during, and after incident occurrence and clean-up. However, budget and time constraints required a decrease in the number of groups surveyed in this study. After careful deliberation of different alternatives considered during the planning process, the system users were categorized into the following two main groups:

- **Incident Responders**-Including police, fire departments, ambulance/ rescue squadrons, and other public safety agencies.

- **Motor Carrier-Including** shippers, carriers, and recipients of HazMat.

3.4.4. Sampling Method and Composition

The purpose of sampling exercise is to select a sample representative of the population, at lowest possible cost, that will provide necessary data to create models precise enough for this study.

To ensure the credibility of results, the Evaluation Committee decided that a minimum of thirty motor carriers and sixty incident responders need to be recruited for the survey. It was agreed that a third party and/or NIER will do the sampling. The sample size determination was done by considering hypotheses testing significance and power while at the same time controlling for method of analysis (paired t-tests, non-parametric tests, and possibly analysis of covariance).

The final sample sizes of participants, recruited by NIER for this test, were 24 and 28 for Incident Responder and Motor Carrier groups respectively, which are considerably lower than determined by the evaluation team for the incident responders. In addition, no attempt was made to correlate respondents characteristics to the target population(s). Description of the participants and summary of their background information is provided in Section 4.2.1.

3.4.5. Sampling Error and Bias

Two distinct types of error are encountered in survey sampling-sampling error and sampling bias. Sampling error arises simply because the survey is dealing with a sample and not with the total population. It is primarily a function of the sample size and the variability of the parameters under investigation. Although unavoidable, it does not seriously affect the expected values, but its affect is evident on the confidence which one can place on the average value inferred by the survey sample. Sampling bias, on the other hand,

is a completely different concept and arises because of mistakes made in choosing the sample frame, the sampling techniques, or other aspects of the sample. If the sample is not carefully selected, sampling bias can easily affect the expected values resulting in a more severe distortion of the sample results.

Due to the small sample size and non-random sampling methods used in this sample survey, sampling error and bias are unavoidable. The extent of error will only be evident after a careful analysis of the survey results. Although it was not possible to avoid these errors due to limited resources available for the recruitment of survey participants, the Tranzit ***XPress*** Operational Test evaluation has attempted to control all sorts of other errors, such as response error, to the greatest extent possible within the given resource constraints. In interpreting the results here, however, these ideas should be kept in mind and the operational test should be considered a pilot test for the second (Port of LA application) and third phases (presumably Port of Philadelphia application) of Tranzit ***XPress.***

3.4.6. Survey Instrument Design

The aim of this section is to present the principles and some specific arguments considered while going through the process of survey instrument design.

Basic requirements of the survey instrument, and its anticipated contents were briefly discussed during the preliminary planning stage. This section deals with the issue of deciding exactly what information needs to be collected and how the specific questions are presented on the survey instrument to the participants.

Decision about the content of survey should be made keeping in mind the fact that the data collected must be relevant, reliable and must accurately represent what is being examined. As we will see later in this report one of the assumptions, i.e., the respondents are familiar with the times associated with incident response, was wrong. Therefore, during this stage of the survey, each test hypothesis is examined and an explicit rationale is derived to provide guidelines for the format of the relevant questions. This not only requires an understanding of why the information is needed and how it is going to be

analyzed, but also requires a backward linkage from the coding and analysis phases of the survey.

During the final selection of questions to be included in the survey, it must also be kept in mind that the information sought should not only be relevant to the study purposes but should appear to be relevant to the respondents as well.

This section discusses the specific items in survey instrument which are particularly relevant to the study.

3.4.6.1. Questionnaire Content

Having identified the need for various items of information for all three surveys, the final selection of questions is based on the survey objectives, the available resources, and the affects of survey length and format on the participants and the validity of responses. This study required the inclusion of sufficient number of questions to test all the hypotheses listed in Section 3.2. The process involved in finalizing the questions is discussed in the following sections.

As explained earlier, the data collection scheme is divided into three phases. The first survey collects classification information and also asks the participants to rate the existing system based on their experience. After the system demonstration, the second survey requires the participants to rate the existing as well as the Tranzit ***XPress*** system. The third survey, identical to the second survey in format and content, is sent out to the participants several weeks after the demonstration to record the changes in the participant's perception of the system with the passage of time.

3.4.6.2. Format and Types of Questions

The format of a question describes the way in which the question is asked and, most important, the way in which the answer is recorded. The choice of question format is closely related to the instrument format as well as the choice of data processing procedures to be used later in the survey process (see

Chapter 4). Two basic types of question formats available for self-completion surveys-open and closed-are used in the survey.

In constructing the questionnaire two basic types of questions are included: classification, and opinion.

Classification Questions

These questions are required in order to obtain a basic description, or classification of the respondent. Responses to these questions will provide a better understanding of the sample composition. It is also anticipated that this information will help in drawing conclusions from the survey outcome. Following are the items of information covered by this type of questions:

- Demographic characteristics
- Occupation/employer information
- HazMat transportation experience
- Relevant training and incident experiences

Opinion Questions

Detailed information about the participant's perception of the Tranzit ***XPress*** system is necessary to evaluate the benefits and impacts of the system and its components. Similar information about the existing system is also required to enable a comparison between the existing and the Tranzit ***XPress*** systems. This survey is designed to obtain the participant's opinions and attitudes, which will be analyzed to test the hypotheses developed for this study and listed in Section 3.2. The items of information deemed necessary for this purpose are:

- Incident response time
- Effectiveness of the systems and components
- Accessibility of information
- Usefulness of information
- Accuracy of information
- Motor carrier compliance

. Expected use of Tranzit ***XPress***
. List of needs
. Positive and negative aspects of the systems

All questionnaires are designed to obtain three types of responses: "closed-question" self-coded responses (e.g., system ratings), "open questions" discrete data (e.g., incident response time), and "open-question" lexicographic/ qualitative response (e.g., name and address, comments).

3.4.6.3. Instrument Format

This section briefly discusses the basic guidelines followed in the physical design of the survey questionnaires used in this data collection scheme. Careful attention to this aspect of the survey design has lead to an efficient job performance by the participants, and has facilitated in minimizing the data coding errors.

The following guidelines helped in the design of questionnaires for the Tranzit ***XPress*** Operational Test evaluation:

- The overall layout must be clear and concise. In general, the layout should guide the respondents to the next questions.

- A minimal amount of writing should be required. Questions should require a "tick the box" reply wherever and whenever possible.

. Brief general instruction on how to fill out the questionnaires must be included at the start of the form.

. Detailed instructions must be provided to the participants if necessary.

. Assurance of confidentiality should be stated in the introduction.

. The survey documents should look professional and printed in clear, easily readable type face.

. The questionnaires should be designed to encourage even the participants who are not used to filling out such forms.

. The format of the questionnaires should be suitable for developing a computer-based data coding and entry scheme.

3.4.7. Test Introduction

The questionnaire is only one part of the documentation needed to conduct the survey. Also needed is a set of instructions explaining to respondents the significance of their participation and how to fill in the questionnaires.

Since the test was conducted in a closely monitored setting, it was decided that these instructions, and a brief introduction about the evaluation, would be presented to the participants at a session for introduction of evaluation and motivation at the start of the test conduct activities.

The key instruction to this type of survey has been the description of a typical incident. This was a compact description of an incident and it was also prepared to be distributed to all the participants before the system demonstration, to ensure compatibility of responses in all three surveys (the respondents kept the description for later use).

3.4.8. Pilot Testing

3.4.8.1. Description

It is useful to try out the questionnaire and the field methods on a small scale. This gives a chance to improve the original design and may reveal other troubles that will be serious on a large scale. Generally, the best pilot test is one which compares the applicable survey methods and then tests the chosen one for possible improvements.

For Tranzit ***XPress*** Operational Test evaluation, once the survey questionnaires were finalized, the Evaluator arranged the participation of eight members from

a local volunteer fire department (in State College, PA) for a pilot test of the scheme. It was conducted to test all aspects of the survey scheme selected for data collection, therefore special attention was paid to follow the plans for the actual data collection scheme as closely as possible. The participants were given a brief introduction of the system and were handed out the first survey questionnaire to record their opinion about the existing HazMat systems. The first survey was followed by a recorded/video overview of the system (prepared by PGSC), which highlighted the capabilities of the system. Second survey questionnaires have been administered after the system overview to the participants. The participants were asked not only to complete the questionnaires, but also to provide comments and suggestions for further improvements. Furthermore, some of the participants were debriefed to determine how they interpreted the questions. All the data collected were analyzed to determine whether any changes or clarifications to the data collection instruments were necessary prior to the distribution for full testing.

3.4.8.2. Lessons Learned from Pilot

Following conclusions were drawn from the information collected through the pilot survey, as well as the suggestions provided by the participants:

. Overall format of the questionnaire is clear, simple and easy to follow.

. Closed question format is effective in collecting the required data.

. Completion of each questionnaire requires approximately 10 minutes.

- Minor changes in the layout of questions can improve the quality of responses.

All the three survey questionnaires were amended and finalized for the field test after incorporating the suggested changes. The video (it is a promotional video) did not provide enough detail and it could bias the responses. But this was not deemed a problem since the survey intended to use the developers to demonstrate the system and answer clarification questions. It was realized, however, that in addition to the system description participants desired to see and handle the technologies included in the system. The response to the pilot

test also helped in developing the data processing scheme, which was designed before the actual data collection phase.

3.5. TEST CONDUCT ACTIVITIES

As discussed in the previous sections, the test participants were categorized into two groups: Incident Responders, and Motor Carriers. At the initial stages of planning, two separate tests were intended for the two user groups. But, soon it was realized that both the tests are almost identical and therefore, they were designed and conducted as one test with separate sessions for the groups. This section briefly discusses the test conduct activities, and the discussion can be considered as valid for both groups, unless otherwise specified.

3.5.1. Descriptions/Participants

The system demonstration/data collection activities were carried out in three sessions, instead of two, because sufficient number of incident responders could not be arranged for the second session.

The test conduct activities closely followed the outline decided by the Evaluation Committee, and given in the Tranzit ***XPress*** Test Plan. Figure 3-6 provides a summary of tasks completed during these sessions

At a later date, follow-up questionnaires (third survey) were faxed to all the participants. Participants willing to participate in the survey completed and returned the questionnaires by fax or mail.

3.5.2. Procedures

As stated earlier, three different data collection methods were used in the conduct of this test: research, interviews, and surveys. Most of the data collection was carried out in a systematic manner involving introduction/ motivation, first survey (baseline-considered the “before”), system

Figure 3-6
Summary of Test Sessions

Description	Test Sessions		
	Session-1	Session-2	Session-3
Session Details			
Date	Oct. 17, 1996	Oct. 17, 1996	Dec. 13, 1996
Location	Harrisburg	Harrisburg	Mayfield
Participant Group	Motor Carrier	Incident Responders	Incident Responders
Number of Participants	28	10	14
Test Activities			
Outline of the Test Activities	NIER	NIER	NIER
Introduction and Distribution of the First Survey Questionnaire	PSU	PSU	PSU
Collection of the First Survey Questionnaire	PSU	PSU	PSU
Tranzit *XPress* System Overview	PGSC	PGSC	NIER
Equipment/Architecture Demo	PGSC	PGSC	NIER
Operations Center	PGSC	PGSC	NIER
Vehicle Electronics*	PGSC	PGSC	NIER
Non-Emergency Scenarios	PGSC	PGSC	-
HazMat Incident Scenarios	PGSC	PGSC	NIER
Wrap Up - Questions and Clarification	PGSC	PGSC	NIER
Introduction and Distribution of the Second Survey Questionnaire	PSU	PSU	PSU
Collection of the Second Survey Questionnaire	PSU	PSU	PSU
Conclusion of the Test Activities	NIER	NIER	NIER

* Vehicle Electronics sub-system was assembled and demonstrated in the Operations Center. Participants were not shown the system installed in the truck.

demonstration, and second survey (considered the after). Research and interviews were conducted as appropriate. The third survey (follow-up) was distributed at a later date.

This section describes the steps followed during the collection of the test data. Brief description of the system demonstration carried out by the representatives of NIER/PGSC is also included here:

3.5.2.1. Research

Some of the baseline data needed to make comparisons between the Tranzit ***XPress*** system and the existing HazMat systems were obtained through research. This research also helped in determining the specific data requirements necessary for the evaluation (e.g., identification of incident response time segments).

3.5.2.2. Interviews

Several incident responders associated with the local public safety agencies were interviewed during the planning stages of this evaluation. The information obtained through these interviews facilitated the development of proper test strategies. Interviews were also planned for the test participants to clarify and expand upon their survey responses, but after the preliminary analysis it was not deemed necessary.

3.5.2.3. Introduction/Motivation Session

The data collection procedure began with an introduction of HazMat transportation to the participants. To achieve the necessary objectives of the test, this session included:

- a brief overview of the current HazMat transportation practice,
- examples of the risks involving HazMat and how they affect the safety of the public as well as the people directly involved in this work,

- examples of typical HazMat incidents, which have affected public health and safety or had the potential to do so,

- the difference between hazardous material, hazardous waste, and hazardous substance,

- the definition of the components of response time from occurrence of incident to the clean-up of site,

- reference to the regulatory requirements for placard information and record keeping,

- explanation to the participants how effective placard information can assist in the emergency response,

- reference to how effective record keeping can help them in meeting the regulatory requirements,

- emphasis on the importance of the active involvement of the test participants,

- description of a typical incident involving HazMat.

3.5.2.4. First Survey

After the introduction and motivation session, baseline questionnaires were distributed by the Evaluator among the participants to collect baseline data regarding user perception of the incident response time and existing HazMat management/tracking systems.

This survey provided some of the information necessary to compare the performance of the Tranzit ***XPress*** system with the existing systems. This survey also obtained classification and background information about the participants.

3.5.2.5. System Presentation and Demonstration

Since most of the data collection in this study is dependent on the effective demonstration of the system, a well organized system presentation and demonstration was critical to the success of the test. Representatives of PGSC and NIER conducted this stage of the test as summarized in Figure 3-6. The activities carried out during the presentation/demonstration were based on the guidelines set in the Tranzit ***XPress*** Test Plan. This section discusses the specific details of the demonstration which are particularly relevant to the study.

PGSC/NIER started with a Tranzit ***XPress*** system overview. Important aspects of the system were highlighted and its components and capabilities were pointed out.

Next, the participants were given a demonstration of the Tranzit ***XPress*** system. The system demonstration was carried out in such a way that the capabilities of all major components of the system i.e., Operations Center, Vehicle Electronics, the Interrogators and Asset Tags, were explained to the participants. Main features of this demonstration are listed below.

Operations Center

During the demonstration of the Operations Center, PGSC/NIER representatives;

- pointed out the different components of the Operations Center,
- demonstrated how shippers can send cargo information to Operations Center,
- demonstrated how Operations Center sends cargo information to vehicles,
- explained how the Vehicle Gateway obtains information from the trucks,
- demonstrated how the Operations Center can determine location of vehicles using the Global Positioning System (GPS) data,

- demonstrated how the movement of vehicles can be traced on a map using the information obtained from them,

- described how, in case of an incident, the necessary information is forwarded to emergency dispatchers (911 etc.)

- explained the potential importance of timely availability of information to emergency response agencies,

- explained how the system functions with respect to the incident response time, incident notification, identification of the incident site, cargo identification, notification of emergency management and rescue agencies, containment and stabilization, evacuation and clean up,

- demonstrated how the system complements placard information,

- explained how the system aids in maintaining record of shipments, which can assist the users in meeting the regulatory requirements,

- pointed out how the Tranzit ***XPress*** system can accomplish tasks that are not possible by existing systems.

Vehicle Electronics System

The Vehicle Electronics were not installed in a truck, as originally decided in the test plan. Instead, all the components were assembled in a meeting room (in one of the surveys the MER Operations Center) and the demonstration was conducted there. During the demonstration PGSC/NIER representatives;

- pointed out the different components of the Tractor and Trailer Electronics

- explained how PDA can be used to transmit information about schedules, routes, stops, vehicle location, cargo, and incidents,

- demonstrated how a PDA can be used to obtain and update information from the tags,

- pointed out the design of PDA and its human interface elements,
- demonstrated how the GPS receiver is used to obtain location (from satellite) and transmit the location data to the Operations Center (through Tractor Electronics),
- demonstrated the ability of the cellular communication transceiver to transmit information to the Operations Center,
- explained how, in case of an incident, Tranzit ***XPress*** components are used to inform the Operations Center,
- demonstrated how a wireless communication device inside the trailer talks to the tags,
- illustrated how asset tags are used to store information about the cargo,
- illustrated how the I & R Module plays back summarized cargo information.
- explained the type of information provided by the asset tags and respond module,
- demonstrated how a police radar gun can be used to obtain information about the cargo from the tags and respond module.

3.5.2.6. Second Survey

Immediately after the demonstration the second survey questionnaires were distributed to collect the perceptional as well as behavioral and attitudinal data (e.g., system preference and ease of use) from the system users. Participants were also asked to once again express their opinion about the existing HazMat systems. These data, together with the information collected through the first survey, provided the basis for the system evaluation.

3.5.2.7. Third Survey

Approximately two weeks after the last session of the system demonstration, another round of survey was conducted. All the participants of the first two surveys were sent the third survey questionnaire, either by fax or by mail. This survey was intended to gather data to assess changes in the perception of test participants with time, based on subsequent recollection. A variety of recontacts were designed and implemented to increase response rate (e.g., telephone calls, reminder letters, and mail/fax of new survey forms), which as expected was much lower than in the demonstration session.

3.6. KEY CONSTRAINTS AND LIMITATIONS

Some test and evaluation limitations that restrict a purely objective and statistically satisfactory evaluation of this project are discussed here. While these limitations were realistically unavoidable within the scope of this study, their effects do need to be recognized and understood. The major constraints and limitations are listed below:

- Participating motor carrier and incident responder personnel recruited for the data collection scheme were selected in a manner that may severely limit any generalizations about the National and Statewide motor carrier industry and incident response agencies.

- Participating motor carrier and incident responder personnel may have little or no past experience with the existing incident response systems, which explains the low completion rate in the "time" questions.

- Both the limited number of motor carrier (28) and incident responder (24) participants will limit the test's ability to generate a sufficient amount of statistical data adequate to reach or achieve high level of confidence in the test evaluation results. This has been accounted for in the analysis using exact probability calculations.

- Small sample size may make statistics questionable due to population non-coverage.

- Since the system is still not operational, the participants only observed a staged system demonstration. No opportunity for hands-on experience was provided. Lack of simulated incidents also restricted the participants from getting a feel of the system performance under different incident scenarios in real life.

- Since the system is still not operational the evaluation is based on the qualitative data from participant perception of the system.

- First impression, obtained after a one-time demonstration could be quite different from long term exposure to system operations.

- Due to budget constraints shippers and recipients, originally included, have not been included in this evaluation.

4. DATA PROCESSING AND STATISTICAL ANALYSIS

Once the surveys were conducted, the actual process of editing, coding and analysis of the information was started. Although the physical component of this task began early, the planning and designing phases were actually completed much earlier in the survey process. These tasks were finalized in an interactive manner when the design of the questionnaires and the sample was being considered.

The task of transforming completed questionnaires into useable results is composed of several discrete tasks including initial editing of questionnaires, coding, data entry and editing, analysis, and interpretation of results. This chapter concentrates on all aspects including initial coding, preliminary analysis, and statistical analysis and interpretation of results.

4.1. DATA PROCESSING

4.1.1. Initial Questionnaire Editing

All the completed questionnaires were checked for legibility and missing information immediately after their collection. Missing names and contact address were obtained from the participants before moving on to the next step. Since participation in this data collection scheme was voluntary, and the participants were allowed to decline to answer any specific questions, no attempt was made to ask the participants to answer other incomplete sections of the surveys.

4.1.2. Coding

Coding is the translation of data into labeled categories suitable for computer processing. In case of this data collection scheme it means numerical labeling. In devising a coding procedure, it is important to first decide on the general method to be used for coding and data entry. During the initial stages of survey questionnaires design it was decided to develop an interactive computer

interface for data processing. Through an iterative process, a computer-based data coding and entry scheme was created. Section 4.1.3 describes this interface in further detail.

The data entry interface combined the tasks of coding and data entry into one by having the coder enter data directly into the computer from the questionnaire form, instead of writing the data onto coding sheets first. This procedure provided for a much quicker coding and data entry, while minimizing the possibility of coding errors.

4.1.3. Data Entry/Editing and Database Management

With the advances in computer technology, it is now possible to improve the data processing schemes through customized data entry interfaces. This study utilizes ***Microsoft Access ,*** a commercially available database program, for the development of a comprehensive data processing and management scheme.

4.1.3.1. Data Entry

The main features of this ***Microsoft Access(R)*** interface/database scheme affecting the data entry process are listed below.

. The survey questionnaires are replicated on the computer screen and they act as user interface for data entry. Figure 4-l shows the similarity between the actual survey questionnaire and the data entry interface developed for this study.

. Data is entered directly into the computer.

. Quick error detection is possible by visual comparison of the original questionnaire and the computer interface.

. All responses are coded automatically.

Figure 4-1
Computer Interface for Data Entry

1. For the incident described in your handout, if Tranzit *XPress* system is used, how much time is required for the:

Vehicle operator to realize that a problem exists	5 min.	☐ Don't know
Vehicle operator to call 911 or other emergency number	5 min.	☐ Don't know
Vehicle operator to properly identify vehicle location	5 min.	☐ Don't know
First responder to reach the incident site	15 min.	☐ Don't know
Cargo recognition and identification by first responder	5 min.	☐ Don't know
Notification of fire department / rescue squad	5 min.	☐ Don't know
Notification of HazMat team and/or emergency management agency	5 min.	☐ Don't know
Determination of what equipment is needed (incl. additional crews)	15 min.	☐ Don't know
Secondary responders to reach the site with proper equipment	30 min.	☐ Don't know
Passive containment and stabilization (e.g. fire dept. digging trenches)	30 min.	☐ Don't know
Containment and stabilization by specialists (HazMat crews)	30 min.	☐ Don't know
Evacuation of persons from the affected area (if necessary)	120 min.	☐ Don't know
Clean up of the accident/incident site	2 days min.	☐ Don't know

2. Please rate the effectiveness of the:

a. Current recordkeeping system (i.e. skipping papers) at:

	Very Effective 1	2	Average 3	4	Very Ineffective 5
maintaining safety	☐	☐	☐	☒	☐
maintaining efficiency	☐	☐	☐	☒	☐
accurately tracking hazardous materials	☐	☐	☐	☒	☐
assisting in meeting regulatory requirements	☐	☐	☐	☒	☐
accurately reflecting mixed loads (e.g. herbicides, minimum toxic quantities, toxic combinations etc.)	☐	☐	☐	☒	☐

1. For the incident described in your handout, if Tranzit XPress system is used, how much time is required for the:

Vehicle operator to realize that a problem exists	5 min.	☐ Don't know
Vehicle operator to call 911 or other emergency number	5 mn.	☐ Don't know
Vehicle operator to properly identify vehicle location	5 min.	☐ Don't know
First responder to reach the incident site	15 min.	☐ Don't know
Cargo recognition and identification by first responder	5 mn.	☐ Don't know
Notification of fire department / rescue squad	5 min.	☐ Don't know
Notification of HazMat team and/or emergency management agency	5 mn.	☐ Don't know
Determination of what equipment is needed (incl. additional crew)	15 min.	☐ Don't know
Secondary responders to reach the site with proper equipment	30 min.	☐ Don't know
Passive containment and stabilization (e.g. fire dept. digging trenches)	30 min.	☐ Don't know
Containment and stabilization by specialists (HazMat crews)	30 min.	☐ Don't know
Evacuation of persons from the affected area (if necessary)	120 mn	☐ Don't know
Clean up of the accident/incident site	2880 mn.	☐ Don't know

2. Please rate the effectiveness of the:

a. Current recordkeeping system (i.e. skipping papers) at:

	Very Effective 1	2	Average 3	4	Very Ineffective 5
maintaining safety	☐	☐	☐	☒	☐
maintaining efficiency	☐	☐	☐	☒	☐
accurately tracking hazardous materials	☐	☐	☐	☒	☐
assisting in meeting regulatory requirements	☐	☐	☐	☒	☐
accurately reflecting mixed loads (e.g. herbicides, minimum toxic quantities, toxic combinations etc.)	☐	☐	☐	☒	☐

Record: 12 of 28

- Interface allows three types of responses: closed self-coded (e.g., system ratings), open numerical values (e.g., incident response time), and open lexicographic (e.g., name and address).

During the data entry process, each completed survey questionnaire was at least once compared with its coded version on computer screen for consistency. Random checks were also conducted to make sure that no mistakes were committed in the data entry. No errors were detected during these checks, which proves the effectiveness of the data processing scheme.

4.1.3.2. Database Management

The data are also maintained in a relational database format using ***Microsoft Access@.*** Responses from different surveys are stored in separate tables and are linked through a unique ID assigned to each participant during the data entry process.

Complete list of data tables and the relationships between them are given in Appendix-D.

4.2. STATISTICAL ANALYSIS

After coding and editing the data, the clean datasets for incident responders and motor carriers were exported to SPSS" (Statistical Package for Social Sciences). Three types of analyses were carried out using the two datasets: preliminary, non-parametric, and parametric.

The preliminary analysis carried out for this study can be grouped into two categories: classification of the test participants, and participants' perception of the HazMat systems.

4.2.1. Classification of the Test Participants

At the out set of the study, responses to the classification questions were intended to be used to form sub-groups of participants. But due to the relatively smaller sample size, such sub-grouping is not feasible any more. Nevertheless, the information gained through the analysis of these data is vital for a better understanding of the participants' background.

The most conventional way to look at the survey data is by means of tabulating frequencies. A close inspection of these frequencies can provide useful information about the composition of the survey sample.

4.2. 1. 1. Incident Responders

Age

The participants are categorized into six age groups. The information gathered in the first questionnaire shows the following distribution:

Age Groups	Frequency	Percent
Under 21 years	0	0.0
21 to 30 years	1	4.2
31 to 40 years	3	12.5
41 to 50 years	11	45.8
51 to 64 years	7	29.2
65 years and over	2	8.3
Total	24	100.0

Occupation/Employer and Job Experience

The participants are categorized into nine groups based on their occupation and employers. The distribution of the participants is as follows:

Occupation/Employer	Frequency	Percent
Police Department	0	0.0
Paid Fire Department	5	20.8
Volunteer Fire Department	3	12.5
Paid Ambulance/Rescue Squad	0	0.0
Vol. Ambulance/Rescue Squad	0	0.0
Federal Public Safety Agency	0	0.0
State Public Safety Agency	6	25.0
Local Public Safety Agency	6	25.0
Special HazMat Response Team	4	16.7
Total	24	100.0

The job experience of participants can contribute to the individual's perception of the system. Therefore, the survey questionnaire asked the participants to provide information about how long they have been at their present occupation. The information is summarized below:

Job Experience	Frequency	Percent
Less than 1 year	1	4.2
1 to 2 years	1	4.2
3 to 5 years	7	29.2
6 to 10 years	2	8.3
11 to 20 years	6	25.0
More than 20 years	7	29.2
Total	24	100.0

Experience in HazMat Transportation

Distribution of participants based on their involvement in HazMat transportation is given below.

Transportation Experience	Frequency	Percent
Not applicable	4	16.7
Less than 1 year	0	0.0
1 to 2 years	1	4.2
3 to 5 years	4	16.7
6 to 10 years	11	45.8
11 to 20 years	3	12.5
More than 20 years	1	4.2
Total	24	**100.0**

Experience of HazMat Incidents

The distribution of incident responders based on their experience with HazMat incidents in their career is given below.

HazMat Incidents-Career	Frequency	Percent
None	3	12.5
1 to 10 incidents	2	a.4
11 to 25 incidents	1	4.2
26 to 50 incidents	4	16.7
51 to 100 incidents	3	12.5
More than 100 incidents	3	12.5
Not applicable	3	12.5
No response	5	20.8
Total	24	100.0

Similar to the preceding distribution, the following distribution summarizes the information collected on the experience of incident responders with HazMat incidents in the last three years.

HazMat Incidents-Last 3 years	Frequency	Percent
None	1	4.2
1 to 10 incidents	5	20.8
11 to 25 incidents	3	12.5
26 to 50 incidents	5	20.8
51 to 100 incidents	0	0.0
More than 100 incidents	2	8.4
Not applicable	3	12.5
No response	5	20.8
Total	*24*	100.0

HazMat Training

Incident responders' current level of HazMat training is summarized below. It must be noted that the participants were asked to select all applicable categories and therefore this summary does not represent the distribution of participants in different categories.

HazMat Training	Frequency	Percent
a. None	0	0.0
b. Basic Recognition (2hrs./yr.)	13	54.2
c. Operations (16 hrs./yr.)	11	45.8
d. Technician (40 hrs./yr.)	4	16.7
e. Specialist (40+ hrs./yr.)	5	20.8
f. 49 C.F.R. Training	6	25.0
g. Other Training	4	16.7

4.2.1.2. Motor Carriers

Age

The participants are categorized into six age groups. The information gathered in the first questionnaire shows the following distribution:

Age Groups	Frequency	Percent
Under 21 years	0	0.0
21 to 30 years	0	0.0
31 to 40 years	6	21.4
41 to 50 years	6	21.4
51 to 64 years	14	50.0
65 years and over	2	7.1
Total	28	100.0

Occupation/Employer and Job Experience

The participants are categorized into three groups based on the principle business of their employers. The distribution of the participants is given below:

Occupation/Employer	Frequency	Percent
Shipping Company	1	3.6
Carrier	26	92.9
Recipient	0	0.0
No Response	1	3.6
Total	28	100.0

The job experience of participantscan contribute to the individual's perception of the system. Therefore, the survey questionnaire asked the participants to provide information about how long they have been at their present occupation. The information is summarized below:

Job Experience	Frequency	Percent
Less than 1 year	1	3.6
1 to 2 years	2	7.1
3 to 5 years	a	28.6
6 to 10 years	4	14.3
11 to 20 years	9	32.1
More than 20 years	4	14.3
Total	28	100.0

Experience in HazMat Transportation

The distribution of motor carrier participants, based on their duration of involvement with HazMat transportation is given below:

HazMat Transportation	Frequency	Percent
Not applicable	4	14.3
Less than 1 year	0	0.0
1 to 2 years	1	3.6
3 to 5 years	2	7.1
6 to 10 years	5	17.9
11 to 20 years	8	28.6
More than 20 years	8	28.6
Total	28	100.0

Experience as Professional Truck Driver

The survey asked the motor carrier participants to provide information about their experience as professional truck driver. First part of the question asked the participants for their total experience, and the second part asked for the years past since their last experience. The participants are categorized into 5 groups based on their experience as professional truck driver.

Truck Driver Experience	Frequency	Percent
1 to 5 years	2	7.1
6 to 10 years	0	0.0
11 to 15 years	2	7.1
16 to 25 years	7	25.0
More than 25 years	5	17.9
Not applicable	12	42.9
Total	28	100.0

The participants are categorized into 4 groups based on how many years ago their last experience ended.

Last Experience Ended	Frequency	Percent
1 to 5 years ago	1	3.6
6 to 15 years ago	6	21.4
16 to 25 years ago	0	0.0
More than 25 years ago	2	7.1
Not applicable	12	42.9
No response	7	25.0
Total	28	100.0

Experience of HazMat Incidents

The distribution of motor carrier participants based on their experience with HazMat incidents in their career as drivers is given below.

As a Driver-Career	Frequency	Percent
None	6	21.4
1 to 10 incidents	4	14.3
11 to 25 incidents	0	0.0
26 to 100 incidents	0	0.0
More than 100 incidents	0	0.0
Not applicable	13	46.4
No response	5	17.9
Total	28	100.0

Similar to the preceding distribution, the following distribution summarizes the information collected on the experience of motor carrier participants with HazMat incidents during the last three years, as drivers.

As a Driver-Last 3 Years	Frequency	Percent
None	9	32.1
1 to 10 incidents	0	0.0
11 to 25 incidents	0	0.0
26 to 100 incidents	0	0.0
More than 100 incidents	0	0.0
Not applicable	14	50.0
No response	5	17.9
Total	28	100.0

The following distribution depicts the involvement of motor carrier participants with HazMat incidents in their career as respondents.

As a Respondent-Career	Frequency	Percent
None	4	14.3
1 to 10 incidents	8	28.6
11 to 25 incidents	4	14.3
26 to 100 incidents	1	3.6
More than 100 incidents	1	3.6
Not applicable	7	25.0
No response	3	10.7
Total	28	100.0

Similar to the preceding distribution, the following distribution summarizes the information collected on the experience of motor carrier participants with HazMat incidents during the last three years, as respondents.

As a Respondent-Last 3 Years	Frequency	Percent
None	6	21.4
1 to 10 incidents	10	35.7
11 to 25 incidents	1	3.6
26 to 100 incidents	1	3.6
More than 100 incidents	1	3.6
Not applicable	7	25.0
No response	2	7.1
Total	28	100.0

Emergency Contact

The frequency of motor carrier participants obtained from their responses to a question about whom the driver contacts first in case of an incident is given below.

Emergency Contact	Frequency	Percent
Police	8	28.6
Fire Department	1	3.6
Rescue Squad	0	0.0
Public Safety Agency	0	0.0
Employer	11	39.3
911 (or other emergency number)	5	17.9
Other Contacts	2	7.1
No response	1	3.6
Total	28	100.0

4.2.2. System Perception

Another way of looking at the data is by means of a number of summary statistics such as mean, median, standard deviation, skewness, and confidence intervals. Several of these statistics may also be summarized graphically by means of a box plot. Exploring the data in this way is very useful in getting some idea about the data, and an intuitive feel for the hypotheses testing. In addition, parametric and non-parametric analyses have been used to test a variety of hypotheses as it is explained below. For this survey setting the usual test statistics used in comparisons of means are the paired t-test, which takes into account the repeated observation of the same individuals over time. Other methods that could be used for this setting are also panel analysis methods. However, for Tranzit Press there are two reasons that preference should be given to more “robust” statistical procedures. The first reason is the small sample sizes of the interviewed groups. Small sample size means we should not be using inferential statistics that are strongly based on asymptotic theory (i.e., statistics that are valid as our sample size goes to infinity). The second reason regards the underlying assumption of normality associated with the t-test, which is unproven in this case. However, the t-test has been used as a preliminary analysis step and it is not shown here. For the second reason we are using non-parametric tests such as the sign test. In addition, to the use of non-parametric tests to perform the before and after comparison of perceptions we also employ exact statistics, i.e., again we avoid using in inference any asymptotic statistics. This makes a difference in the conclusions drawn from the study.

The statistical tests applied to the data at hand are divided into two groups. The first group attempts to measure the difference in response of the same individual(s) in two different questions. For example, judgment scores on existing HazMat system versus Tranzit ***XPress.*** To do this we use the Wilcoxon signed-rank test for continuous data such as incident response times. For categorical data such as the judgment scales we use the marginal homogeneity test, which examines the equality of responses in the two questions. The Wilcoxon signed rank test for paired data provides a z-value, which can be interpreted the same way as the t-test, i.e., high values of z indicate significant difference in responses (with an associated low p-value). Similarly, in the marginal homogeneity test, high p-values indicate statistical equality of responses. The second group of tests is applied to more than two questions (in statistics called the K-related samples inference). This test, called the Friedman's test, provides indications regarding the homogeneity (significant similarity) of responses. High values of the chi-square reported below or equivalently a low value of the exact significance p-value indicate significant differences among the question answers.

The objectives here are to statistically examine the following questions, which are divided into core and reliability:

Core Questions

- Is Tranzit ***XPress*** perceived as an improvement over existing system(s)?
- Does Tranzit ***XPress*** ' perception of system users change over time?
- Does it become more positive or negative?

Reliability Questions

- Is the existing system status response affected by the experiment exposure?
- Does the perception of the existing system status change over time?

4.2.2.2. Incident Responders

This section provides a brief discussion about the responses of incident responders to different survey questions.

Time typically required for the vehicle operator to realize that a problem exists

- This question corresponds to Measure 1.1.1 and Measure 1.1.2.
- The descriptive summary is given in Figure 4-2.
- Eight participants answered this question during the first survey. The mean value obtained from their responses is 7.0 minutes.
- Twelve participants responded to the question in the second survey. The mean value obtained from their responses is 6.9 minutes.
- When analyzing the responses in the first and second surveys separately, no significant change in the mean time is perceived through the use of Tranzit ***XPress.*** The medians of responses show an increase of 0.5 minutes. No significant differences in responses is shown by the Wilcoxon test with a value of z equal to -0.703 and an exact significance p-value equal to 0.625.

Figure 4-2
Time typically required for the vehicle operator to realize that a problem exists

AIR13A Existing System (Survey-l)

Valid cases:	8.0	Missing cases:	16.0	Percent missing:	66.7		
Mean	7.0000	Std Err	3.3166	Min	1.0000	Skewness	2.7204
Median	4.0000	Variance	88.0000	Max	30.0000	S E Skew	.7521
5% Trim	6.0556	Std Dev	9.3808	Range	29.0000	Kurtosis	7.5705
95% CI for Mean	(-.8426, 14.8426)			IQR	1.7500	S E Kurt	1.4809

BIRlA Tranzit ***XPress*** (Survey-21

Valid cases:	12.0	Missing cases:	12.0	Percent missing:	50.0		
Mean	6.9167	Std Err	2.3240	Min	1.0000	Skewness	2.4269
Median	4.5000	Variance	64.8106	Max	30.0000	S E Skew	.6373
5% Trim	5.9630	Std Dev	8.0505	Range	29.0000	Kurtosis	6.7872
95% CI for Mean	(1.8016, 12.0317)			IQR	8.5000	S E Kurt	1.2322

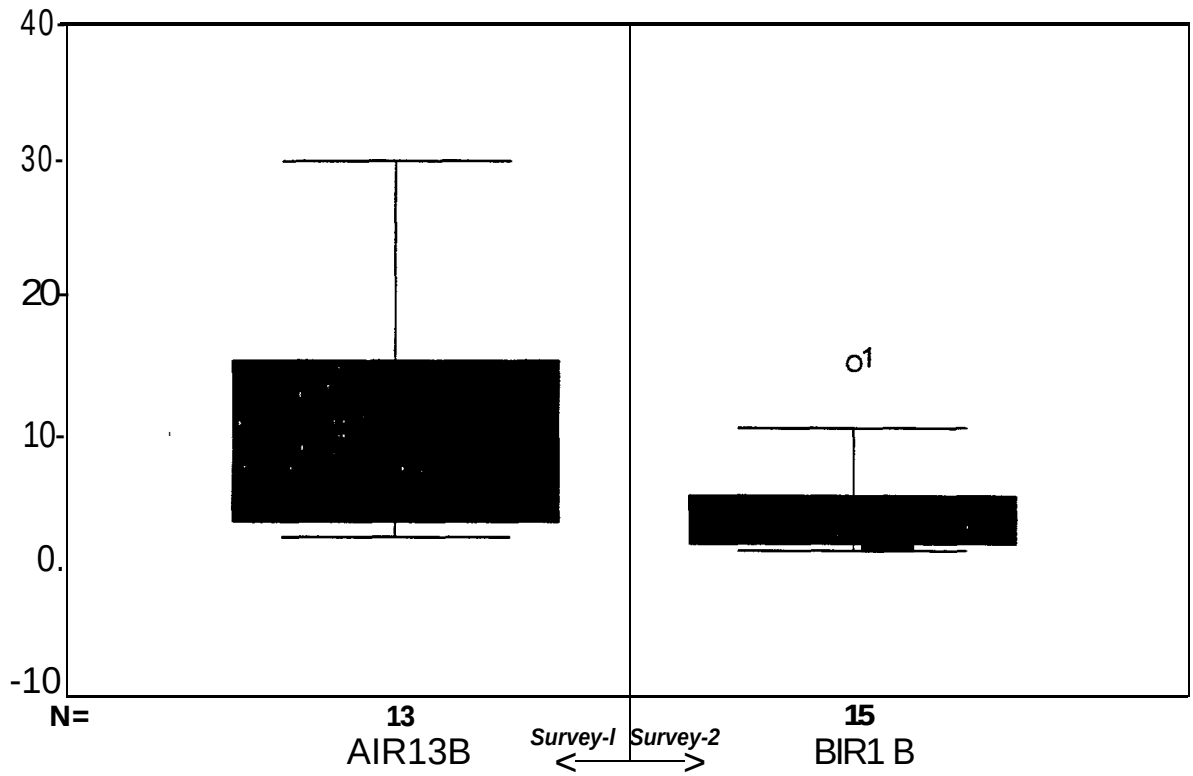
Time typically requiredfor the vehicle operator to call 911 or other emergency number

- This question corresponds to Measure 1.1.1 and Measure 1.1.2.
- The descriptive summary is given in Figure 4-3.
- Thirteen participants answered this question during the first survey. The mean value obtained from their responses is 10.6 minutes.
- Fifteen participants responded to the question in the second survey. The mean value obtained from their responses is 4.1 minutes.
- A decrease of 6.5 minutes is anticipated through the use of Tranzit ***XPress.*** The medians of responses also show a decrease of 7.0 minutes. However, the Wilcoxon test shows a decrease of approximately 1.609 minutes, and an associated p-value of 0.125.

Time typically required for the vehicle operator to properly identify vehicle location

- This question corresponds to Measure 1.1.1 and Measure 1.1.2.
- The descriptive summary is given in Figure 4-4.
- Eleven participants answered this question during the first survey. The mean value obtained from their responses is 6.9 minutes.
- Seventeen participants responded to the question in the second survey. The mean value obtained from their responses is 3.7 minutes.
- A decrease of 3.2 minutes is anticipated through the use of Tranzit ***XPress.*** The medians of responses also show a decrease of 1 .O minutes. When applying the Wilcoxon test, however, the z value is 1.340 and the associated p-value is 0.242 leading to no statistical difference.

Figure 4-3
Time typically required for the vehicle operator to call 911 or other emergency number



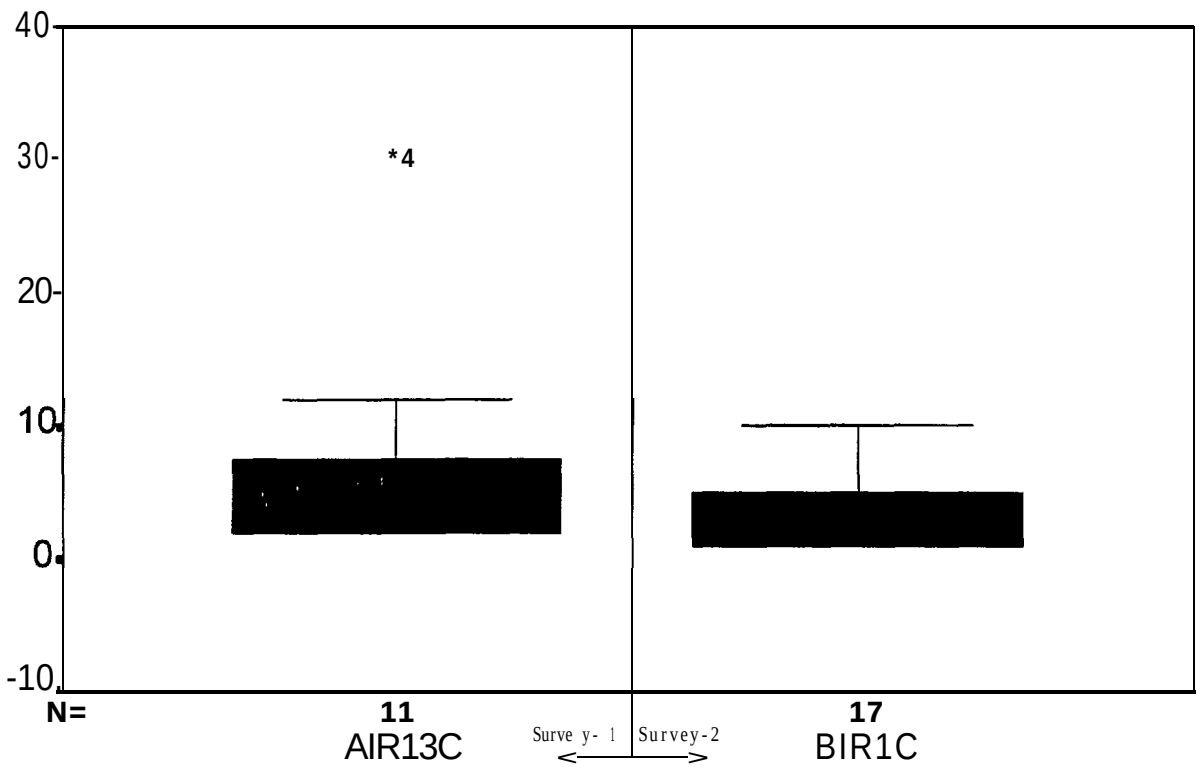
AIR13B Existing System (Survey-l)

Valid cases:	13.0	Missing cases:	11.0	Percent missing:	45.8		
Mean	10.6154	Std Err	2.3137	Min	2.0000	Skewness	.9343
Median	10.0000	Variance	69.5897	Max	30.0000	S E Skew	.6163
5% Trim	10.0171	Std Dev	8.3420	Range	28.0000	Kurtosis	.7814
95% CI for Mean (5.5743, 15.6564)				IQR	12.0000	S E Kurt	1.1909

BIRlB Tranzit ***XPress (Survey-l)***

Valid cases:	15.0	Missing cases:	9.0	Percent missing:	37.5		
Mean	4.1333	Std Err	.9994	Min	1.0000	Skewness	1.9133
Median	3.0000	Variance	14.9810	Max	15.0000	S E Skew	.5801
5% Trim	3.7037	Std Dev	3.8705	Range	14.0000	Kurtosis	3.8563
95% CI for Mean (1.9899, 6.2768)				IQR	4.0000	S E Kurt	1.1209

Figure 4-4
Time typically required for the vehicle operator to properly identify vehicle location



AIR13C Existing System (Survey-l)

Valid cases:	11.0	Missing cases:	13.0	Percent missing:	54.2		
Mean	6.9091	Std Err	2.5279	Min	2.0000	Skewness	2.4611
Median	3.0000	Variance	70.2909	Max	30.0000	S E Skew	.6607
5% Trim	5.8990	Std Dev	8.3840	Range	28.0000	Kurtosis	6.5151
95% CI for Mean	(1.2767, 12.5415)			IQR	8.0000	S E Kurt	1.2794

BIRlC Tranzit *XPress (Survey-l)*

Valid cases:	17.0	Missing cases:	7.0	Percent missing:	29.2		
Mean	3.7059	Std Err	.8124	Min	1.0000	Skewness	1.1832
Median	2.0000	Variance	11.2206	Max	10.0000	S E Skew	5497
5% Trim	3.5065	Std Dev	3.3497	Range	9.0000	Kurtosis	.0221
95% CI for Mean	(1.9836, 5.4281)			IQR	4.5000	S E Kurt	1.0632

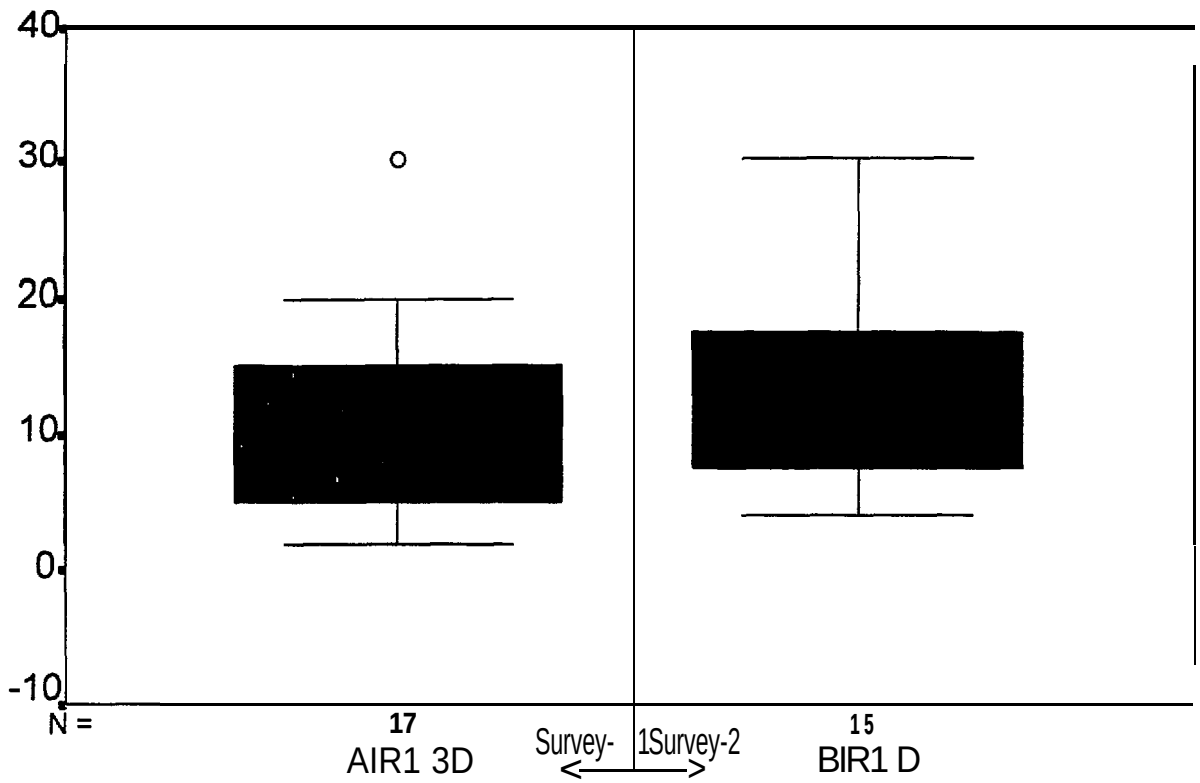
Time typically requiredfor the first responder to reach the incident site

- This question corresponds to Measure l-l.1 and Measure l-1.2.
- The descriptive summary is given in Figure 4-5.
- Seventeen participants answered this question during the first survey. The mean value obtained from their responses is 12.9 minutes.
- Fifteen participants responded to the question in the second survey. The mean value obtained from their responses is 13.9 minutes.
- An increase of 1.0 minutes is anticipated through the use of Tranzit ***XPress*** using a naive comparison. However, the medians of responses show no change as the Wilcoxon z score is 0.632 with a p-value of 0.656.

Time typically requiredfor the cargo recognition and identification by first responder

- This question corresponds to Measure 1.1.1 and Measure 1.1.2
- The descriptive summary is given in Figure 4-6
- Sixteen participants answered this question during the first survey. The mean value obtained from their responses is 15.3 minutes
- Sixteen participants responded to the question in the second survey, The mean value obtained from their responses is 10.1 minutes
- A decrease of 5.2 minutes is anticipated through the use of Tranzit ***XPress*** The medians of responses also show a decrease of 7.5 minutes. The Wilcoxon z-score shows a decrease at a value of 2.494 with an associated p-value of 0.012, which is as expected given Tranzit ***XPress*** is designed to do exactly cargo identification.

Figure 4-5
Time typically required for the first responder to reach the incident site



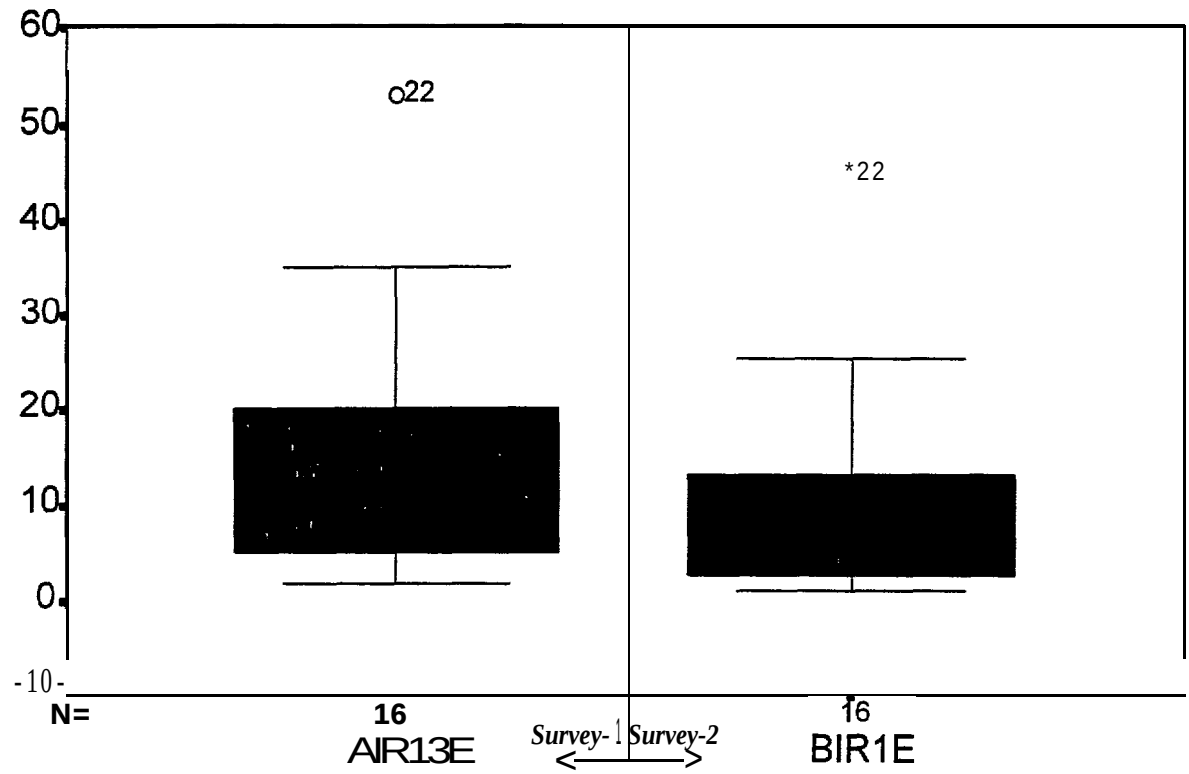
AIR13D Existing System (Survey-l)

Valid cases:	17.0	Missing cases:	7.0	Percent missing:	29.2		
Mean	12.9412	Std Err	2.2727	Min	2.0000	Skewness	.9773
Median	10.0000	Variance	87.8088	Max	30.0000	S E Skew	.5497
5% Trim	12.6013	Std Dev	9.3706	Range	28.0000	Kurtosis	-.2256
95% CI for Mean (8.1232, 17.7591)				IQR	12.5000	S E Kurt	1.0632

BIRlD ***Tranzit XPress (Survey-2)***

Valid cases:	15.0	Missing cases:	9.0	Percent missing:	37.5		
Mean	13.9333	Std Err	2.4073	Min	4.0000	Skewness	.9637
Median	10.0000	Variance	86.9238	Max	30.0000	S E Skew	.5801
5% Trim	13.5926	Std Dev	9.3233	Range	26.0000	Kurtosis	· .4497
95% CI for Mean (8.7703, 19.0964)				IQR	13.0000	S E Kurt	1.1209

Figure 4-6
Time typically required for the cargo recognition and identification by first responder



AIR13E Existing System (Survey-l)
Valid cases: 16.0 Missing cases: 8.0 Percent missing: 33.3

Mean	15.2500	Std Err	3.3547	Min	2.0000	Skewness	1.6721
Median	12.5000	Variance	180.0667	Max	53.0000	S E Skew	.5643
5% Trim	13.8889	Std Dev	13.4189	Range	51.0000	Kurtosis	3.3250
95% CI for Mean (8.0996, 22.4004)				IQR	15.0000	S E Kurt	1.0908

BIRlE Tranzit *XPress* (Survey-?)
Valid cases: 16.0 Missing cases: 8.0 Percent missing: 33.3

Mean	10.0625	Std Err	2.9161	Min	1.0000	Skewness	2.0786
Median	5.0000	Variance	136.0625	Max	45.0000	S E Skew	.5643
5% Trim	8.6250	Std Dev	11.6646	Range	44.0000	Kurtosis	4.7946
95% CI for Mean (3.8469, 16.2781)				IQR	11.2500	S E Kurt	1.0908

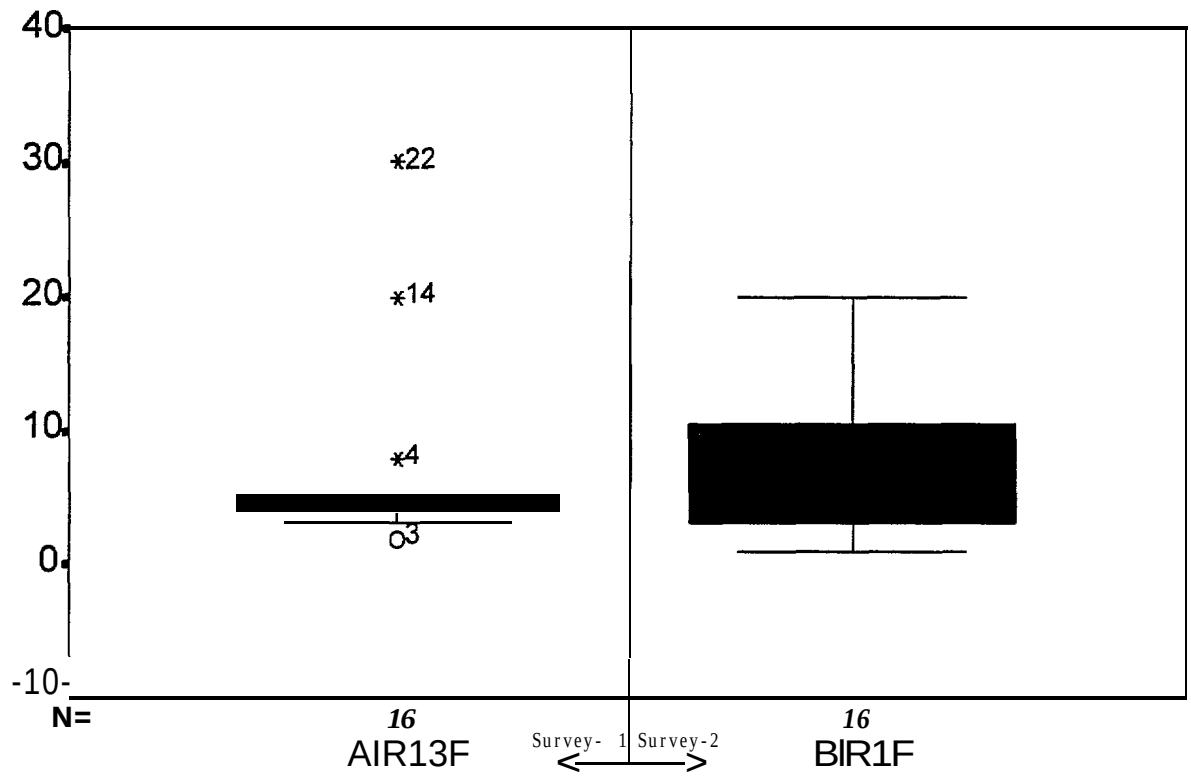
Time typically required for the notification of fire department/rescue squad

- This question corresponds to Measure 1.1.1 and Measure 1.1.2.
- The descriptive summary is given in Figure 4-7.
- Sixteen participants answered this question during the first survey. The mean value obtained from their responses is 7.0 minutes.
- Sixteen participants responded to the question in the second survey. The mean value obtained from their responses is 6.9 minutes.
- A naive comparison would show a decrease of 1.0 minute through the use of Tranzit ***XPress.*** The Wilcoxon test provides a z-score of 0.105 and a p-value of 1.000 indicating no improvement by Tranzit ***XPress.***

Time typically requiredfor the cargo notification of HazMat team and/or emergency management agency

- This question corresponds to Measure 1.1.1 and Measure 1.1.2.
- The descriptive summary is given in Figure 4-8.
- Sixteen participants answered this question during the first survey. The mean value obtained from their responses is 2 1.7 minutes.
- Fourteen participants responded to the question in the second survey. The mean value obtained from their responses is 15.9 minutes.
- A decrease of 5.8 minutes is anticipated through the use of Tranzit ***XPress.*** The medians of responses also show a decrease of 2.5 minutes. The Wilcoxon z-score is 1.887 and the associated p-value is 0.063, which is almost a significant improvement shown by Tranzit ***XPress.***

Figure 4-7
Time typically required for the notification of fire department / rescue squad



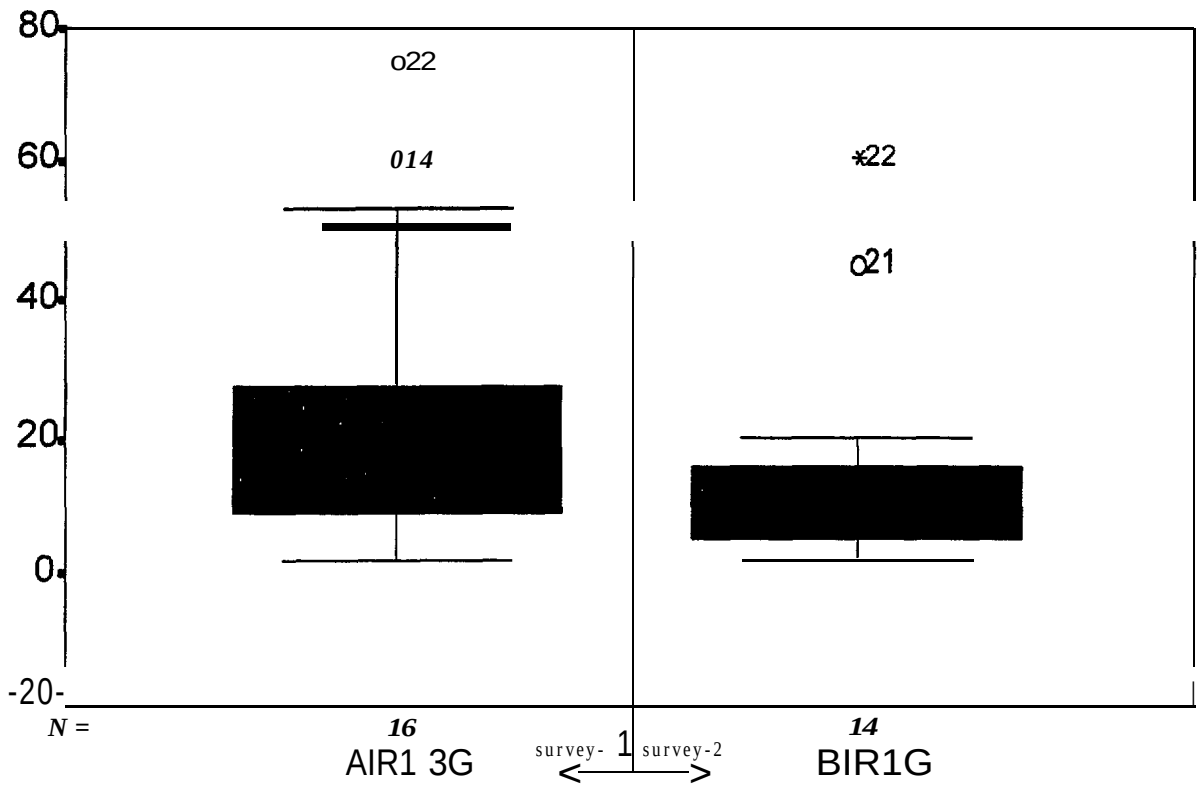
AIR13F Existing System (Survey-l)
Valid cases: 16.0 Missing cases: 8.0 Percent missing: 33.3

Mean	7.0000	Std Err	1.8439	Min	2.0000	Skewness	2.6501
Median	5.0000	Variance	54.4000	Max	30.0000	S E Skew	.5643
5% Trim	6.0000	Std Dev	7.3756	Range	28.0000	Kurtosis	6.7267
95% CI for Mean (3.0698, 10.9302)				IQR	1.0000	S E Kurt	1.0908

BIRlF Tranzit ***XPress (Survey-2)***
Valid cases: 16.0 Missing cases: 8.0 Percent missing: 33.3

Mean	6.8750	Std Err	1.4829	Min	1.0000	Skewness	1.1296
Median	5.0000	Variance	35.1833	Max	20.0000	S E Skew	.5643
5% Trim	6.4722	Std Dev	5.9316	Range	19.0000	Kurtosis	.0656
95% CI for Mean (3.7143, 10.0357)				IQR	9.7500	S E Kurt	1.0908

Figure 4-8
Time typically required for the notification of HazMat team and/or emergency management agency



AIR13G Existing System (Survey-l)
Valid cases: 16.0 Missing cases: 8.0 Percent missing: 33.3

Mean	21.6875	Std Err	5.4839	Min	2.0000	Skewness	1.5262
Median	12.5000	Variance	481.1625	Max	75.0000	S E Skew	.5643
5% Trim	19.8194	Std Dev	21.9354	Range	73.0000	Kurtosis	1.3007
95% CI for Mean (9.9989, 33.3761)				IQR	20.2500	S E Kurt	1.0908

BIRlG Tranzit ***XPress*** (Survey-21
Valid cases: 14.0 Missing cases: 10.0 Percent missing: 41.7

Mean	15.9286	Std Err	4.4320	Min	2.0000	Skewness	2.0051
Median	10.0000	Variance	274.9945	Max	60.0000	S E Skew	.5974
5% Trim	14.2540	Std Dev	16.5830	Range	58.0000	Kurtosis	3.5740
95% CI for Mean (6.3539, 25.5033)				IQR	12.0000	S E Kurt	1.1541

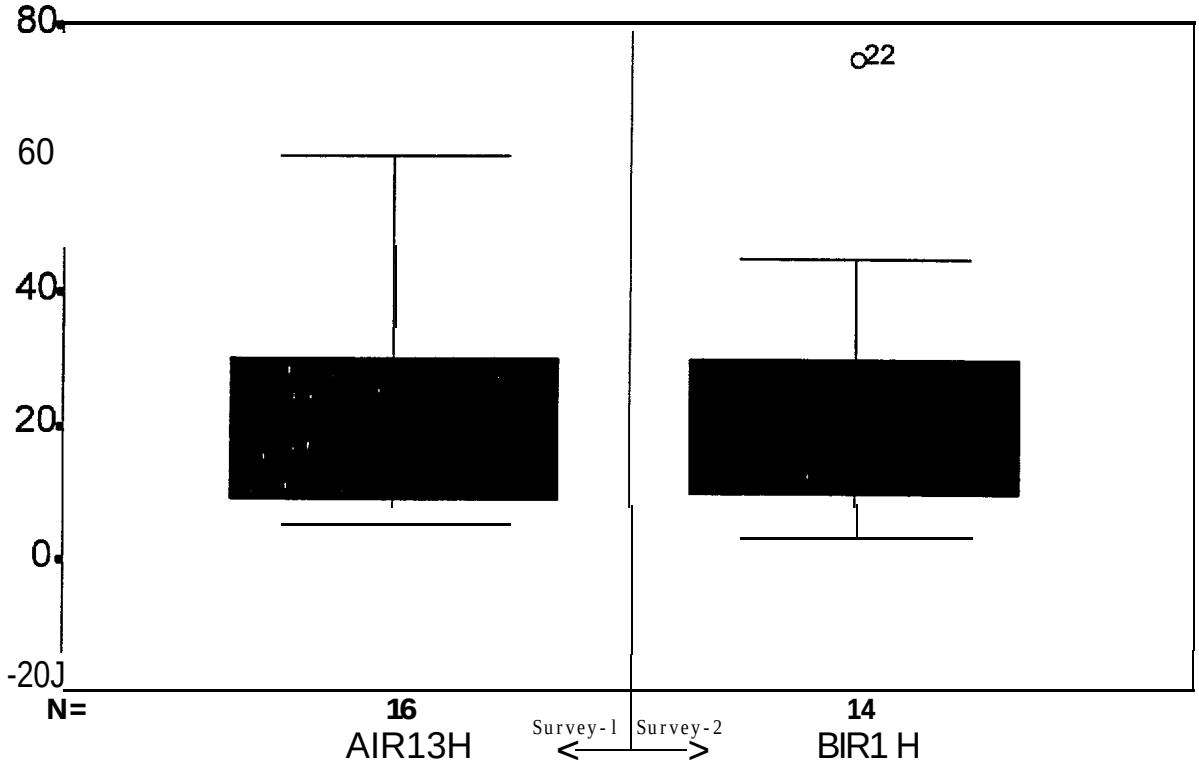
Time typically requiredfor the determination of what equipment is needed (including additional crews)

- This question corresponds to Measure 1.1.1 and Measure 1.1.2.
- The descriptive summary is given in Figure 4-9.
- Sixteen participants answered this question during the first survey. The mean value obtained from their responses is 26.3 minutes.
- Fourteen participants responded to the question in the second survey. The mean value obtained from their responses is 22.4 minutes.
- A decrease of 3.9 minutes is anticipated through the use of Tranzit ***XPress.*** The medians of responses also show a decrease of 10.5 minutes. The Wilcoxon test, however, contradicts this indication with a z-score of 0.238 and a p-value of 0.863, which means no significant improvement in the determination of equipment needed.

Time typically requiredfor the secondary responders to reach the site with proper equipment

- This question corresponds to Measure 1.1.1 and Measure 1.1.2.
- The descriptive summary is given in Figure 4-10.
- Fourteen participants answered this question during the first survey. The mean value obtained from their responses is 58.0 minutes.
- Thirteen participants responded to the question in the second survey. The mean value obtained from their responses is 45.8 minutes.
- A decrease of 4.2 minutes is anticipated through the use of Tranzit ***XPress.*** The medians of responses also show a decrease of 7.0 minutes. This is somewhat confirmed by the Wilcoxon test with a z-score of 1.693 and a p-value of 0.094.

Figure 4-9
Time typically required for the determination of what equipment is needed (including additional crews)



AIR13H Existing System (Survey-l)
Valid cases: 16.0 Missing cases: 8.0 Percent missing: 33.3

Mean	26.3125	Std Err	4.8371	Min	5.0000
Median	26.5000	Variance	374.3625	Max	60.0000
5% Trim	25.6250	Std Dev	19.3484	Range	55.0000
95% CI for Mean (16.0024, 36.6226)				IQR	21.5000

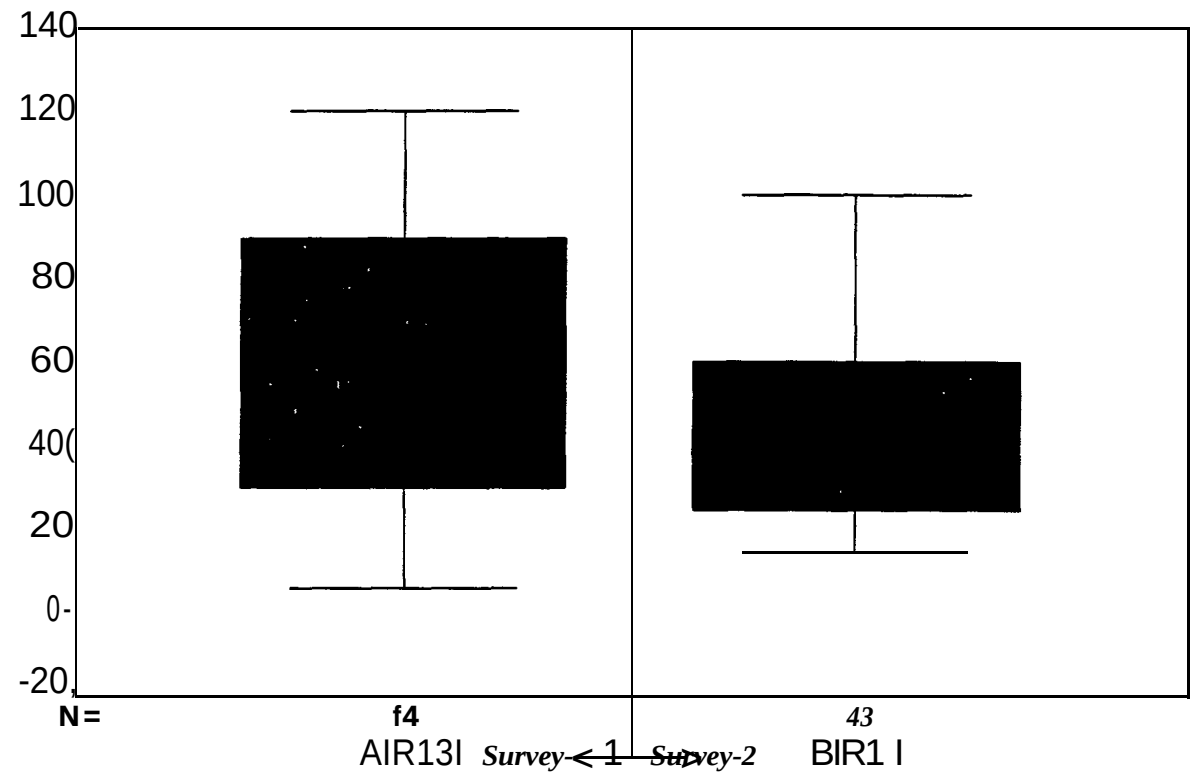
Skewness	7750
S E Skew	.5643
Kurtosis	-.3782
S E Kurt	1.0908

BIR1H Tranzit ***XPress*** (Survey-2)
Valid cases: 14.0 Missing cases: 10.0 Percent missing: 41.7

Mean	22.3571	Std Err	4.9886	Min	3.0000
Median	16.0000	Variance	348.4011	Max	75.0000
5% Trim	20.5079	Std Dev	18.6655	Range	72.0000
95% CI for Mean (11.5800, 33.1343)				IQR	20.0000

Skewness	1.9683
S E Skew	.5974
Kurtosis	4.4162
S E Kurt	1.1541

Figure 4-10
Time typically required for the secondary responders to reach the site with proper equipment



AIR131 Existing System (Survey-l)
Valid cases: 14.0 Missing cases: 10.0 Percent missing: 41.7

Mean	58.0000	Std Err	9.0384	Min	6.0000	Skewness	.2630
Median	52.5000	Variance	1143.692	Max	120.0000	S E Skew	.5974
5% Trim	57.4444	Std Dev	33.8185	Range	114.0000	Kurtosis	-.8702
35% CI for Mean	(38.4738, 77.5262)			IQR	61.7500	S E Kurt	1.1541

BIR11 Tranzit *XPress* (Survey-2)
Valid cases: 13.0 Missing cases: 11.0 Percent missing: 45.8

Mean	45.7692	Std Err	7.5923	Min	15.0000	Skewness	.7801
Median	45.0000	Variance	749.3590	Max	100.0000	S E Skew	.6163
5% Trim	44.4658	Std Dev	27.3744	Range	85.0000	Kurtosis	-.2091
35% CI for Mean	(29.2270, 62.3114)			IQR	37.5000	S E Kurt	1.1909

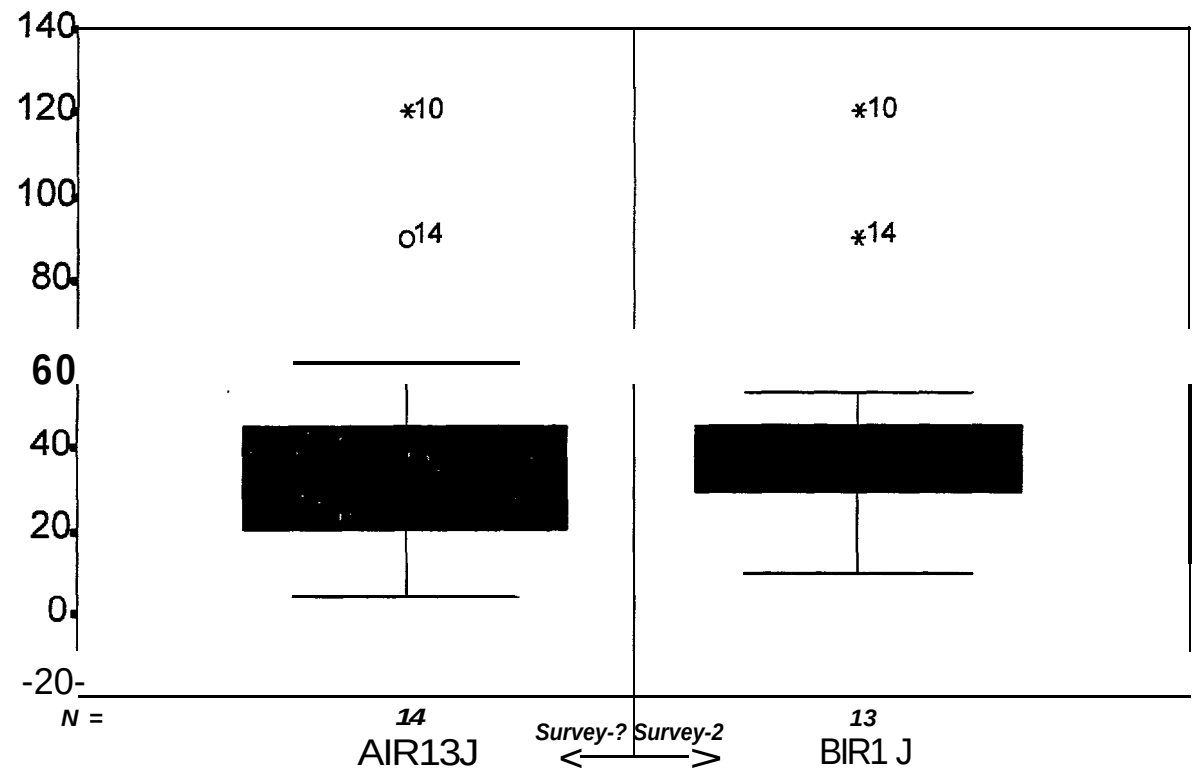
Time typically requiredfor the passive containment and stabilization (e.g. fire department digging trenches)

- This question corresponds to Measure 1.1.1 and Measure l.1.2.
- The descriptive summary is given in Figure 4-l1.
- Fourteen participants answered this question during the first survey. The mean value obtained from their responses is 39.4 minutes.
- Thirteen participants responded to the question in the second survey. The mean value obtained from their responses is 42.8 minutes.
- An increase of 3.4 minutes is anticipated through the use of Tranzit ***XPress.*** The medians of responses show no significant change in responses (Wilcoxon z-score 0.350 and p-value 0.758).

Time typically required for the containment and stabilization by specialists (HazMat crews)

- This question corresponds to Measure 1.1.1 and Measure 1.1.2.
- The descriptive summary is given in Figure 4-12.
- Eleven participants answered this question during the first survey. The mean value obtained from their responses is 79.1 minutes.
- Fourteen participants responded to the question in the second survey. The mean value obtained from their responses is 58.8 minutes.
- A mean decrease of 20.3 minutes is anticipated through the use of Tranzit ***XPress.*** When comparing the responses of individuals that gave answers to both questions, however, the Wilcoxon z-score is 0.841 and the associated p-value is 0.469, indicating no perceived improvement.

Figure 4-11
Time typically required for the passive containment and stabilization (e.g. fire department digging trenches)



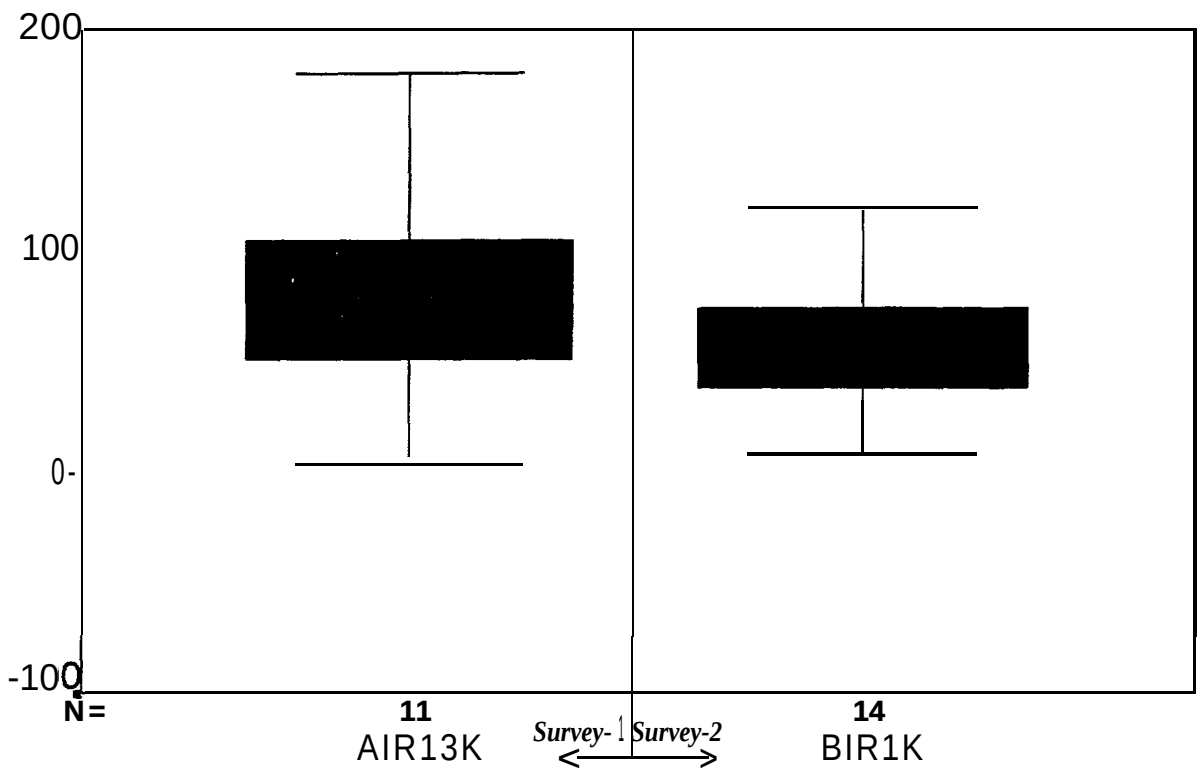
AIR13 J Existing System (Survey-l)
Valid cases: 14.0 Missing cases: 10.0 Percent missing: 41.7

Mean	39.4286	Std Err	8.3848	Min	4.0000	Skewness	1.6828
Median	30.0000	Variance	984.2637	Max	120.0000	S E Skew	.5974
5% Trim	36.9206	Std Dev	31.3730	Range	116.0000	Kurtosis	2.6256
95% CI for Mean (21.3144, 57.5428)				IQR	28.7500	S E Kurt	1.1541

BIRlJ Tranzit ***XPress*** (Survey-21
Valid cases: 13.0 Missing cases: 11.0 Percent missing: 45.8

Mean	42.7692	Std Err	8.5890	Min	10.0000	Skewness	1.5939
Median	30.0000	Variance	959.0256	Max	120.0000	S E Skew	.6163
5% Trim	40.2991	Std Dev	30.9681	Range	110.0000	Kurtosis	2.5383
95% CI for Mean (24.0554, 61.4831)				IQR	22.5000	S E Kurt	1.1909

Figure 4-12
Time typically required for the containment and stabilization by specialists (HazMat crews)



AIR13K Existing System (Survey-l)

Valid cases:	11.0	Missing cases:		13.0	Percent missing:		54.2
Mean	79.0909	Std Err	15.8662	Min	***5.0000***	Skewness	.6947
Median	60.0000	Variance	2769.091	Max	180.0000	S E Skew	.6607
5% Trim	77.6010	Std Dev	52.6222	Range	175.0000	Kurtosis	-.0488
95% CI for Mean (43.7389, 114.4430)				IQR	75.0000	S E Kurt	1.2794

BIRlK Tranzit ***XPress (Survey-2)***

Valid cases:	14.0	Missing cases:		10.0	Percent missing:		***41.7***
Mean	58.7857	Std Err	8.1127	Min	10.0000	Skewness	.4053
Median	60.0000	Variance	921.4121	Max	***120.0000***	S E Skew	.5974
5% Trim	58.0952	Std Dev	30.3548	Range	110.0000	Kurtosis	.0108
95% CI for Mean (41.2594, 76.3120)				IQR	41.2500	S E Kurt	1.1541

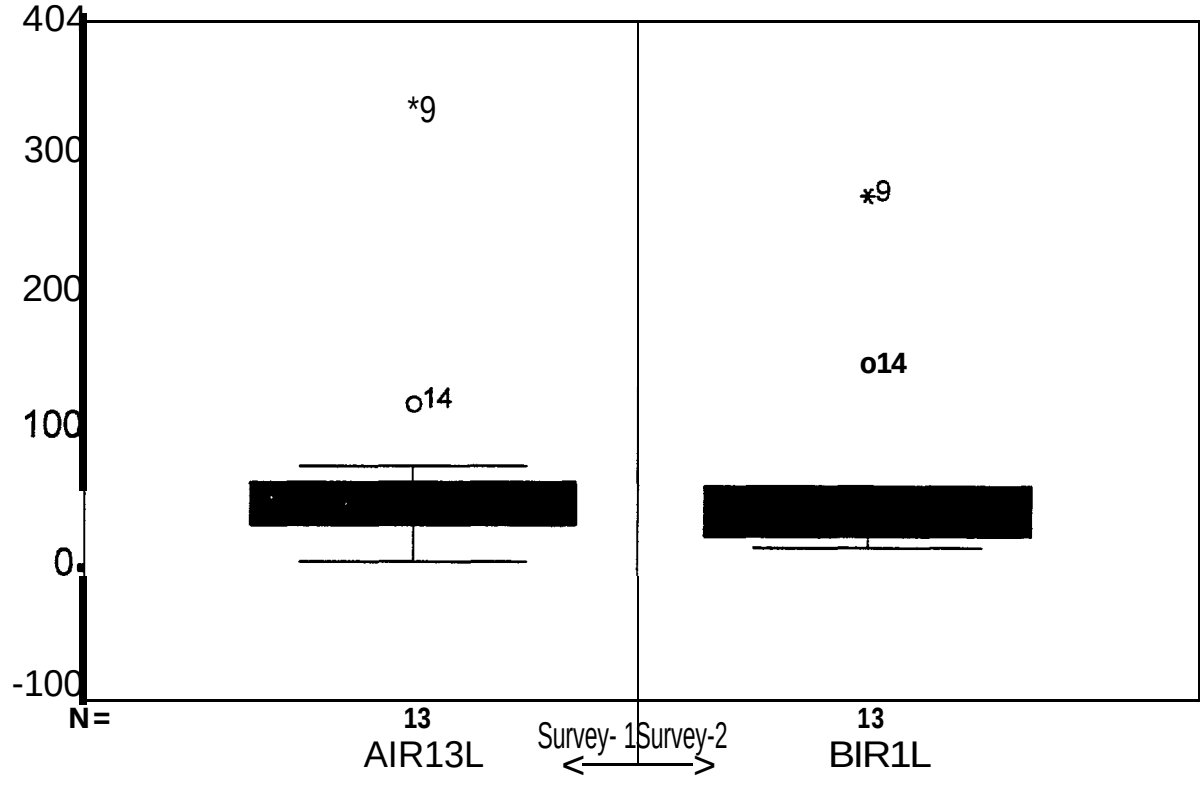
Time typically requiredfor the evacuation ofpersons from the affected area (if necessary)

- This question corresponds to Measure 1.1.1 and Measure l.1.2.
- The descriptive summary is given in Figure 4- 13.
- Thirteen participants answered this question during the first survey. The mean value obtained from their responses is 69.9 minutes.
- Thirteen participants responded to the question in the second survey. The mean value obtained from their responses is 62.5 minutes.
- A mean decrease of 7.4 minutes is anticipated through the use of Tranzit ***XPress.*** The medians are misleading when looking at the figure because the Wilcoxon z-score is 0.63 1 and its p-value is 0.625, indicating no significant improvement.

Time typically requiredfor the clean-up of the accident/incident site

- This question corresponds to Measure 1.1. I and Measure 1.1.2.
- The descriptive summary is given in Figure 4-14.
- Nine participants answered this question during the first survey. The mean value obtained from their responses is 237.1 minutes.
- Eight participants responded to the question in the second survey. The mean value obtained from their responses is 264.4 minutes.
- An increase of 27.3 minutes is anticipated through the use of Tranzit ***XPress.*** The Wilcoxon z-score is 0 and the p-value is 1.000 indicating no statistical significance.

Figure 4-13
Time typically required for the evacuation of persons from the affected area (if necessary)



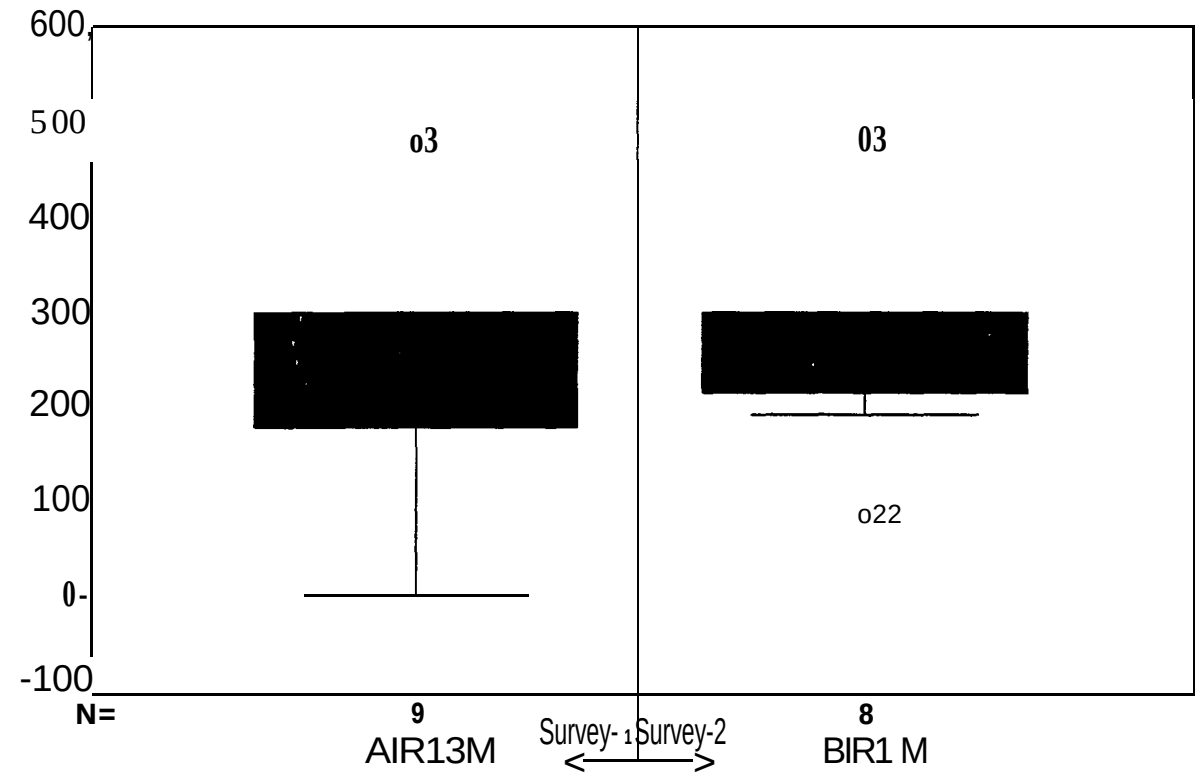
AIR13L Existing System (Survey-l)

Valid cases:	13.0	Missing cases:	11.0	Percent missing:	45.8		
Mean	69.9231	Std Err	23.1745	Min	4.0000	Skewness	2.8780
Median	60.0000	Variance	6981.744	Max	330.0000	S E Skew	.6163
5% Trim	59.1368	Std Dev	83.5568	Range	326.0000	Kurtosis	9.1316
95% CI for Mean	(19.4302, 120.4160)			IQR	37.5000	S E Kurt	1.1909

BIRlL Tranzit ***XPress (Survey-l)***

Valid cases:	13.0	Missing cases:	11.0	Percent missing:	45.8		
Mean	62.5385	Std Err	19.8771	Min	15.0000	Skewness	2.4524
Median	30.0000	Variance	5136.269	Max	270.0000	S E Skew	.6163
5% Trim	53.6538	Std Dev	71.6678	Range	255.0000	Kurtosis	6.1520
95% CI for Mean	(19.2301, 105.8469)			IQR	38.5000	S E Kurt	1.1909

Figure 4-14
Time typically required for the clean-up of the accident/incident site



AIR13M Existing System (Survey-I)
Valid cases: 9.0 Missing cases: 15.0 Percent missing: 62.5

Mean	237.1111	Std Err	43.9888	Min	4.0000	Skewness	.0961
Yedian	240.0000	Variance	17415.11	Max	480.0000	S E Skew	.7171
5% Trim	236.5679	Std Dev	131.9663	Range	476.0000	Kurtosis	1.2215
95% CI for Mean (135.6728, 338.5494)				IQR	135.0000	S E Kurt	1.3997

BIRlM Tranzit *XPress* (Survey-2)
Valid cases: 8.0 Missing cases: 16.0 Percent missing: 66.7

Mean	264.3750	Std Err	39.0677	Min	90.0000	Skewness	.6283
Median	255.0000	Variance	12210.27	Max	480.0000	S E Skew	.7521
5% Trim	262.0833	Std Dev	110.5001	Range	390.0000	Kurtosis	2.2597
95% CI for Mean (171.9946, 356.7554)				IQR	93.7500	S E Kurt	1.4809

The effectiveness of recordkeeping systems (Current and Tranzit XPress) at maintaining safety

- This question provides information to evaluate Measure 1.2.1, 1.2.2 and 1.2.3.

- The descriptive summary is given in Figure 4- 15

- Twenty participants answered this question during the first survey by rating the existing/current system. The mean rating is 3.2. The median rating is 3.0

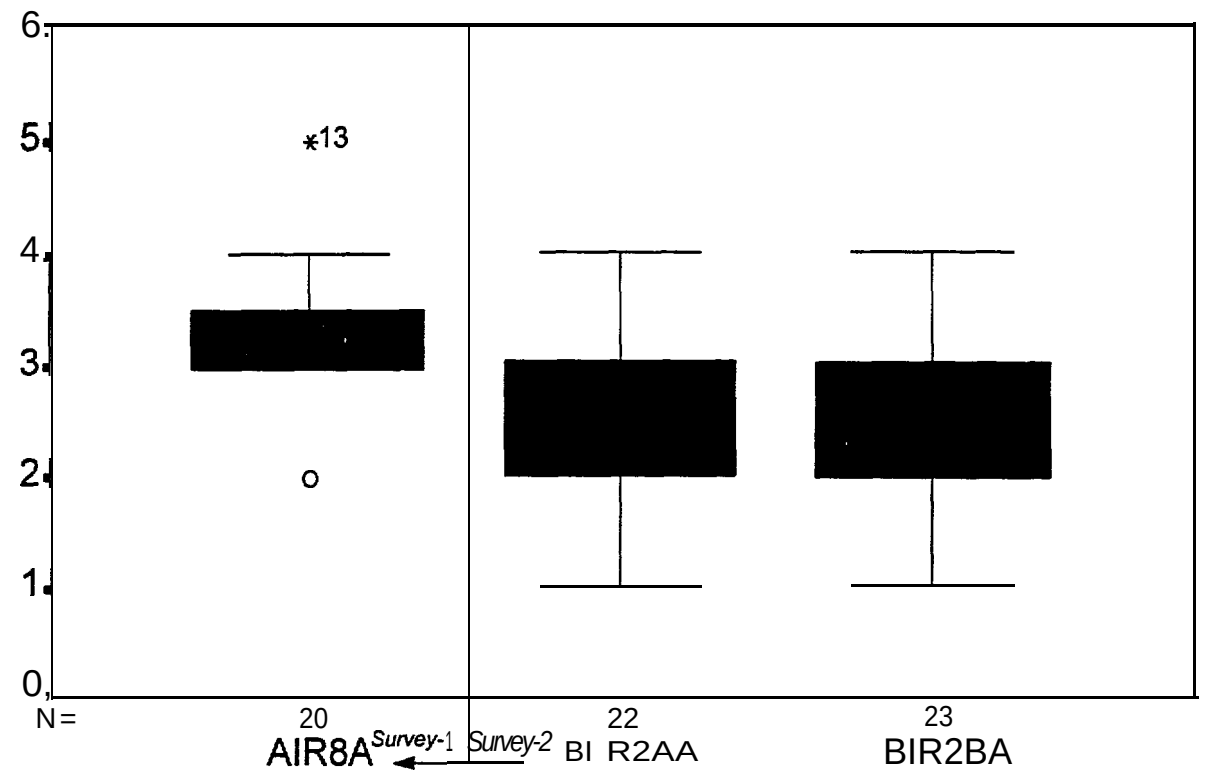
- Twenty-two participants rated the existing system in the second survey by responding to this question. The mean rating is 2.8. The median rating is 3.0

- Twenty three participants rated Tranzit ***XPress*** in the second survey by responding to this question. The mean rating is 2.4. The median rating is 2.0

- The mean ratings suggest that after the Tranzit ***XPress*** system demonstration the participants changed their perception of the existing system by giving it a better rating. However, this change is not significant, therefore, respondents provided consistent judgments on the existing system.

- Tranzit ***XPress*** is perceived to be better than the existing system when compared with the existing system rating obtained before the system demonstration (with a marginal homogeneity test p-value of 0,006) and also with the existing system rating after the demonstration (with a marginal homogeneity test p-value of 0.050).

Figure 4-15
The effectiveness of recordkeeping systems (Current and Tranzit *XPress)* at maintaining safety



AIR8A Existing System (Survey-l)

Valid cases:	20.0	Missing cases:	4.0	Percent missing:	16.7		
Mean	3.2000	Std Err	.1556	Min	2.0000	Skewness	.7498
Median	3.0000	Variance	.4842	Max	5.0000	S E Skew	.5121
5% Trim	3.1667	Std Dev	.6959	Range	3.0000	Kurtosis	1.4842
95% CI for Mean (2.8743, 3.5257)				IQR	.7500	S E Kurt	.9924

BIR2AA Existing System (Survey-21

Valid cases:	22.0	Missing cases:	2.0	Percent missing:	8.3		
Mean	2.8182	Std Err	.1695	Min	1.0000	Skewness	-.2740
Median	3.0000	Variance	.6320	Max	4.0000	S E Skew	.4910
5% Trim	2.8485	Std Dev	.7950	Range	3.0000	Kurtosis	-.0796
95% CI for Mean (2.4657, 3.1707)				IQR	1.0000	S E Kurt	.9528

BIR2BA Tranzit ***XPress (Survey-2)***

Valid cases:	23.0	Missing cases:	1.0	Percent missing:	4.2		
Mean	2.3478	Std Err	.1845	Min	1.0000	Skewness	.0767
Median	2.0000	Variance	.7826	Max	4.0000	S E Skew	.4813
5% Trim	2.3309	Std Dev	.8847	Range	3.0000	Kurtosis	-.5620
95% CI for Mean (1.9653, 2.7304)				IQR	1.0000	S E Kurt	.9348

The effectiveness of recordkeeping systems (Current and Tranzit XPress) at maintaining efficiency

- This question provides information to evaluate Measure 1.2.1, 1.2.2 and 1.2.3.

- The descriptive summary is given in Figure 4- 16

- Twenty participants answered this question during the first survey by rating the existing/current system. The mean rating is 3.4. The median rating is 3.0

- Twenty-two participants rated the existing system in the second survey by responding to this question. The mean rating is 2.9. The median rating is 3.0

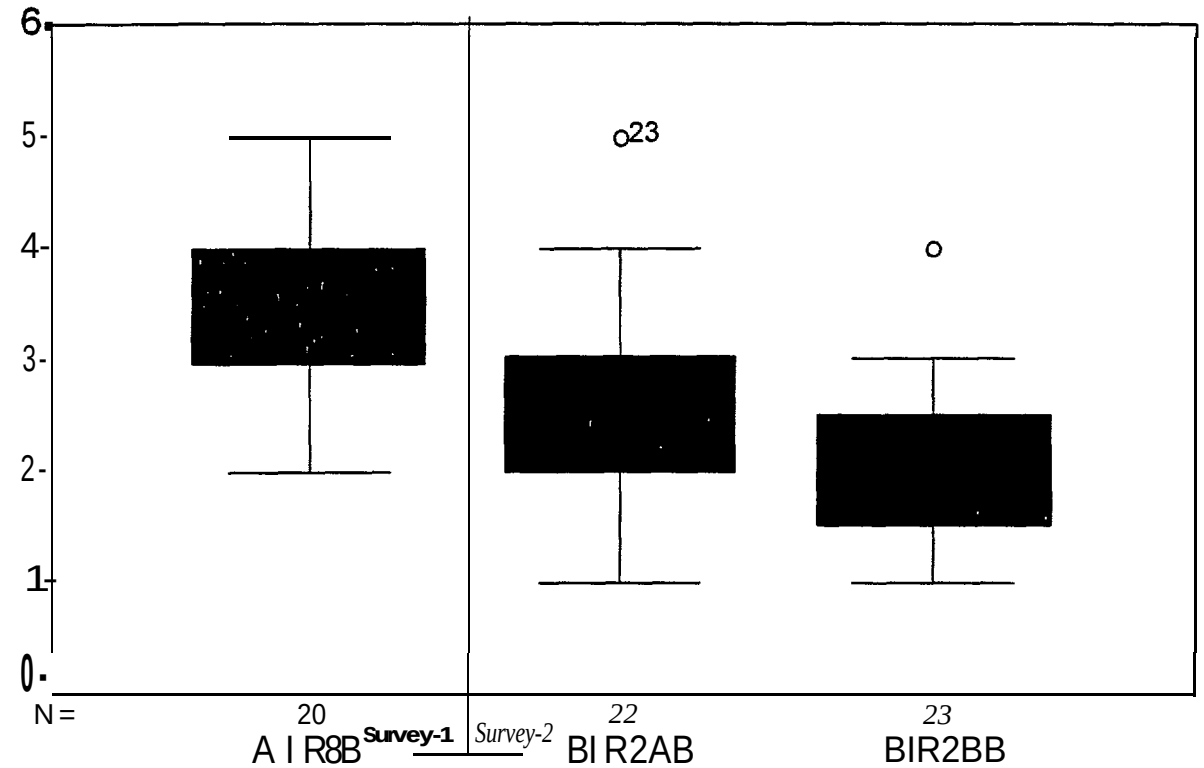
- Twenty-three participants rated Tranzit ***XPress*** in the second survey by responding to this question. The mean rating is 2.1. The median rating is 2.0

- The mean ratings suggest that after the Tranzit ***XPress*** system demonstration the participants changed their perception of the existing system by giving it a better rating. The medians show no change.

- Tranzit ***XPress*** is perceived to be better than the existing system when compared with the existing system rating obtained before the system demonstration (marginal homogeneity test p-value of 0.001)

- Tranzit ***XPress*** is also perceived to be better than the existing system when compared with the existing system rating obtained after the system demonstration (marginal homogeneity test p-value of 0.006). Judgments on the existing system before and after the demonstration have been statistically similar (p-value of 0.083).

Figure 4-16
The effectiveness of recordkeeping systems (Current and Tranzit *XPress)* at maintaining efficiency



AIR8B Existing System (Survey-l)
Valid cases: 20.0 Missing cases: 4.0 Percent missing: 16.7

Mean	3.3500	Std Err	.1817	Min	2.0000	Skewness	-.1127
Median	3.0000	Variance	.6605	Max	5.0000	S E Skew	.5121
5% Trim	3.3333	Std Dev	.8127	Range	3.0000	Kurtosis	-.4058
95% CI for Mean (2.9696, 3.7304)				IQR	1.0000	S E Kurt	.9924

BIR2AB Existing System (Survey-l)
Valid cases: 22.0 Missing cases: 2.0 Percent missing: 8.3

Mean	2.8636	Std Err	.2111	Min	1.0000	Skewness	-.0281
Median	3.0000	Variance	.9805	Max	5.0000	S E Skew	.4910
5% Trim	2.8535	Std Dev	.9902	Range	4.0000	Kurtosis	.1070
95% CI for Mean (2.4246, 3.3027)				IQR	1.2500	S E Kurt	.9528

BIR2BB Tranzit ***XPress*** (Survey-2)
Valid cases: 23.0 Missing cases: 1.0 Percent missing: 4.2

Mean	2.0870	Std Err	.1877	Min	1.0000	Skewness	.6371
Median	2.0000	Variance	.8103	Max	4.0000	S E Skew	.4813
5% Trim	2.0411	Std Dev	.9002	Range	3.0000	Kurtosis	-.0046
95% CI for Mean (1.6977, 2.4762)				IQR	2.0000	S E Kurt	.9348

The effectiveness of recordkeeping systems (Current and Tranzit XPress) at accurately tracking HazMat

- This question provides information to evaluate Measure 1.2.1, 1.2.2 and 1.2.3.

- The descriptive summary is given in Figure 4- 17.

- Twenty-one participants answered this question during the first survey by rating the existing/current system. The mean rating is 3.8. The median rating is 4.0.

- Twenty-three participants rated the existing system in the second survey by responding to this question. The mean rating is 2.8. The median rating is 3.0.

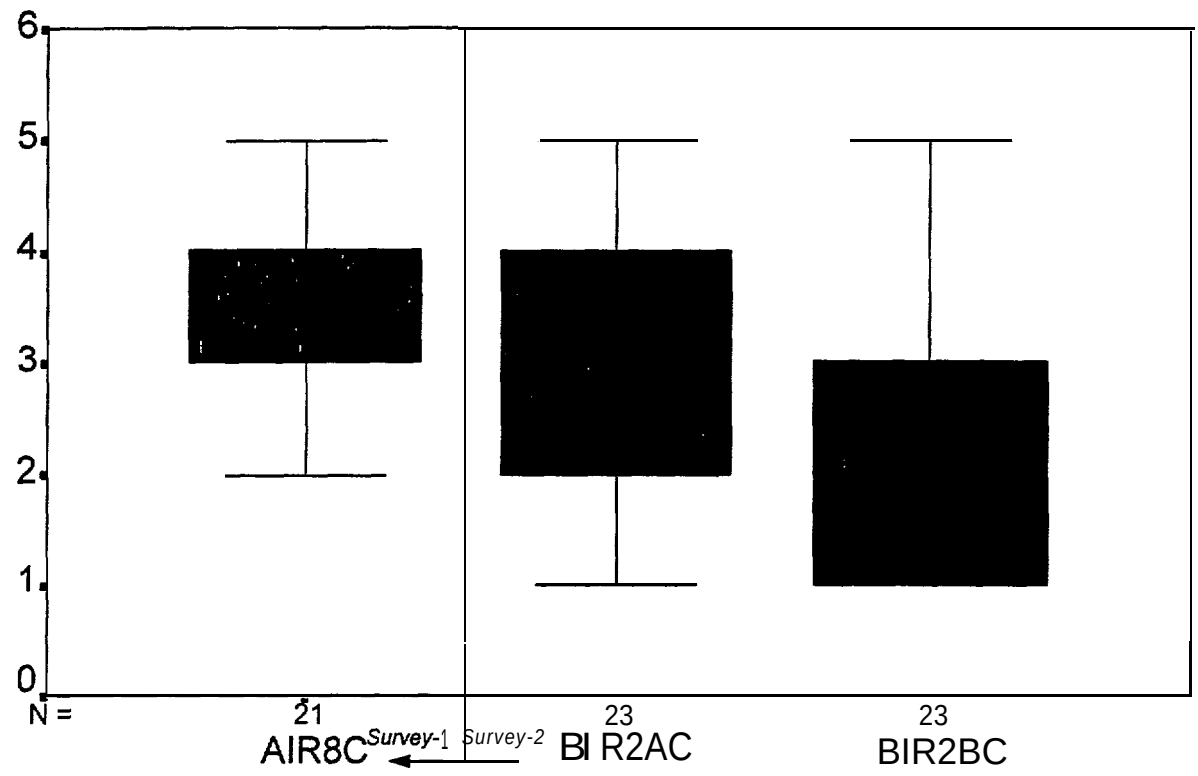
- Twenty-three participants rated Tranzit ***XPress*** in the second survey by responding to this question. The mean rating is 2.1. The median rating is 2.0.

- The mean ratings suggest that after the Tranzit ***XPress*** system demonstration the participants changed their perception of the existing system by giving it a better rating. The medians follow the same trend and the marginal homogeneity test yields a p-value of 0.008.

- Tranzit ***XPress*** is perceived to be better than the existing system when compared with the existing system rating obtained before the system demonstration with a p-value 0.001.

- Tranzit ***XPress*** is also perceived to be better than the existing system when compared with the existing system rating obtained after the system demonstration with a smaller confidence of a p-value 0.016.

Figure 4-l 7
The effectiveness of recordkeeping systems (Current and Tranzit *XPress)* at accurately tracking hazardous materials



AIR8C Existing System (Survey-l)
Valid cases: 21.0 Missing cases: 3.0 Percent missing: 12.5

Mean	3.7619	Std Err	.2059	Min	2.0000	Skewness	-.2628
Median	4.0000	Variance	.8905	Max	5.0000	S E Skew	.5012
5% Trim	3.7910	Std Dev	.9437	Range	3.0000	Kurtosis	-.6919
95% CI for Mean (3.3324, 4.1914)				IQR	1.5000	S E Kurt	.9719

BIR2AC Existing System (Survey-2)
Valid cases: 23.0 Missing cases: 1.0 Percent missing: 4.2

Mean	2.8261	Std Err	.2323	Min	1.0000	Skewness	-.0588
Median	3.0000	Variance	1.2411	Max	5.0000	S E Skew	.4813
5% Trim	2.8140	Std Dev	1.1140	Range	4.0000	Kurtosis	-.7466
95% CI for Mean (2.3443, 3.3078)				IQR	2.0000	S E Kurt	.9348

BIR2BC Tranzit *XPress* (Survey-2)
Valid cases: 23.0 Missing cases: 1.0 Percent missing: 4.2

Mean	2.1304	Std Err	.2378	Min	1.0000	Skewness	.9318
Median	2.0000	Variance	1.3004	Max	5.0000	SE Skew	.4813
5% Trim	2.0411	Std Dev	1.1403	Range	4.0000	Kurtosis	.3439
95% CI for Mean (1.6373, 2.6236)				IQR	2.0000	S E Kurt	.9348

The effectiveness of recordkeeping systems (Current and Tranzit XPress) at accurately reflecting mixed loads

- This question provides information to evaluate Measure 1.2.1, 1.2.2 and 1.2.3.

- The descriptive summary is given in Figure 4- 18.

- Twenty-one participants answered this question during the first survey by rating the existing/current system. The mean rating is 4.0. The median rating is 4.0.

- Twenty-three participants rated the existing system in the second survey by responding to this question. The mean rating is 3.1. The median rating is 3.0.

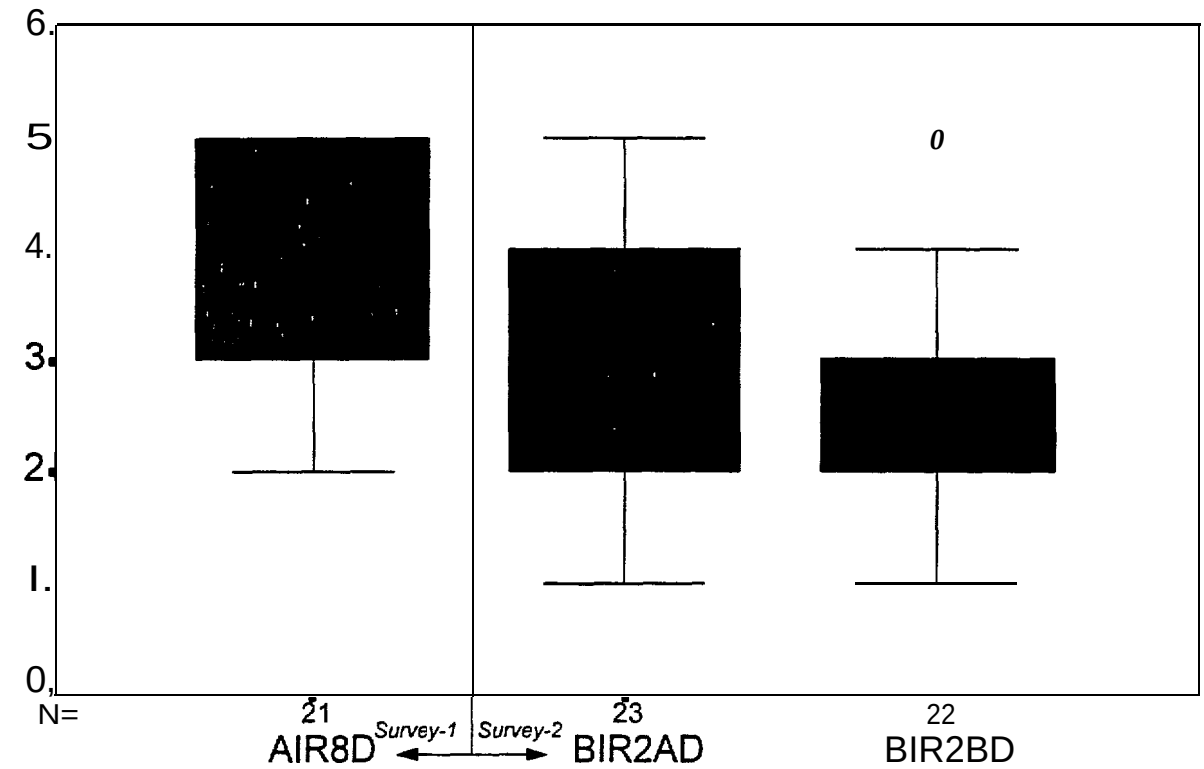
- Twenty-two participants rated Tranzit ***XPress*** in the second survey by responding to this question. The mean rating is 2.6. The median rating is 2.5.

- The mean ratings suggest that after the Tranzit ***XPress*** system demonstration the participants changed their perception of the existing system by giving it a better rating. The medians follow the same trend and the marginal homogeneity test yields a p-value equal to 0.035.

- Tranzit ***XPress*** is perceived to be better than the existing system when compared with the existing system rating obtained before the system demonstration (p-value 0.00 1)

- Tranzit ***XPress*** is also perceived to be better than the existing system when compared with the existing system rating obtained after the system demonstration (p-value 0.024).

Figure 4-18
The effectiveness of recordkeeping systems (Current and Tranzit *XPress)* at accurately reflecting mixed loads



AIR8D Existing System (Survey-l)
Valid cases: 21.0 Missing cases: 3.0 Percent missing: 12.5

Mean	3.9524	Std Err	.1887	Min	2.0000	Skewness	-.4156
Median	4.0000	Variance	.7476	Max	5.0000	S E Skew	.5012
5% Trim	4.0000	Std Dev	.8646	Range	3.0000	Kurtosis	-.3825
95% CI for Mean (3.5588, 4.3460)				IQR	2.0000	S E Kurt	.9719

BIR2AD Existing System (Survey-21
Valid cases: 23.0 Missing cases: 1.0 Percent missing: 4.2

Mean	3.1304	Std Err	.2762	Min	1.0000	Skewness	-.1319
Median	3.0000	Variance	1.7549	Max	5.0000	S E Skew	.4813
5% Trim	3.1449	Std Dev	1.3247	Range	4.0000	Kurtosis	-1.0855
95% CI for Mean (2.5576, 3.7033)				IQR	2.0000	S E Kurt	.9348

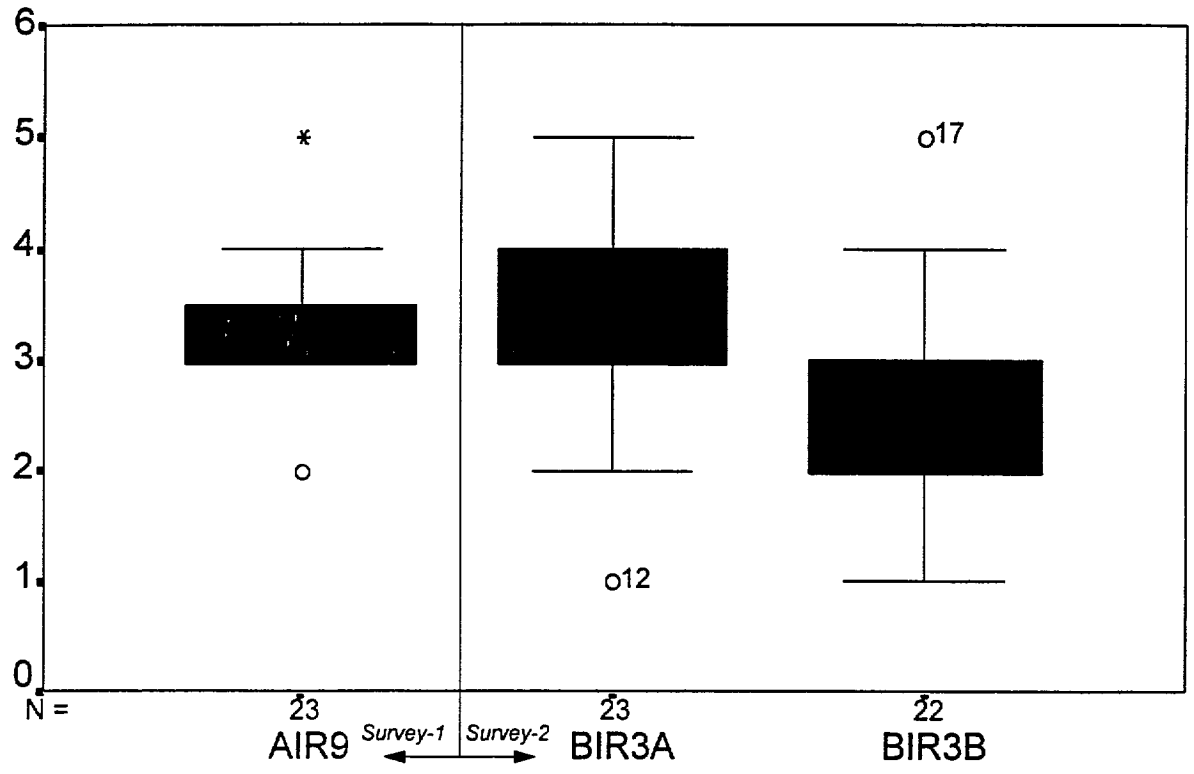
BIR2BD Tranzit ***XPress*** (Survey-2)
Valid cases: 22.0 Missing cases: 2.0 Percent missing: 8.3

Mean	2.5909	Std Err	.2685	Min	1.0000	Skewness	.4036
Median	2.5000	Variance	1.5866	Max	5.0000	S E Skew	.4910
5% Trim	2.5455	Std Dev	1.2596	Range	4.0000	Kurtosis	-.6572
95% CI for Mean (2.0324, 3.1494)				IQR	1.5000	S E Kurt	.9528

Effectiveness ofplacard system for identifying truck contents in determining optimal emergency response and cleanup strategies

- This question corresponds to Measure 1.2.1 and 1.3.1.
- The descriptive summary is given in Figure 4- 19.
- Twenty-three participants answered this question during the first survey by rating the existing/current system. The mean rating is 3.1. The median rating is also 3.0.
- Twenty-three participants rated the existing system in the second survey by responding to this question. The mean rating is 3.2. The median rating is 3.0.
- Twenty-two participants rated Tranzit ***XPress*** in the second survey by responding to this question. The mean rating is 2.4. The median rating is 2.0.
- The mean ratings suggest that after the Tranzit ***XPress*** system demonstration the participants changed their perception of the existing system by rating it less effective. However, the medians show no change and the marginal homogeneity test yields a p-value of 0.5 13.
- Tranzit ***XPress*** is perceived to be better than the existing system when compared with the existing system rating obtained before the system demonstration (p-value 0.048).
- Tranzit ***XPress*** is also perceived to be better than the existing system when compared with the existing system rating obtained after the system demonstration with even more confidence (p-value of 0.003).

Figure 4-19
Effectiveness of the placard system for identifying truck contents in determining optimal emergency response and cleanup strategies



AIR9 Existing System (Survey-1)

Valid cases:	23.0	Missing cases:	1.0	Percent missing:	4.2		
Mean	3.1304	Std Err	.1812	Min	2.0000	Skewness	.6413
Median	3.0000	Variance	.7549	Max	5.0000	S E Skew	.4813
5% Trim	3.0894	Std Dev	.8689	Range	3.0000	Kurtosis	.1999
95% CI for Mean (2.7547, 3.5062)				IQR	1.0000	S E Kurt	.9348

BIR3A Existing System (Survey-2)

Valid cases:	23.0	Missing cases:	1.0	Percent missing:	4.2		
Mean	3.2174	Std Err	.1773	Min	1.0000	Skewness	-.4544
Median	3.0000	Variance	.7233	Max	5.0000	S E Skew	.4813
5% Trim	3.2415	Std Dev	.8505	Range	4.0000	Kurtosis	1.2608
95% CI for Mean (2.8496, 3.5852)				IQR	1.0000	S E Kurt	.9348

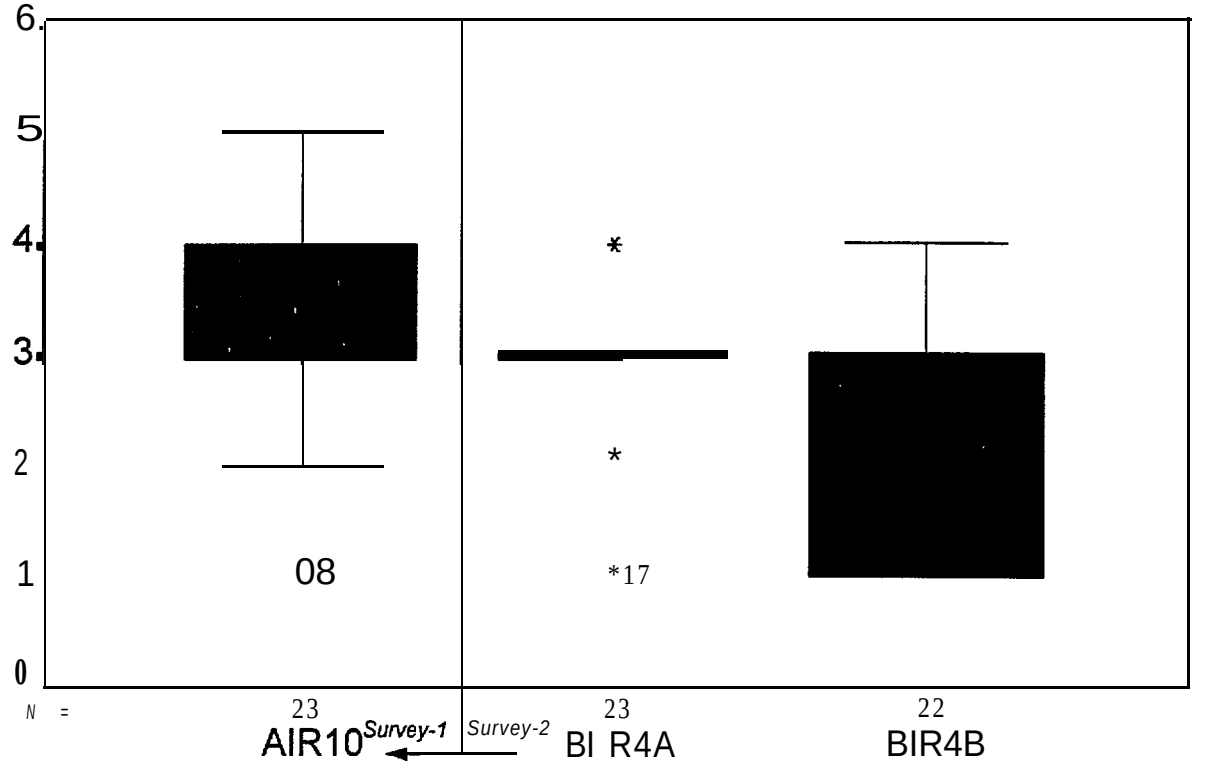
BIR3B Tranzit *XPress* (Survey-2)

Valid cases:	22.0	Missing cases:	2.0	Percent missing:	8.3		
Mean	2.4091	Std Err	.2341	Min	1.0000	Skewness	.4915
Median	2.0000	Variance	1.2056	Max	5.0000	S E Skew	.4910
5% Trim	2.3485	Std Dev	1.0980	Range	4.0000	Kurtosis	-.0512
95% CI for Mean (1.9223, 2.8959)				IQR	1.2500	S E Kurt	.9528

Effectiveness of the information available through the systems in determining optimal emergency response and cleanup strategies

- This question corresponds to Measure 1.3.1.
- The descriptive summary is given in Figure 4-20.
- Twenty-three participants answered this question during the first survey by rating the existing/current system. The mean rating is 3.2. The median rating is 3.0.
- Twenty-three participants rated the existing system in the second survey by responding to this question. The mean rating is 3.0. The median rating is 3.0.
- Twenty-two participants rated Tranzit ***XPress*** in the second survey by responding to this question. The mean rating is 2.2. The median rating is 2.0.
- The mean ratings suggest that after the Tranzit ***XPress*** system demonstration the participants changed their perception of the existing system by giving it a slightly better rating. The medians, however, show no change and the marginal homogeneity test p-value is 1.000.
- Tranzit ***XPress*** is perceived to be better than the existing system when compared with the existing system rating obtained before the system demonstration (p-value 0.002).
- Tranzit ***XPress*** is also perceived to be better than the existing system when compared with the existing system rating obtained after the system demonstration (p-value 0.005).

Figure 4-20
Effectiveness of the information available through the systems in determining optimal emergency response and cleanup strategies



AIRlO *Existing* System (Survey-l)

Valid cases:	23.0	Missing cases:	1.0	Percent missing:	4.2		
lean	3.1739	Std Err	.1953	Min	1.0000	Skewness	-.0117
Median	3.0000	Variance	.8775	Max	5.0000	S E Skew	.4813
5% Trim	3.1860	Std Dev	.9367	Range	4.0000	Kurtosis	.6248
35% CI for Mean	(2.7688, 3.5790)			IQR	1.0000	S E Kurt	.9348

BIR4A Existing System (Survey-l)

Valid cases:	23.0	Missing cases:	1.0	Percent missing:	4.2		
Mean	3.0435	Std Err	.1472	Min	1.0000	Skewness	-.9109
Median	3.0000	Variance	.4980	Max	4.0000	S E Skew	.4813
5% Trim	3.0966	Std Dev	.7057	Range	3.0000	Kurtosis	2.3221
95% CI for Mean	(2.7383, 3.3486)			IQR	.0000	S E Kurt	.9348

BIR4B Tranzit ***XPress*** (Survey-a)

Valid cases:	22.0	Missing cases:	2.0	Percent missing:	a.3		
Mean	2.2273	Std Err	.2366	Min	1.0000	Skewness	.4257
Median	2.0000	Variance	1.2316	Max	4.0000	S E Skew	.4910
5% Trim	2.1970	Std Dev	1.1098	Range	3.0000	Kurtosis	-1.1060
95% CI for Mean	(1.7352, 2.7193)			IQR	2.0000	S E Kurt	.9528

Current Motor Carrier compliance with HazMat regulations

- This question provides information to evaluate Measure 1.4.1.

- The distribution of incident responders, based on their rating of motor carrier compliance with HazMat regulations is given below:

Motor Carrier **Compliance**	Frequency	Percent
1. Satisfactory	0	0.0
2. Above Average	2	8.3
3 Average	17	70.8
4. Below Average	2	8.3
5. Unsatisfactory	2	a.3
No response	1	4.2
Total	24	100.0

- The descriptive summary of the survey responses is given below.

Descriptive Statistics

Mean	3.1739	Std Err	.1495	Min	2.0000	Skewness	1.3491
Median	3.0000	Variance	.5138	Max	*5.0000*	S E Skew	.4813
5% Trim	3.1377	Std Dev	.7168	Range	3.0000	Kurtosis	2.6485
95% CI for Mean (2.8639, 3.4839)							

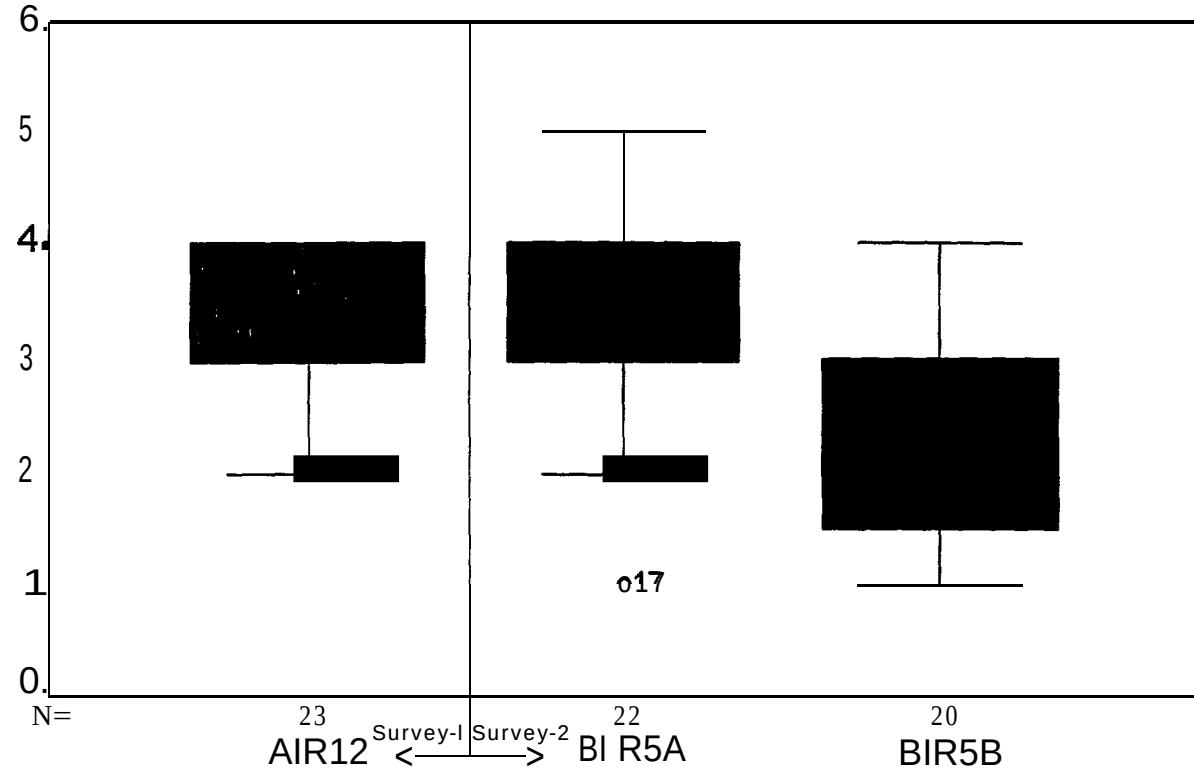
- Twenty three (95.8 percent) participants answered this question during the survey. The mean rating is 3.2. The median rating is 3.0. A total of nineteen participants (79.2 percent) rated the motor carrier compliance as average.

- The mean ratings suggest that the incident responders perceive an average compliance of HazMat regulations by motor carriers.

Effectiveness of the systems in assuring motor carrier compliance with HazMat regulations

- This question corresponds to Measure 1.4.1.
- The descriptive summary is given in Figure 4-2 1.
- Twenty-three participants answered this question during the first survey by rating the existing/current system. The mean rating is 3.2. The median rating is 3.0.
- Twenty-two participants rated the existing system in the second survey by responding to this question. The mean rating is 3.1. The median rating is 3.0.
- Twenty participants rated Tranzit ***XPress*** in the second survey by responding to this question. The mean rating is 2.3. The median rating is 2.0.
- The mean ratings suggest that after the Tranzit ***XPress*** system demonstration the participants changed their perception of the existing system by giving it a slightly better rating. The medians show no change confirmed also by the marginal homogeneity test p-value of 0.37 1.
- Tranzit ***XPress*** is perceived to be better than the existing system when compared with the existing system rating obtained before the system demonstration (p-value 0.009).
- Tranzit ***XPress*** is also perceived to be better than the existing system when compared with the existing system rating obtained after the system demonstration (p-value 0.016) but with a lower significance.

Figure 4-2 1
Effectiveness of the systems in assuring motor carrier compliance with HazMat regulations



AIR12 Existing System (Survey-1)
Valid cases: 23.0 Missing cases: 1.0 Percent missing: 4.2

Mean	3.2174	Std Err	.1251	Min	2.0000	Skewness	-.0916
Median	3.0000	Variance	.3597	Max	4.0000	S E Skew	.4813
5% Trim	3.2415	Std Dev	.5997	Range	2.0000	Kurtosis	-.2016
95% CI for Mean (2.9580, 3.4767)				IQR	1.0000	S E Kurt	.9348

BIR5A Existing System (Survey-2)
Valid cases: 22.0 Missing cases: 2.0 Percent missing: 8.3

Mean	3.0909	Std Err	.1850	Min	1.0000	Skewness	-.1867
Median	3.0000	Variance	.7532	Max	5.0000	S E Skew	.4910
5% Trim	3.1010	Std Dev	.8679	Range	4.0000	Kurtosis	.9956
95% CI for Mean (2.7061, 3.4757)				IQR	1.0000	S E Kurt	.9528

BIR5B Tranzit *XPress* (Survey-1)
Valid cases: 20.0 Missing cases: 4.0 Percent missing: 16.7

Mean	2.3000	Std Err	.2188	Min	1.0000	Skewness	.0674
Median	2.0000	Variance	.9579	Max	4.0000	S E Skew	.5121
5% Trim	2.2778	Std Dev	.9787	Range	3.0000	Kurtosis	-.9637
95% CI for Mean (1.8419, 2.7581)				IQR	1.7500	S E Kurt	.9924

Effectiveness of Tranzit XPress in providing information through links with other systems

- This question corresponds to Measure 1.5.1.

- The distribution of incident responders, based on their rating of the effectiveness of the Tranzit ***XPress*** system in providing information through links with other systems is given below:

Information Through Links With Other Systems	**Frequency**	Percent
1. Very Effective	4	16.7
2. Effective	8	33.3
3. Average	3	12.5
4. Ineffective	2	8.3
5. Very Ineffective	0	0.0
No response	7	29.2
Total	24	100.0

- The descriptive summary of the survey responses is given below.

Descriptive Statistics

Mean	2.1765	Std Err	.2307	Min	1.0000	Skewness	.5967
Median	2.0000	Variance	.9044	Max	4.0000	S E Skew	.5497
5% Trim	2.1405	Std Dev	.9510	Range	3.0000	Kurtosis	-.1872
95% CI for Mean (1.6875, 2.6654)							

- Seventeen (70.8 percent) participants answered this question during the survey. The mean rating is 2.2. The median rating is 2.0. A total of fifteen participants (62.5 percent) rated the effectiveness of the Tranzit ***XPress*** system as average or better.

- The Tranzit ***XPress*** system is perceived by the participants to be effective in providing information through links with other systems.

Intention to use the Tranzit XPress system

. This question corresponds to Measure 2.3.1.

. The distribution of incident responders, based on their intention of using the Tranzit ***XPress*** system is given below:

Intention to use Tranzit XPress	Frequency	Percent
0. No	4	16.7
1. Yes	12	50.0
Cannot decide	2	8.3
No response	6	25.0
Total	24	100.0

. The descriptive summary of the survey responses is given below.

Descriptive Statistics

Mean	.7500	Std Err	.1118	Min	.0000	Skewness	-1.2778
Median	1.0000	Variance	.2000	Max	1.0000	S E Skew	.5643
5% Trim	.7778	Std Dev	.4472	Range	1.0000	Kurtosis	· .4396
95% CI for Mean	(.5117, .9883)						

. Eighteen (75.0 percent) participants answered this question during the survey. The mean rating is 0.8. The median rating is 1 .O. A total of twelve participants (50.0 percent) expressed their intention to use the Tranzit ***XPress*** system.

. The Tranzit ***XPress*** system is perceived as beneficial by the incident responders.

Intention to use individual components of the Tranzit XPress system

- This question corresponds to Measure 2.4.1.

- The distribution of incident responders, based on their intention of using individual components of the Tranzit ***XPress*** system is given below:

Intention to use Tranzit *XPress*	**Frequency**	**Percent**
0. No	**1**	4.2
1. Yes	10	41.7
Cannot decide	5	20.8
No response	8	33.3
Total	24	100.0

- The descriptive summary of the survey responses is given below.

Descriptive Statistics

Mean	.9091	Std Err	.0909	Min	.0000	Skewness	-3.3166
Median	1.0000	Variance	.0909	Max	1.0000	S E Skew	.6607
5% Trim	.9545	Std Dev	.3015	Range	1.0000	Kurtosis	11.0000
95% CI for Mean (.7065, 1.1116)							

- Sixteen (66.7 percent) participants answered this question during the survey. The mean rating is 0.9. The median rating is 1 .O. A total of ten participants (4 1.7 percent) expressed their intention to use individual components of the Tranzit ***XPress*** system.

- Individual components of the Tranzit ***XPress*** system are perceived as beneficial by the incident responders.

Rating of HazMat systems with respect to the accessibility of information which facilitates incident response

- This question corresponds to Measure 2.5.1.
- The descriptive summary is given in Figure 4-22.
- The main HazMat systems considered by the incident responders with respect to the accessibility of information are CAMEO, CHEMTREC, DOT Handbooks. Other systems included 911, Emergency Response Guide, HazMat teams, shipping papers etc.
- The mean ratings suggest that after the Tranzit ***XPress*** system demonstration the participants changed their perception of most of the existing systems by giving them a slightly poorer rating in the second survey.
- Most of the existing HazMat systems are perceived to be better than Tranzit ***XPress*** when compared with the existing systems' ratings obtained before the system demonstration.
- Tranzit ***XPress*** is perceived to be better than the existing system when compared with the existing systems' ratings obtained after the system demonstration.
- Due to smaller number of responses for each existing system the analysis is not statistically significant, but can be used to get an understanding of the trend in the ratings of HazMat systems.

Rating of HazMat systems with respect to the usefulness of information which facilitates incident response

- This question corresponds to Measure 2.5.1.
- The descriptive summary is given in Figure 4-22.
- The main HazMat systems considered by the incident responders with respect to the usefulness of information are CAMEO, CHEMTREC, DOT Handbooks. Other systems included 9 11, Emergency Response Guide, HazMat teams, shipping papers etc.
- The mean ratings suggest that after the Tranzit ***XPress*** system demonstration the participants changed their perception of most of the existing systems by giving them a slightly poorer rating in the second survey.
- Most of the existing HazMat systems are perceived to be better than Tranzit ***XPress*** when compared with the existing system ratings obtained before the system demonstration.
- Tranzit ***XPress*** is perceived to be better than the existing system (except CAMEO) when compared with the existing systems' ratings obtained after the system demonstration.
- Due to smaller number of responses for each existing system the analysis is not statistically significant, but can be used to get an understanding of the trend in the ratings of HazMat systems.

Figure 4-22
HazMat System Rating by Incident Responders
(With Respect to Information That Facilitates Incident Responses)

HazMat Systems and Services	Survey	Total Responses	System Rating					
			1 (Very Effective)	2 (Effective)	3 (Average)	4 (Ineffective)	5 (Very Ineffective)	Mean Rating
Accessibility of Information								
911	1	2		1	1			2.50
	2	0						-
CAMEO	1	3	2		1			1.67
	2	3	1	1	1			2.00
CHEMTREC	1	11	3	4	3	1		2.18
	2	5		1	4			2.80
DOT Handbooks	1	6	3	1	1	1		2.00
	2	1			1			3.00
Emergency Response Guide	1	3	1	1	1			2.00
	2	2			2			3.00
HazMat Teams	1	2	1	1				1.50
	2	0						-
Placard	1	0						-
	2	0						-
Shipping Papers	1	3		1		2		3.33
	2	2		1		1		3.00
Other Existing HazMat Systems	1	10	3	1	3	3		2.60
	2	1		1				2.00
Tranzit XPress	*2*	*19*	*4*	*7*	*5*	*1*	*2*	*2.47*
Usefulness of Information								
911	1	2		2				2.00
	2	0						-
CAMEO	1	3	2		1			1.67
	2	3	1	1	1			2.00
CHEMTREC	1	12	2	6	3	1		2.25
	2	5		2	3			2.60
DOT Handbooks	1	6	1	1	4			2.50
	2	1		1				2.00
Emergency Response Guide	1	3		2	1			2.33
	2	2		1	1			2.50
HazMat Teams	1	2		1	1			2.50
	2	0						-
Placard	1	0						-
	2	0						-
Shipping Papers	1	3			2	1		3.33
	2	2	1			1		2.50
Other Existing HazMat Systems	1	9	5	2	1		1	1.89
	2	3		1	1	1		3.00
Tranzit XPress	*2*	*18*	*9*	*4*	*3*	*2*		*1.89*
Accuracy of Information								
911	1	2		1	1			2.50
	2	0						-
CAMEO	1	3	2		1			1.67
	2	3	1	1	1			2.00
CHEMTREC	1	11	3	6	2			1.91
	2	5	1	1	3			2.40
DOT Handbooks	1	5			4	1		3.20
	2	1			1			3.00
Emergency Response Guide	1	3	1	1	1			2.00
	2	2			2			3.00
HazMat Teams	1	2		2				2.00
	2	0						-
Placard	1	0						-
	2	0						-
Shipping Papers	1	3			2	1		3.33
	2	2		1		1		3.00
Other Existing HazMat Systems	1	8	5		2		1	2.00
	2	2		1	1			2.50
Tranzit XPress	*2*	*18*	*8*	*6*	*3*	*1*		*1.83*

Rating of HazMat systems with respect to the accuracy of information which facilitates incident response

- This question corresponds to Measure 2.5.1.
- The descriptive summary is given in Figure 4-22.
- The main HazMat systems considered by the incident responders with respect to accessibility of information are CAMEO, CHEMTREC, DOT Handbooks. Other systems included 911, Emergency Response Guide, HazMat teams, shipping papers etc.
- The mean ratings suggest that after the Tranzit ***XPress*** system demonstration the participants changed their perception of most of the existing systems by giving them a slightly poorer rating in the second survey.
- Tranzit ***XPress*** is perceived to be better than most of the existing systems, when compared with the existing system ratings obtained before the system demonstration.
- Tranzit ***XPress*** is perceived to be better than the existing system when compared with the existing systems' rating obtained after the system demonstration.
- Due to smaller number of responses for each existing system the analysis is not statistically significant, but can be used to get an understanding of the trend in the ratings of HazMat systems.

4.2.2.3. Motor Carriers

This section provides a brief discussion of the responses of motor carrier participants to different survey questions.

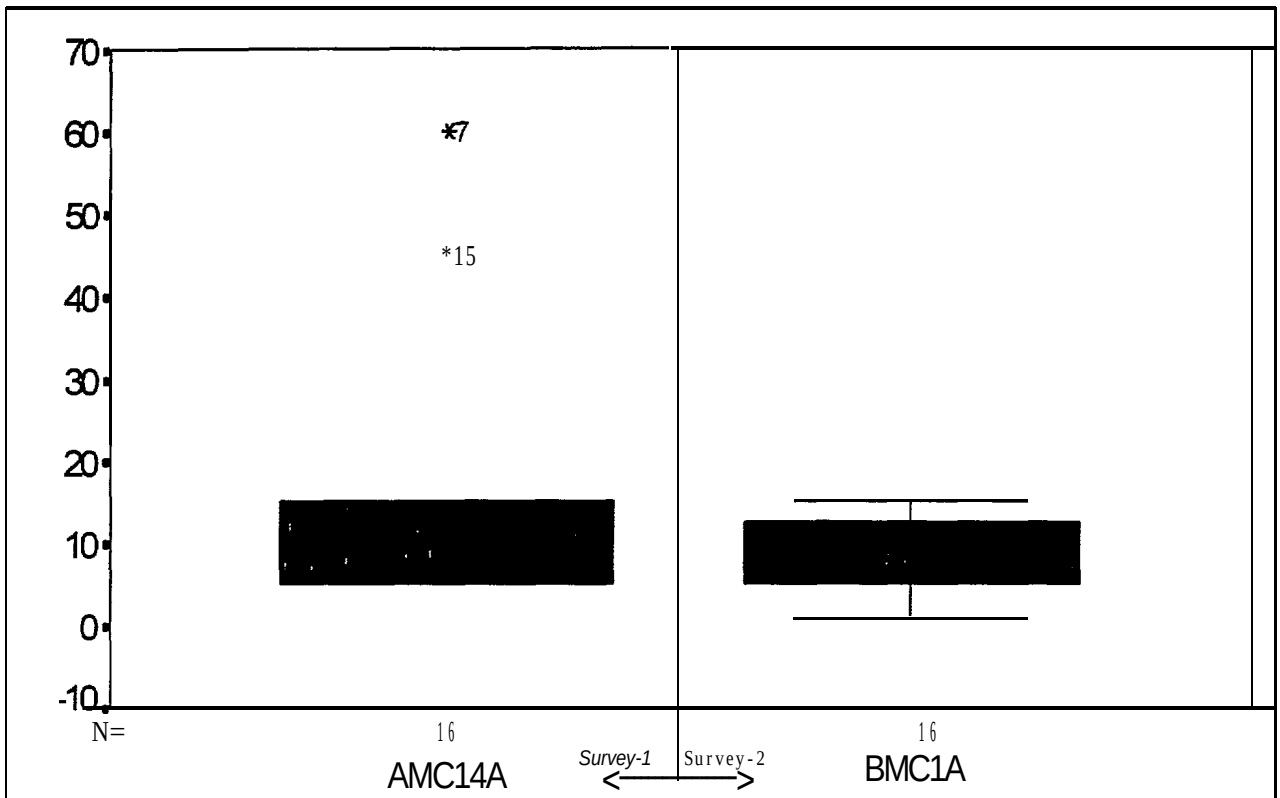
Time typically requiredfor the vehicle operator to realize that a problem exists

- This question corresponds to Measure 1.1.1 and Measure 1.1.2.
- The descriptive summary is given in Figure 4-23.
- Sixteen participants answered this question during the first survey. The mean value obtained from their responses is 14.9 minutes.
- Sixteen participants responded to the question in the second survey. The mean value obtained from their responses is 7.8 minutes.
- A decrease of 7.1 minutes in the mean time is perceived through the use of Tranzit ***XPress.*** The medians also show a decrease of 3.7 minutes. When applying the Wilcoxon test, however, this difference is not significant at the 5% level (z score 2.003 and p-value of 0.03 1).

Time typically requiredfor the vehicle operator to call 911 or other emergency number

- This question corresponds to Measure 1.1.1 and Measure 1.1.2.
- The descriptive summary is given in Figure 4-24.
- Sixteen participants answered this question during the first survey. The mean value obtained from their responses is 16.3 minutes.
- Twenty-two participants responded to the question in the second survey. The mean value obtained from their responses is 4.0 minutes.
- A decrease of 12.3 minutes in the mean time is perceived through the use of Tranzit ***XPress.*** The medians also show a decrease of 9.5 minutes. This improvement is confirmed by the Wilcoxon z-score equal to 2.941 and a p-value equal 0.00 1.

Figure 4-23
Time typically required for the vehicle operator to realize that a problem exists



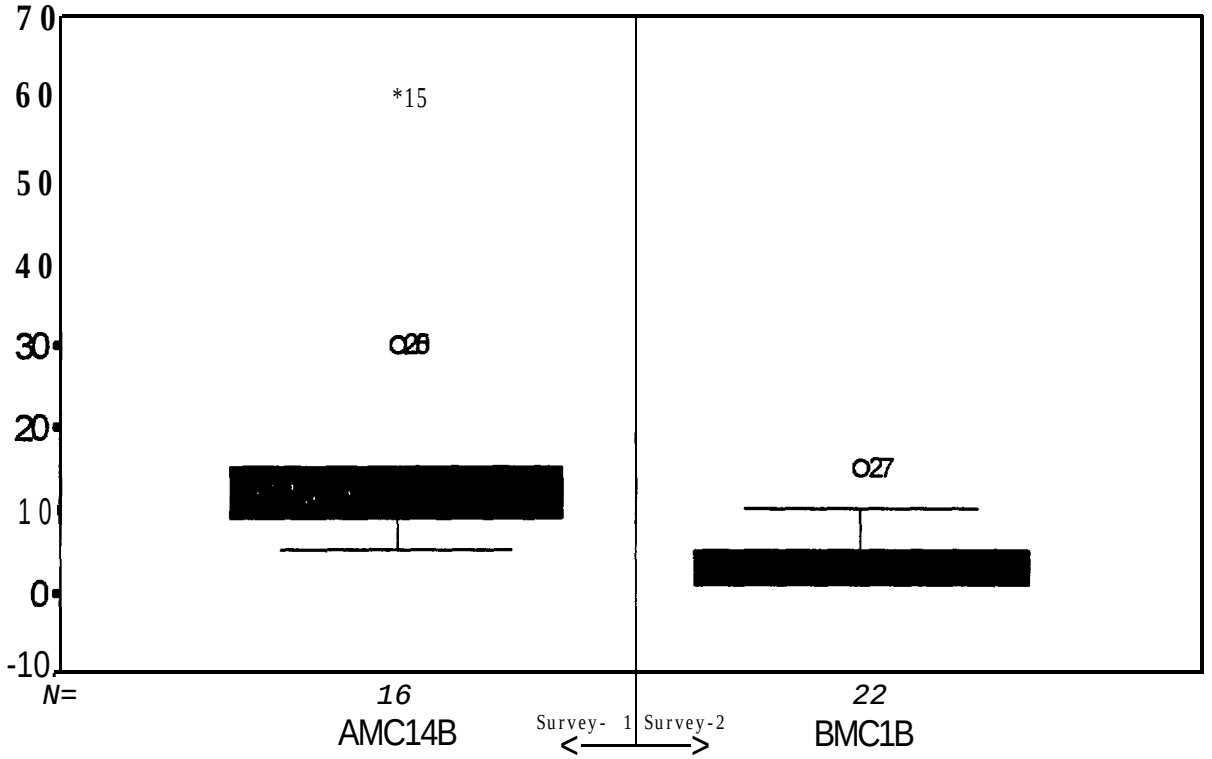
AMCllA Existing System (Survey-l)

Valid cases:	16.0	Missing cases:	12 0	Percent missing	42.9		
Mean	14.8750	Std Err	3.8857	Min	5.0000	Skewness	2.2907
Median	10.0000	Variance	241.5833	Max	60.0000	S E Skew	.5643
5% Trim	12.9167	Std Dev	15.5430	Range	55.0000	Kurtosis	4.8788
95% CI for Mean (6.5927, 23.1573)				IQR	10.0000	S E Kurt	1.0908

BMClA Tranzit *XPress* (Survey-1)

Valid cases:	16.0	Missing cases:	12 0	Percent missing	42.9		
Mean	7.8438	Std Err	1.2908	Min	1.0000	Skewness	.2322
Median	6.2500	Variance	26.6573	Max	15.0000	S E Skew	.5643
5% Trim	7.8264	Std Dev	5.1631	Range	14.0000	Kurtosis	-1.2602
95% CI for Mean (5.0925, 10.5950)				IQR	8.7500	S E Kurt	1.0908

Figure 4-24
Time typically required for the vehicle operator to call 911 or other emergency number



AMC14B Existing System (Survey-l)
Valid cases: 16.0 Missing cases: 12.0 Percent missing: 42.9

Mean	16.2500	Std Err	3.4659	Min	5.0000	Skewness	2.3815
Median	13.5000	Variance	192.2000	Max	60.0000	S E Skew	.5643
5% Trim	14.4444	Std Dev	13.8636	Range	55.0000	Kurtosis	6.5206
95% CI for Mean (8.8626, 23.6374)				IQR	6.5000	S E Kurt	1.0908

BMClB Tranzit ***XPress*** (Survey-2)
Valid cases: 22.0 Missing cases: 6.0 Percent missing: 21.4

Mean	4.0000	Std Err	.7950	Min	1.0000	Skewness	1.5154
Median	4.0000	Variance	13.9048	Max	15.0000	S E Skew	.4910
5% Trim	3.5808	Std Dev	3.7289	Range	14.0000	Kurtosis	2.4387
95% CI for Mean (2.3467, 5.6533)				IQR	4.0000	S E Kurt	.9528

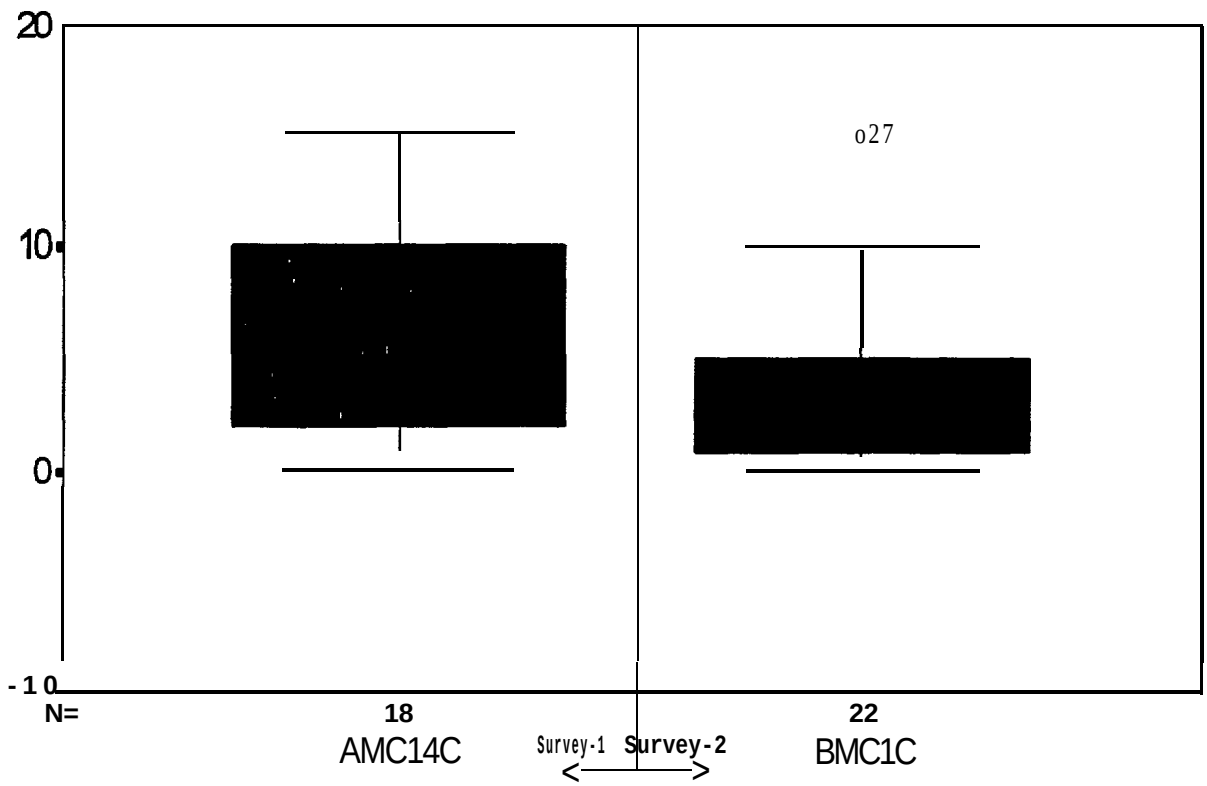
Time typically required for the vehicle operator to properly identify vehicle location

- This question corresponds to Measure 1.1.1 and Measure 1.1.2.
- The descriptive summary is given in Figure 4-25.
- Eighteen participants answered this question during the first survey. The mean value obtained from their responses is 5.8 minutes.
- Twenty-two participants responded to the question in the second survey. The mean value obtained from their responses is 3.6 minutes.
- A decrease of 2.2 minutes in the mean time is perceived through the use of Tranzit ***XPress.*** The medians also show a decrease of 4.0 minutes, however, the Wilcoxon test shows no significant improvement (z-score= 1.26 1, and P-value=0.240).

Time typically requiredfor the first responder to reach the incident site

- This question corresponds to Measure l.l.1 and Measure l.1.2.
- The descriptive summary is given in Figure 4-26.
- Fourteen participants answered this question during the first survey. The mean value obtained from their responses is 20.4 minutes.
- Thirteen participants responded to the question in the second survey. The mean value obtained from their responses is 17.4 minutes.
- A decrease of 3.0 minutes in the mean time is perceived through the use of Tranzit ***XPress.*** The medians also show a decrease of 1.5 minutes, which again based on the indications of the Wilcoxon are not significant (z-score=l.604, and p-value=0.250).

Figure 4-25
Time typically required for the vehicle operator to properly identify vehicle location



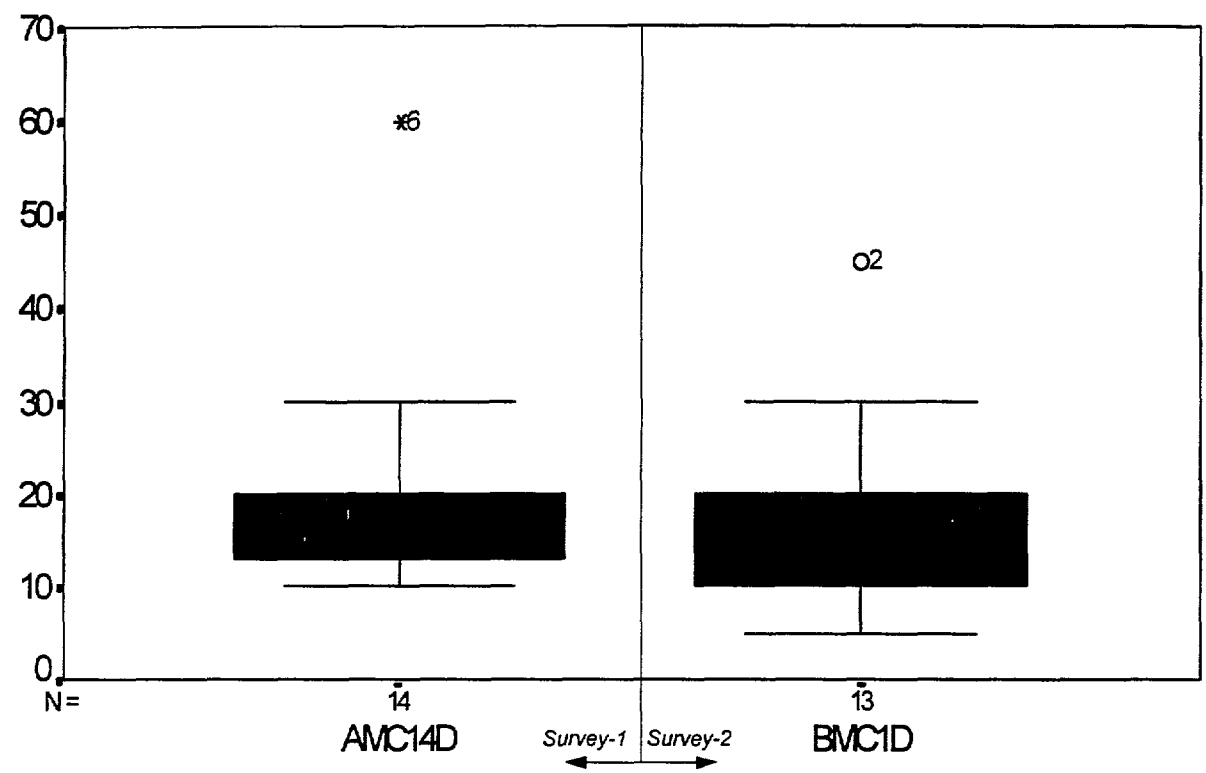
AMC14C Existing System (Survey-l)
Valid cases: 18.0 Missing cases: 10.0 Percent missing: 35.7

Mean	5.8333	Std Err	1.1268	Min	.OOOO	Skewness	.7737
Median	5.0000	Variance	22.8529	Max	15.0000	S E Skew	.5363
5% Trim	5.6481	Std Dev	4.7805	Range	15.0000	Kurtosis	-.5136
95% CI for Mean (3.4561, 8.2106)				IQR	8.0000	S E Kurt	1.0378

BMClC Tranzit ***XPress*** (Survey-2)
Valid cases: 22.0 Missing cases: 6.0 Percent missing: 21.4

Mean	3.5909	Std Err	.8209	Min	.OOOO	Skewness	1.6432
Median	1.0000	Variance	14.8247	Max	15.0000	S E Skew	.4910
5% Trim	3.1768	Std Dev	3.8503	Range	15.0000	Kurtosis	2.5785
95% CI for Mean (1.8838, 5.2980)				IQR	4.0000	S E Kurt	.9528

Figure 4-26
Time typically required for the first responder to reach the incident site



AMC14D Existing System (Survey-1)

Valid cases:	14.0	Missing cases:	14.0	Percent missing:	50.0		
Mean	20.4286	Std Err	3.4968	Min	10.0000	Skewness	2.3805
Median	16.5000	Variance	171.1868	Max	60.0000	S E Skew	.5974
5% Trim	18.8095	Std Dev	13.0838	Range	50.0000	Kurtosis	6.6408
95% CI for Mean	(12.8742, 27.9830)			IQR	10.2500	S E Kurt	1.1541

BMC1D Tranzit *XPress* (Survey-2)

Valid cases:	13.0	Missing cases:	15.0	Percent missing:	53.6		
Mean	17.3462	Std Err	2.9566	Min	5.0000	Skewness	1.6074
Median	15.0000	Variance	113.6410	Max	45.0000	S E Skew	.6163
5% Trim	16.4957	Std Dev	10.6603	Range	40.0000	Kurtosis	2.9757
95% CI for Mean	(10.9042, 23.7881)			IQR	11.2500	S E Kurt	1.1909

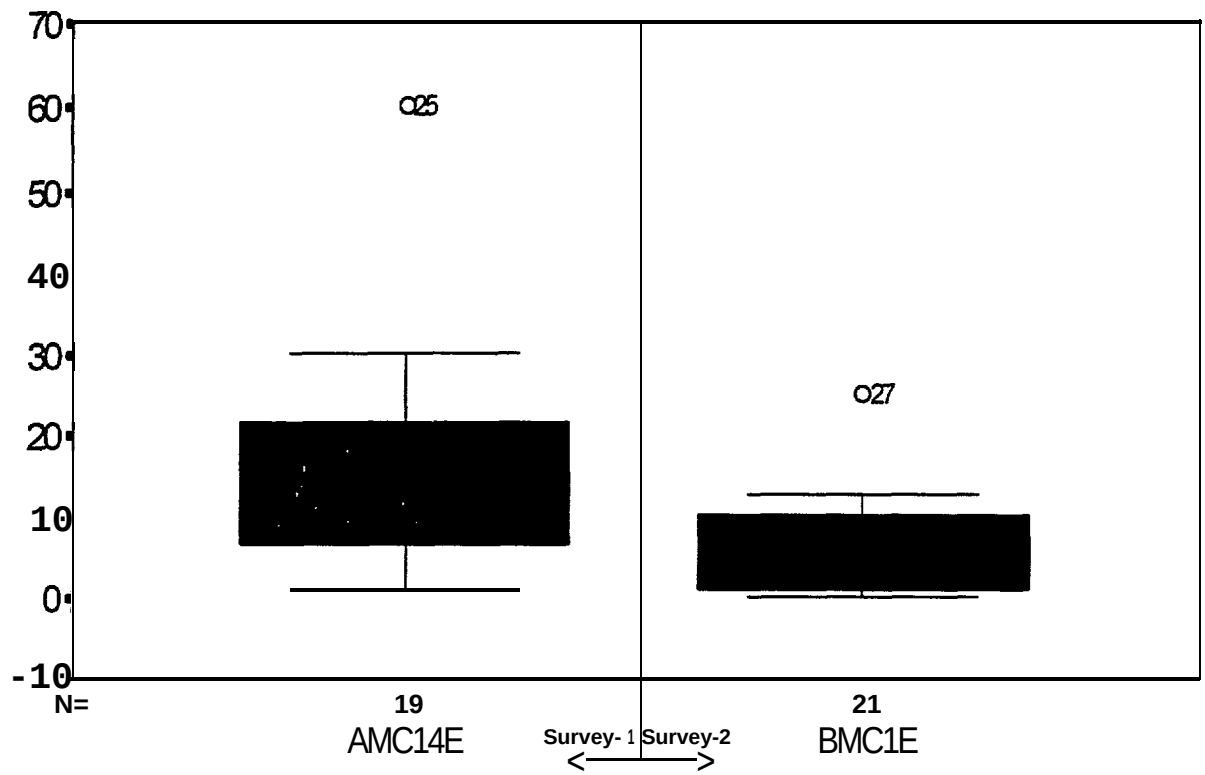
Time typically requiredfor the cargo recognition and identification by first responder

- This question corresponds to Measure 1.1.1 and Measure 1.1.2.
- The descriptive summary is given in Figure 4-27.
- Nineteen participants answered this question during the first survey. The mean value obtained from their responses is 15.5 minutes.
- Twenty-one participants responded to the question in the second survey. The mean value obtained from their responses is 5.6 minutes.
- A decrease of 9.9 minutes in the mean time is perceived through the use of Tranzit ***XPress.*** The medians also show a decrease 5.0 of minutes. This perceived improvement is confirmed by the Wilcoxon test, which yields a z-score of 2.444 and a p-value of 0.012.

Time typically required for the notification of fire department/rescue squad

- This question corresponds to Measure 1.1.1 and Measure 1.1.2.
- The descriptive summary is given in Figure 4-28.
- Fifteen participants answered this question during the first survey. The mean value obtained from their responses is 11.6 minutes.
- Twenty-one participants responded to the question in the second survey. The mean value obtained from their responses is 4.9 minutes.
- A decrease of 4.7 minutes in the mean time is perceived through the use of Tranzit ***XPress.*** The medians also show a decrease of 5.0 minutes. The Wilcoxon is not in agreement with this trend with z-score 1.936 and a p-value 0.065, which is slightly higher than the usual 5%.

Figure 4-27
Time typically required for the cargo recognition and identification by first responder



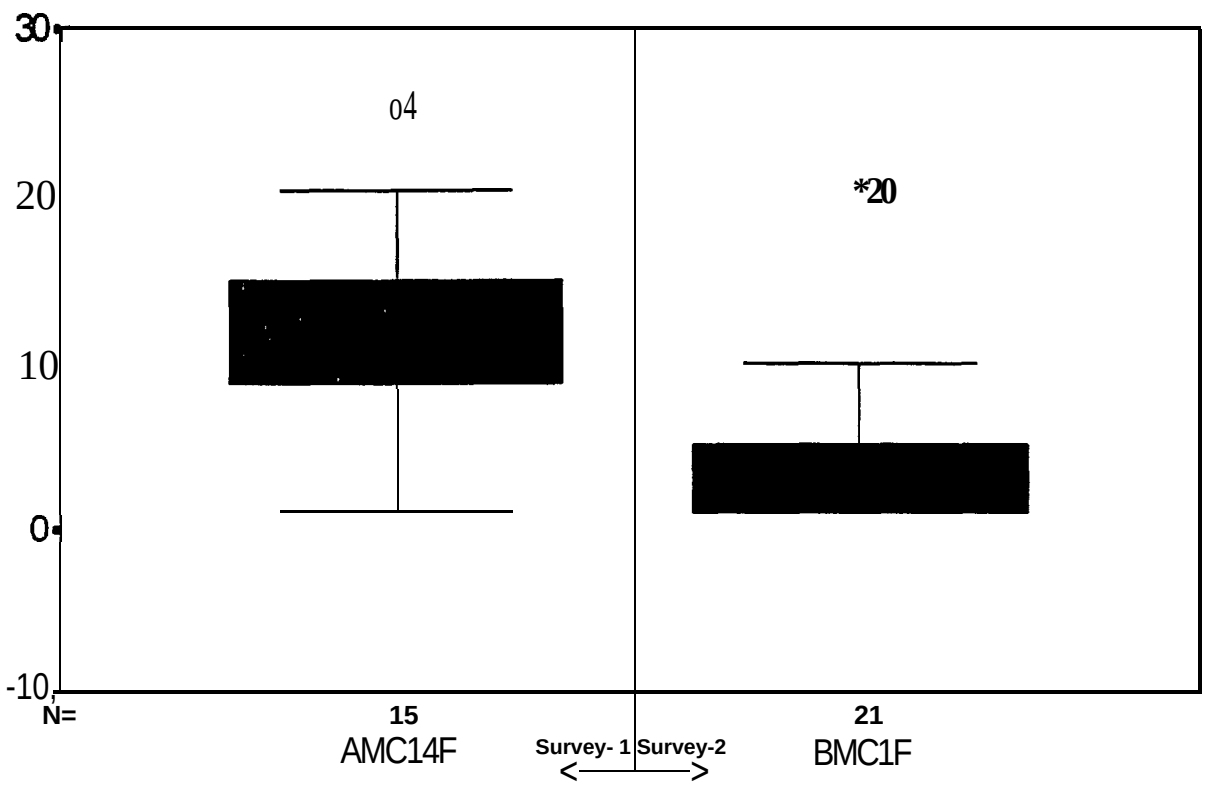
AMC14E **Existing** System (Survey-l)

Valid cases:	19.0	Missing cases:	9.0	Percent missing:	32.1		
Mean	15.5263	Std Err	3.1774	Min	1.0000	Skewness	2.0130
Median	10.0000	Variance	191.8187	Max	60.0000	S E Skew	.5238
5% Trim	13.8626	Std Dev	13.8499	Range	59.0000	Kurtosis	5.1072
95% CI for Mean	(8.8509, 22.2017)			IQR	18.0000	S E Kurt	1.0143

BMClE Tranzit ***XPress*** (Survey-2)

Valid cases:	21.0	Missing cases:	7.0	Percent missing:	25.0		
Mean	5.5476	Std Err	1.3038	Min	.0000	Skewness	1.8514
Median	5.0000	Variance	35.6976	Max	25.0000	S E Skew	.5012
5% Trim	4.8056	Std Dev	5.9747	Range	25.0000	Kurtosis	4.5152
95% CI for Mean	(2.8279, 8.2673)			IQR	9.0000	S E Kurt	.9719

Figure 4-28
Time typically required for the notification of fire department / rescue squad



AMC14F Existing System (Survey-l)
Valid cases: 15.0 Missing cases: 13.0 Percent missing: 46.4

Mean	11.6000	Std Err	1.6498	Min	1.0000	Skewness	.5790
Median	10.0000	Variance	40.8286	Max	25.0000	S E Skew	.5801
5% Trim	11.4444	Std Dev	6.3897	Range	24.0000	Kurtosis	.1263
95% CI for Mean (8.0615, 15.1385)				IQR	7.0000	S E Kurt	1.1209

BMClF Tranzit ***XPress*** *(Survey-2)*
Valid cases: 21.0 Missing cases: 7.0 Percent missing: 25.0

Mean	4.9286	Std Err	1.0214	Min	1.0000	Skewness	1.7999
Median	5.0000	Variance	21.9071	Max	20.0000	S E Skew	.5012
5% Trim	4.3360	Std Dev	4.6805	Range	19.0000	Kurtosis	4.3084
95% CI for Mean (2.7980, 7.0591)				IQR	5.2500	S E Kurt	.9719

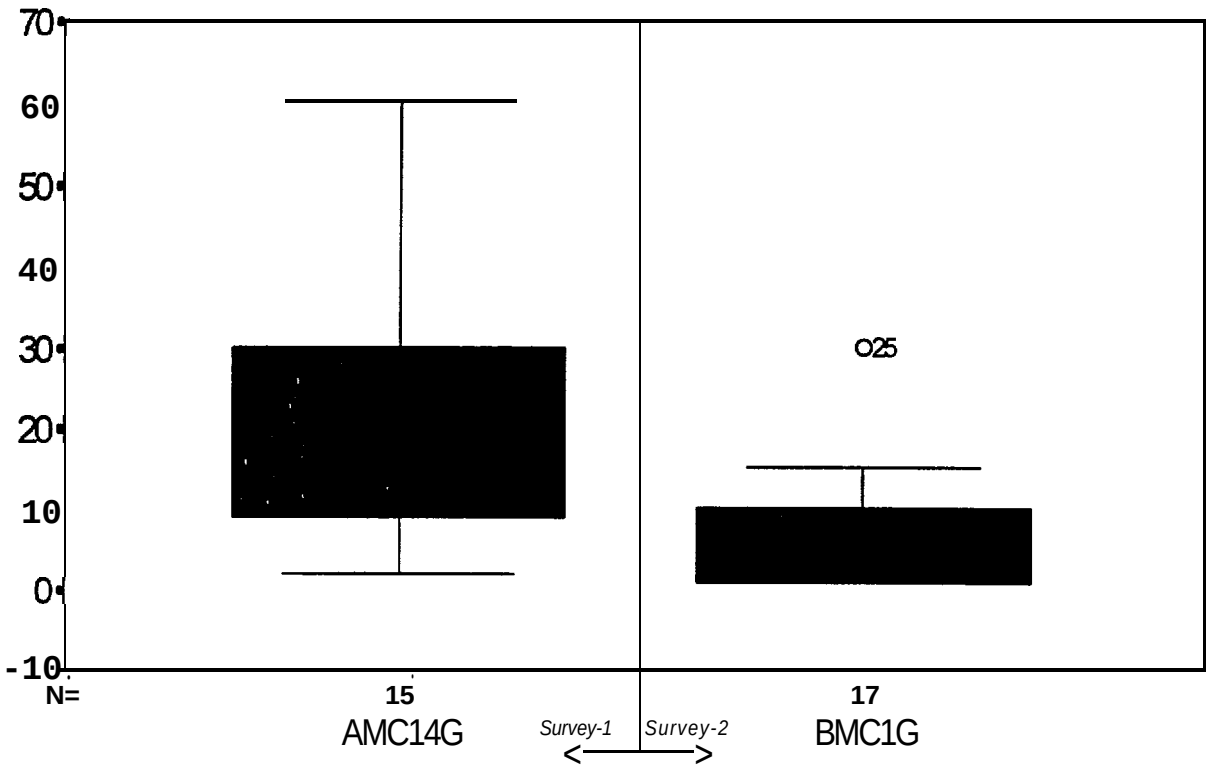
Time typically requiredfor the notification of HazMat team and/or emergency management agency

- This question corresponds to Measure 1.1.1 and Measure 1.1.2.
- The descriptive summary is given in Figure 4-29.
- Fifteen participants answered this question during the first survey. The mean value obtained from their responses is 20.7 minutes.
- Seventeen participants responded to the question in the second survey. The mean value obtained from their responses is 7.3 minutes.
- A decrease of 13.4 minutes in the mean time is perceived through the use of Tranzit ***XPress.*** The medians also show a decrease of 10.0 minutes. The Wilcoxon test confirms this tendency with z-score of 2.201 and p-value of 0.03 1.

Time typically requiredfor the determination of what equipment is needed (including additional crews)

- This question corresponds to Measure 1.1.1 and Measure 1.1.2.
- The descriptive summary is given in Figure 4-30.
- Thirteen participants answered this question during the first survey. The mean value obtained from their responses is 33.3 minutes.
- Sixteen participants responded to the question in the second survey. The mean value obtained from their responses is 20.1 minutes.
- A decrease of 13.2 minutes in the mean time is perceived through the use of Tranzit ***XPress.*** The medians also show a decrease of 16.3 minutes. However, the Wilcoxon contradicts this with a z-score 1.3 8 1 and a p-value 0.186.

Figure 4-29
Time typically required for the notification of HazMat team and/or emergency management agency



AMC14G Existing System (Survey-l)

Valid cases: 15.0 Missing cases: 13.0 Percent missing: *46.4*

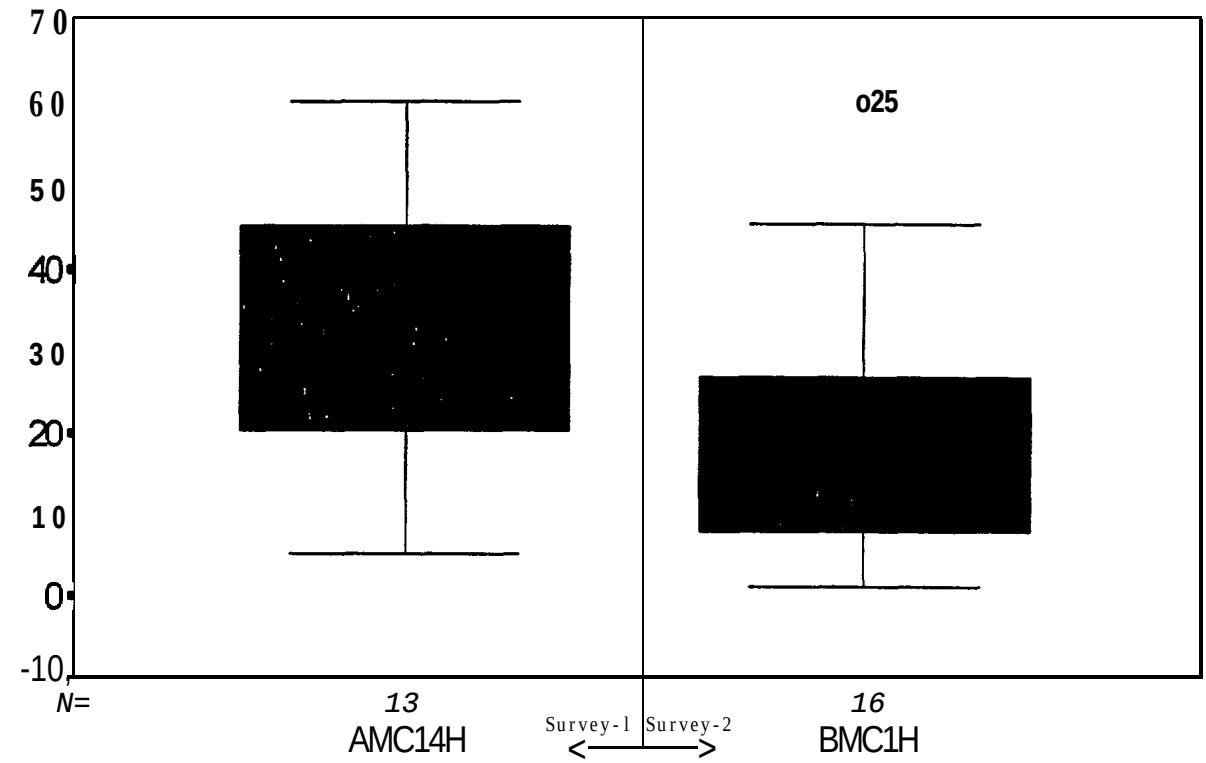
Mean	20.6667	Std Err	4.0304	Min	*2.0000*	Skewness	*1.1400*
Median	15.0000	Variance	*243.6667*	Max	*60.0000*	S E Skew	*.5801*
5% Trim	19.5185	Std Dev	15.6098	Range	58.0000	Kurtosis	*1.4872*
95% CI for Mean	(12.0222, 29.3111)			IQR	22.0000	S E Kurt	1.1209

BMClG Tranzit ***XPress*** (Survey-2)

Valid cases: 17.0 Missing cases: 11.0 Percent missing: 39.3

Mean	7.3235	Std Err	1.8505	Min	1.0000	Skewness	1.7816
Median	5.0000	Variance	58.2169	Max	*30.0000*	S E Skew	.5497
5% Trim	*6.4150*	Std Dev	*7.6300*	Range	29.0000	Kurtosis	3.8986
95% CI for Mean	(3.4005, 11.2465)			IQR	10.0000	S E Kurt	*1.0632*

Figure 4-30
Time typically required for the determination of what equipment is needed (including additional crews)



AMC14H Existing System (Survey-l)

Valid cases:	13.0	Missing cases:	15.0	Percent missing:	53.6

Mean	33.3077	Std Err	4.4555	Min	5.0000
Median	30.0000	Variance	258.0641	Max	60.0000
5% Trim	33.3974	Std Dev	16.0644	Range	55.0000
95% CI for Mean	(23.6001, 43.0153)			IQR	25.0000

Skewness	.2717
S E Skew	.6163
Kurtosis	-.2218
S E Kurt	1.1909

BMClH Tranzit *XPress* (Survey-2)

Valid cases:	16.0	Missing cases:	12.0	Percent missing:	42.9

Mean	20.0938	Std Err	4.8197	Min	1.0000
Median	13.7500	Variance	371.6740	Max	60.0000
5% Trim	18.9375	Std Dev	19.2788	Range	59.0000
95% CI for Mean	(9.8208, 30.3667)			IQR	22.0000

Skewness	1.2438
S E Skew	.5643
Kurtosis	.5619
S E Kurt	1.0908

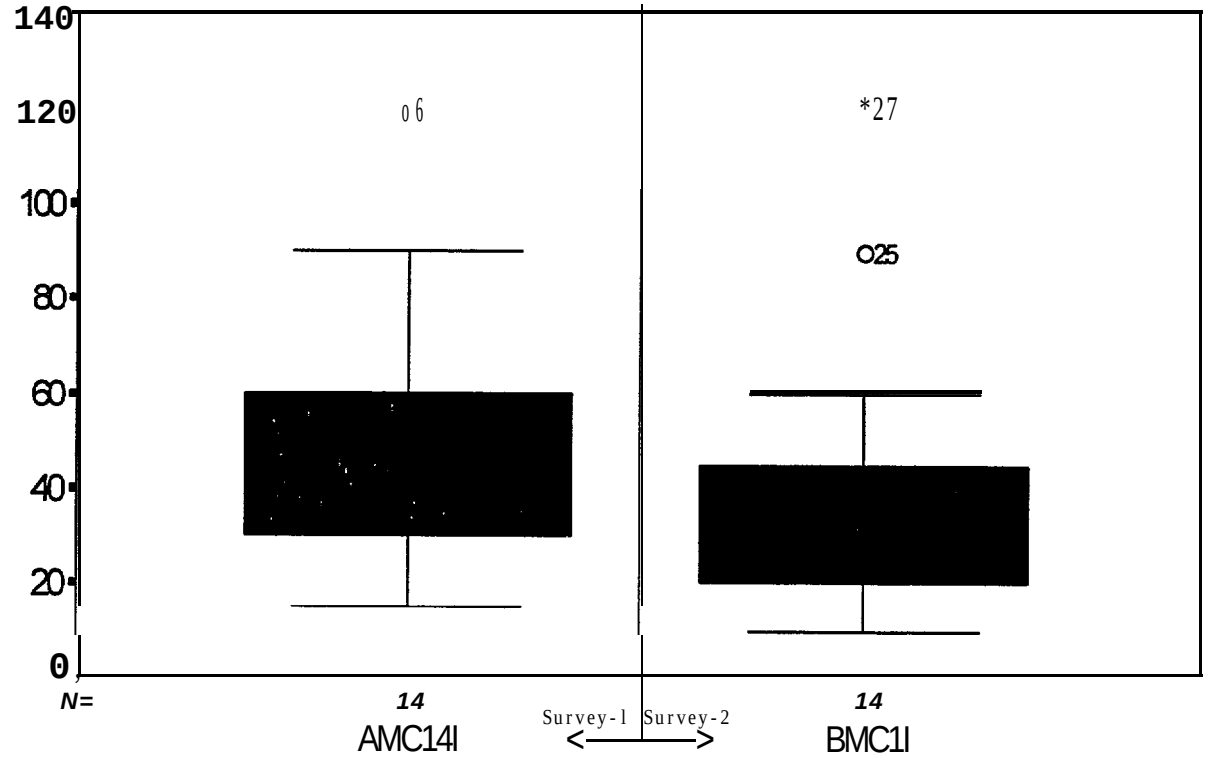
Time typically requiredfor the secondary responders to reach the site with proper equipment

- This question corresponds to Measure 1.1.1 and Measure 1.1.2.
- The descriptive summary is given in Figure 4-3 1.
- Fourteen participants answered this question during the first survey. The mean value obtained from their responses is 48.9 minutes.
- Fourteen participants responded to the question in the second survey. The mean value obtained from their responses is 42.3 minutes.
- A decrease of 6.6 minutes in the mean time is perceived through the use of Tranzit ***XPress.*** The medians also show a decrease of 5.0 minutes, which according to Wilcoxon test should not be considered a significant improvement (z-score 0.426, p-value=0.7 19).

Time typically requiredfor the passive containment and stabilization (e.g. fire department digging trenches)

- This question corresponds to Measure 1.1.1 and Measure 1.1.2.
- The descriptive summary is given in Figure 4-32.
- Fifteen participants answered this question during the first survey. The mean value obtained from their responses is 43.7 minutes.
- Sixteen participants responded to the question in the second survey. The mean value obtained from their responses is 32.0 minutes.
- A decrease of 11.7 minutes in the mean time is perceived through the use of Tranzit ***XPress.*** The medians also show a decrease of 15.0 minutes, which again seems to be at the border line of the usual significance levels (z-score 1.620, p-value=0. 109).

Figure 4-31
Time typically required for the secondary responders to reach the site with proper equipment



AMC14I Existing System (Survey-l)
Valid cases: 14.0 Missing cases: 14.0 Percent missing: 50.0

Mean	48.9286	Std Err	7.4712	Min	15.0000
Median	42.5000	Variance	781.4560	Max	120.0000
5% Trim	46.8651	Std Dev	27.9545	Range	105.0000
95% CI for Mean	(32.7881, 65.0690)			IQR	30.0000

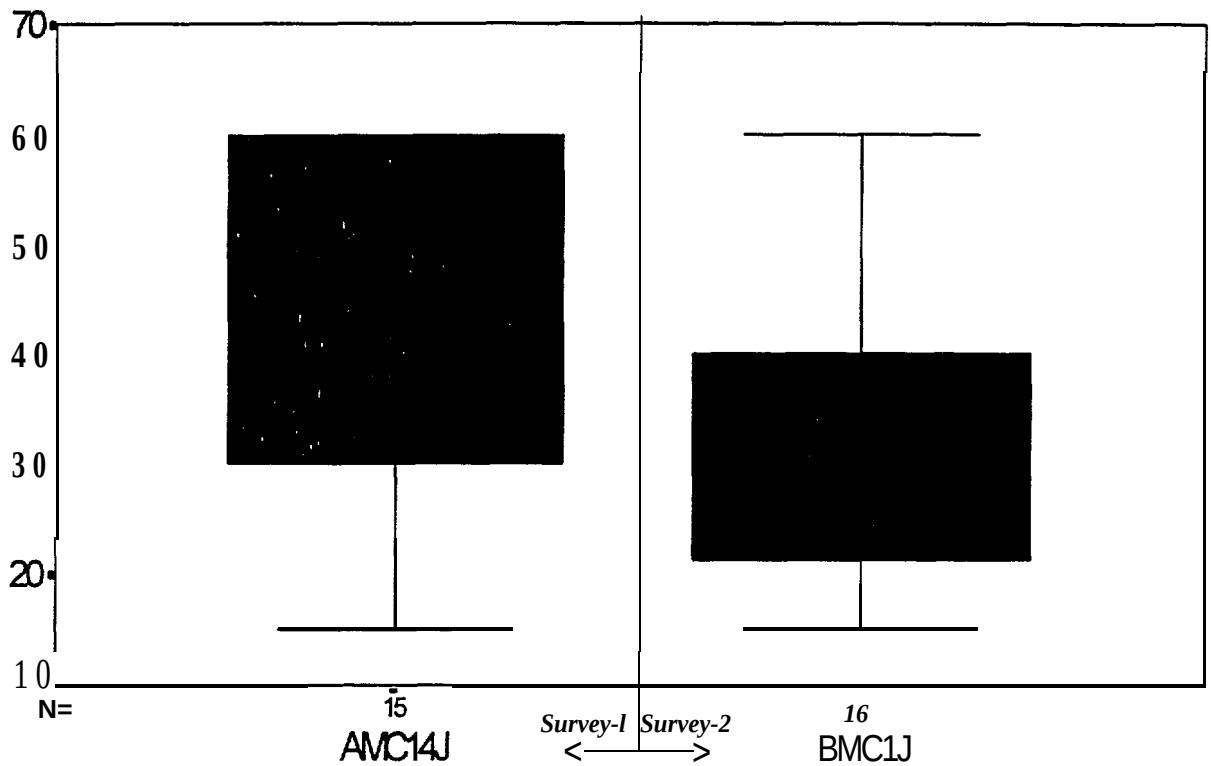
Skewness	1.4730
S E Skew	.5974
Kurtosis	2.2469
S E Kurt	1.1541

BMClI Tranzit ***XPress*** (Survey-2)
Valid cases: 14.0 Missing cases: 14.0 Percent missing: 50.0

Mean	42.3214	Std Err	8.2395	Min	10.0000
Median	37.5000	Variance	950.4464	Max	120.0000
5% Trim	39.8016	Std Dev	30.8293	Range	110.0000
95% CI for Mean	(24.5211, 60.1217)			IQR	29.3750

Skewness	1.4924
S E Skew	.5974
Kurtosis	2.1530
S E Kurt	1.1541

Figure 4-32
Time typically required for the passive containment and stabilization (e.g. fire department digging trenches)



AMC14J Existing System (Survey-l)

Valid cases:	15.0	Missing cases:	13.0	Percent missing:	*46.4*		
Mean	43.6667	Std Err	4.1250	Min	15.0000	Skewness	-.3723
Median	45.0000	Variance	*255.2381*	Max	*60.0000*	S E Skew	.5801
5% Trim	44.3519	Std Dev	15.9762	Range	45.0000	Kurtosis	-1.2034
95% CI for Mean (34.8194, 52.5140)				IQR	30.0000	S E Kurt	1.1209

BMClJ Tranzit ***XPress*** (Survey-2)

Valid cases:	*16.0*	Missing cases:	*12.0*	Percent missing:	42.9		
Mean	32.0313	Std Err	3.5592	Min	*15.0000*	Skewness	.8098
Median	30.0000	Variance	*202.6823*	Max	*60.0000*	S E Skew	.5643
5% Trim	*31.4236*	Std Dev	14.2367	Range	**45.0000**	Kurtosis	.0801
95% CI for Mean (24.4451, 39.6174)				IQR	21.8750	S E Kurt	1.0908

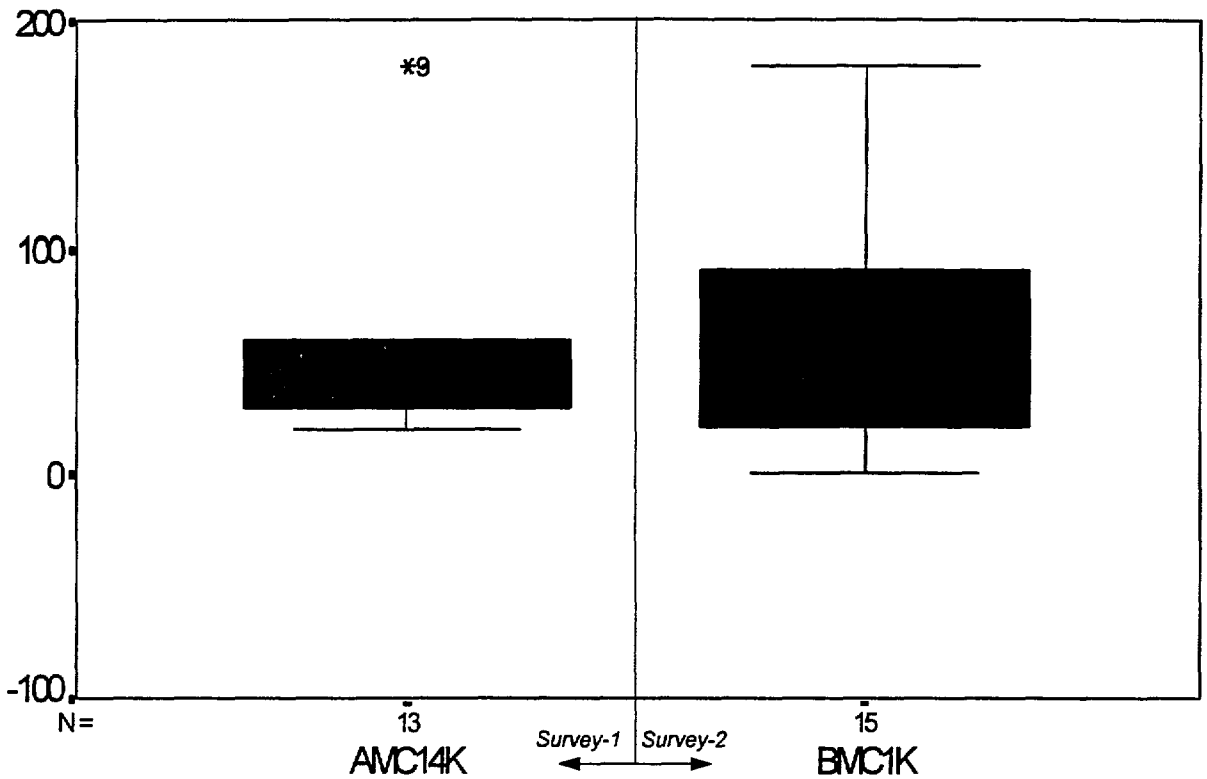
Time typically requiredfor the containment and stabilization by specialists (HazMat crews)

- This question corresponds to Measure 1.1.1 and Measure 1.1.2.
- The descriptive summary is given in Figure 4-33.
- Thirteen participants answered this question during the first survey. The mean value obtained from their responses is 64.2 minutes.
- Fifteen participants responded to the question in the second survey. The mean value obtained from their responses is 62.7 minutes.
- A decrease of 1.5 minutes in the mean time is perceived through the use of Tranzit ***XPress.*** The medians also show a decrease of 10.0 minutes but not at acceptable significance levels (z-score 1.246, and p-value 0.242).

Time typically requiredfor the evacuation ofpersons from the affected area (if necessary)

- This question corresponds to Measure 1.1.1 and Measure 1.1.2.
- The descriptive summary is given in Figure 4-34.
- Eleven participants answered this question during the first survey. The mean value obtained from their responses is 68.2 minutes.
- Fifteen participants responded to the question in the second survey. The mean value obtained from their responses is 74.3 minutes.
- An increase of 6.1 minutes in the mean time is perceived through the use of Tranzit ***XPress.*** The medians show no change, which is confirmed by the Wilcoxon test (z-score 0.677 and p-value 0.625).

Figure 4-33
Time typically required for the containment and stabilization by specialists (HazMat crews)



AMC14K Existing System (Survey-1)

Valid cases: 13.0 Missing cases: 15.0 Percent missing: 53.6

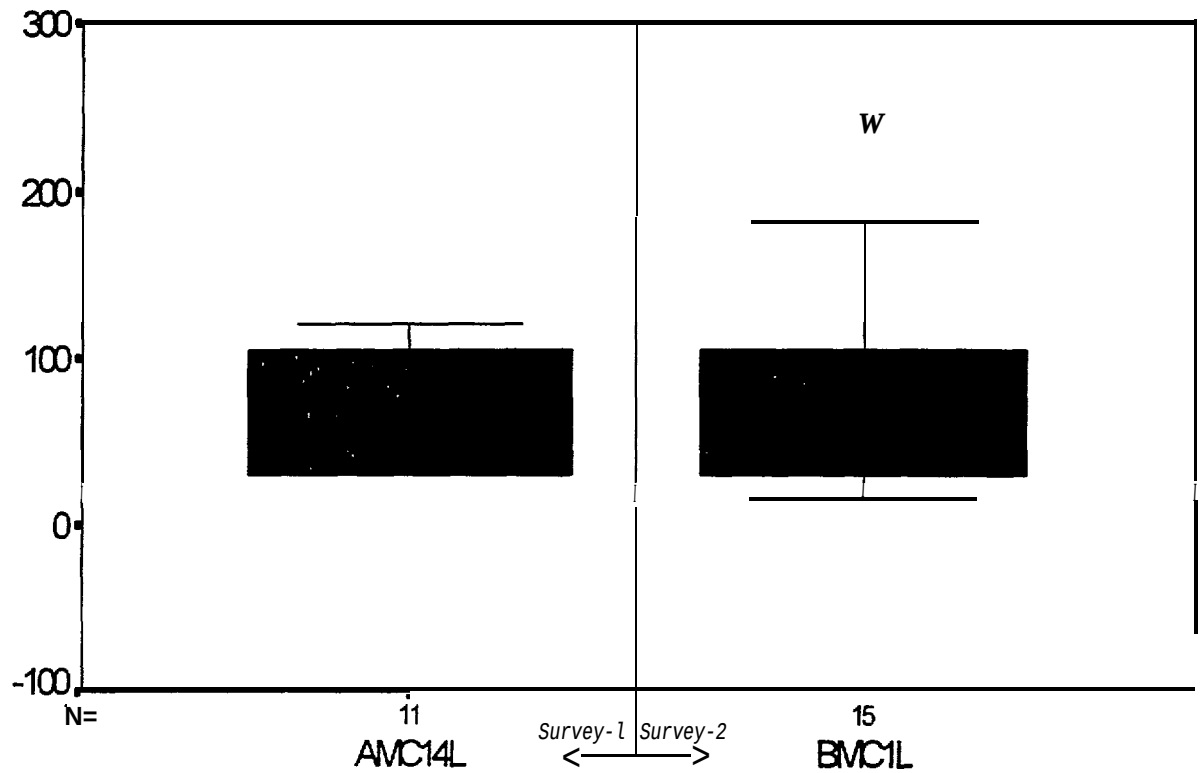
Mean	64.2308	Std Err	14.7831	Min	20.0000	Skewness	1.8509
Median	50.0000	Variance	2841.026	Max	180.0000	S E Skew	.6163
5% Trim	60.2564	Std Dev	53.3013	Range	160.0000	Kurtosis	2.3719
95% CI for Mean	(32.0211, 96.4404)			IQR	30.0000	S E Kurt	1.1909

BMC1K Tranzit *XPress* (Survey-2)

Valid cases: 15.0 Missing cases: 13.0 Percent missing: 46.4

Mean	62.7333	Std Err	14.4472	Min	1.0000	Skewness	1.0583
Median	40.0000	Variance	3130.817	Max	180.0000	S E Skew	.5801
5% Trim	59.6481	Std Dev	55.9537	Range	179.0000	Kurtosis	-.0382
95% CI for Mean	(31.7472, 93.7195)			IQR	100.0000	S E Kurt	1.1209

Figure 4-34
Time typically required for the evacuation of persons from the affected area (if necessary)



AMC14L Existing System (Survey-l)

Valid cases:	11.0	Missing cases:	17.0	Percent missing:	60.7		
Mean	68.1818	Std Err	11.5064	Min	30.0000	Skewness	.4475
Median	60.0000	Variance	1456.364	Max	120.0000	S E Skew	.6607
5% Trim	67.4242	Std Dev	38.1623	Range	90.0000	Kurtosis	-1.5415
95% CI for Mean	(42.5440, 93.8196)			IQR	90.0000	S E Kurt	1.2794

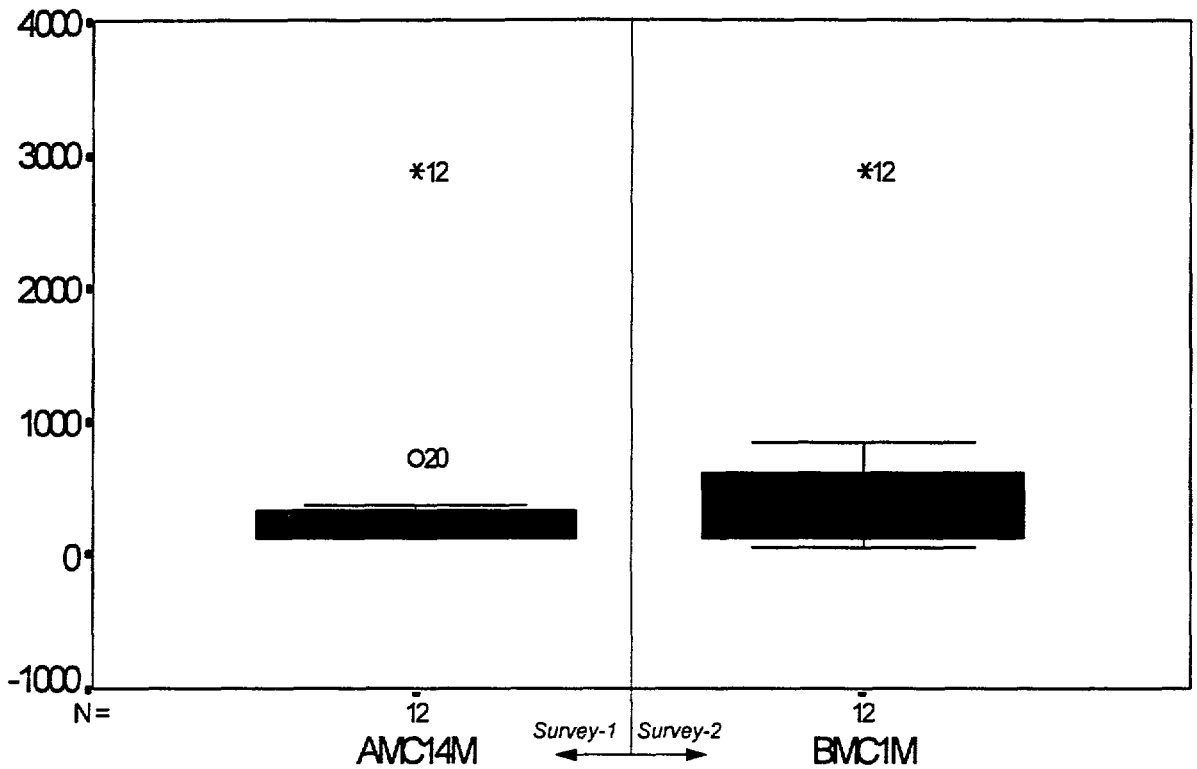
BMClL Tranzit ***XPress*** (Survey-2)

Valid cases:	15.0	Missing cases:	13.0	Percent missing:	46.4		
Mean	74.3333	Std Err	16.8898	Min	15.0000	Skewness	1.5054
Median	60.0000	Variance	4278.988	Max	240.0000	S E Skew	.5801
5% Trim	68.4259	Std Dev	65.4140	Range	225.0000	Kurtosis	1.7924
95% CI for Mean	(38.1083, 110.5584)			IQR	90.0000	S E Kurt	1.1209

Time typically required for the for the clean-up of the accident/incident site

- This question corresponds to Measure 1.1.1 and Measure 1.12.
- The descriptive summary is given in Figure 4-35.
- Twelve participants answered this question during the first survey. The mean value obtained from their responses is 475.0 minutes.
- Twelve participants responded to the question in the second survey. The mean value obtained from their responses is 5 16.3 minutes.
- An increase 4 1.3 minutes in the mean time is perceived through the use of Tranzit ***XPress.*** The medians, on the other hand, show a decrease of 30 minutes. However, when analyzed responses of the same individuals to both questions (9 persons) the Wilcoxon test shows a z-score of 0.184 and a p-value of 1 .000.

Figure 4-35
Time typically required for the clean-up of the accident/incident site



AMC14M Existing System (Survey-1)

Valid cases:	12.0	Missing cases:	16.0	Percent missing:	57.1		
Mean	475.0000	Std Err	223.9470	Min	120.0000	Skewness	3.1970
Median	240.0000	Variance	601827.3	Max	2880.000	S E Skew	.6373
5% Trim	361.1111	Std Dev	775.7753	Range	2760.000	Kurtosis	10.5575
95% CI for Mean	(-17.9041, 967.9041)			IQR	225.0000	S E Kurt	1.2322

BMC1M Tranzit *XPress* (Survey-2)

Valid cases:	12.0	Missing cases:	16.0	Percent missing:	57.1		
Mean	516.2500	Std Err	227.4223	Min	45.0000	Skewness	2.8588
Median	210.0000	Variance	620650.6	Max	2880.000	S E Skew	.6373
5% Trim	411.1111	Std Dev	787.8138	Range	2835.000	Kurtosis	8.8155
95% CI for Mean	(15.6970, 1016.803)			IQR	540.0000	S E Kurt	1.2322

The effectiveness of recordkeeping systems (Current and Tranzit XPress) at maintaining safety

- This question provides information to evaluate Measure 1.2.1, 1.2.2 and 1.2.3.

- The descriptive summary is given in Figure 4-36.

- Twenty-four participants answered this question during the first survey by rating the existing/current system. The mean rating is 2.4. The median rating is 2.5.

- Twenty-five participants rated the existing system in the second survey by responding to this question. The mean rating is 2.3. The median rating is 2.0

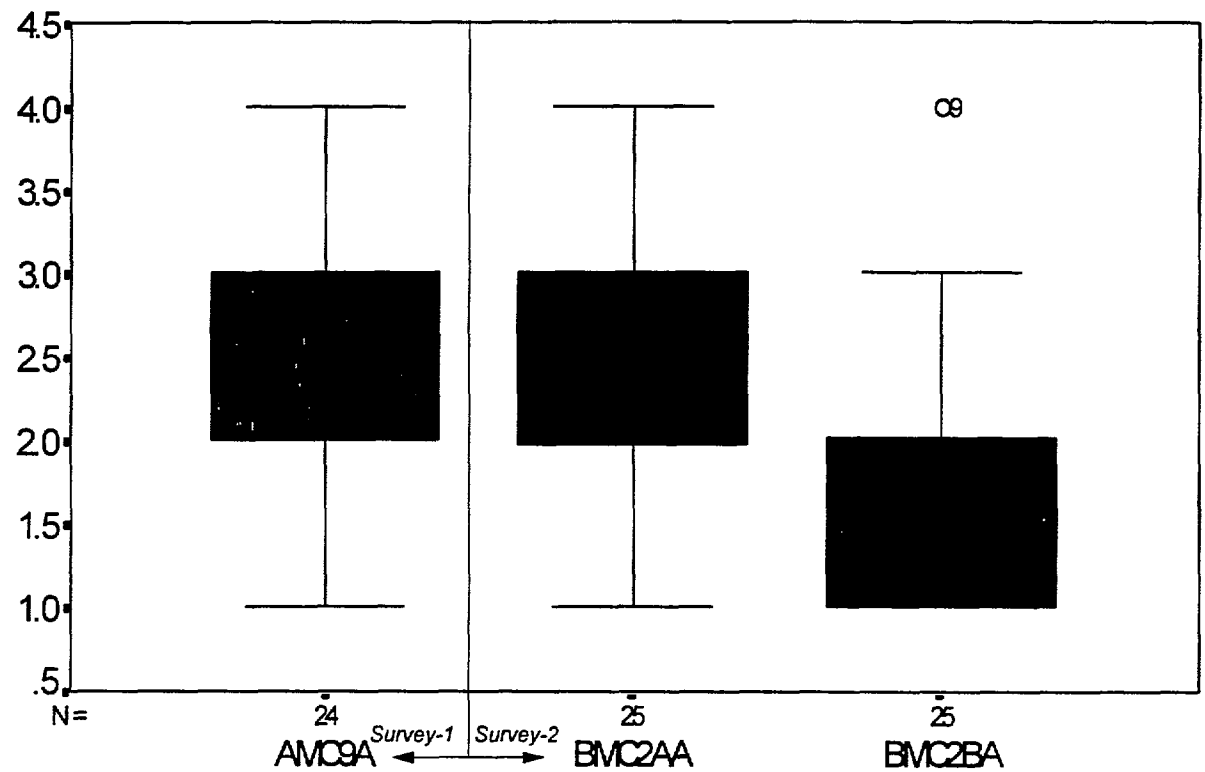
- Twenty-five participants rated Tranzit ***XPress*** in the second survey by responding to this question. The mean rating is 1.9. The median rating is 2.0

- The mean ratings suggest that after the Tranzit ***XPress*** system demonstration the participants changed their perception of the existing system by giving it a better rating. The medians show the same trend. The medians show the same trend and the MH test shows the responses are significantly different (p-value 0.03 1) raising judgment reliability issues.

- Tranzit ***XPress*** is perceived to be better than the existing system when compared with the existing system rating obtained before the system demonstration but not at high significance levels (p-value 0.063)

- Tranzit ***XPress*** is also perceived to be better than the existing system when compared with the existing system rating obtained after the system demonstration but not significantly (p-value 0.492).

Figure 4-36
The effectiveness of recordkeeping systems (Current and Tranzit *XPress*) at maintaining safety



AMC9A Existing System (Survey-1)

Valid cases:	24.0	Missing cases:	4.0	Percent missing:	14.3		
Mean	2.4167	Std Err	.1797	Min	1.0000	Skewness	-.1409
Median	2.5000	Variance	.7754	Max	4.0000	S E Skew	.4723
5% Trim	2.4074	Std Dev	.8805	Range	3.0000	Kurtosis	-.6099
95% CI for Mean	(2.0448, 2.7885)			IQR	1.0000	S E Kurt	.9178

BMC2AA Existing System (Survey-2)

Valid cases:	25.0	Missing cases:	3.0	Percent missing:	10.7		
Mean	2.2800	Std Err	.1873	Min	1.0000	Skewness	.3740
Median	2.0000	Variance	.8767	Max	4.0000	S E Skew	.4637
5% Trim	2.2556	Std Dev	.9363	Range	3.0000	Kurtosis	-.5347
95% CI for Mean	(1.8935, 2.6665)			IQR	1.0000	S E Kurt	.9017

BMC2BA Tranzit *XPress* (Survey-2)

Valid cases:	25.0	Missing cases:	3.0	Percent missing:	10.7		
Mean	1.8800	Std Err	.1451	Min	1.0000	Skewness	.8998
Median	2.0000	Variance	.5267	Max	4.0000	S E Skew	.4637
5% Trim	1.8222	Std Dev	.7257	Range	3.0000	Kurtosis	1.9007
95% CI for Mean	(1.5804, 2.1796)			IQR	1.0000	S E Kurt	.9017

The effectiveness of recordkeeping systems (Current and Tranzit XPress) at maintaining efficiency

- This question provides information to evaluate Measure 1.2.1, 1.2.2 and 1.2.3.

- The descriptive summary is given in Figure 4-37.

- Twenty-four participants answered this question during the first survey by rating the existing/current system. The mean rating is 2.6. The median rating is 3.0.

- Twenty-five participants rated the existing system in the second survey by responding to this question. The mean rating is 2.4. The median rating is 2.0.

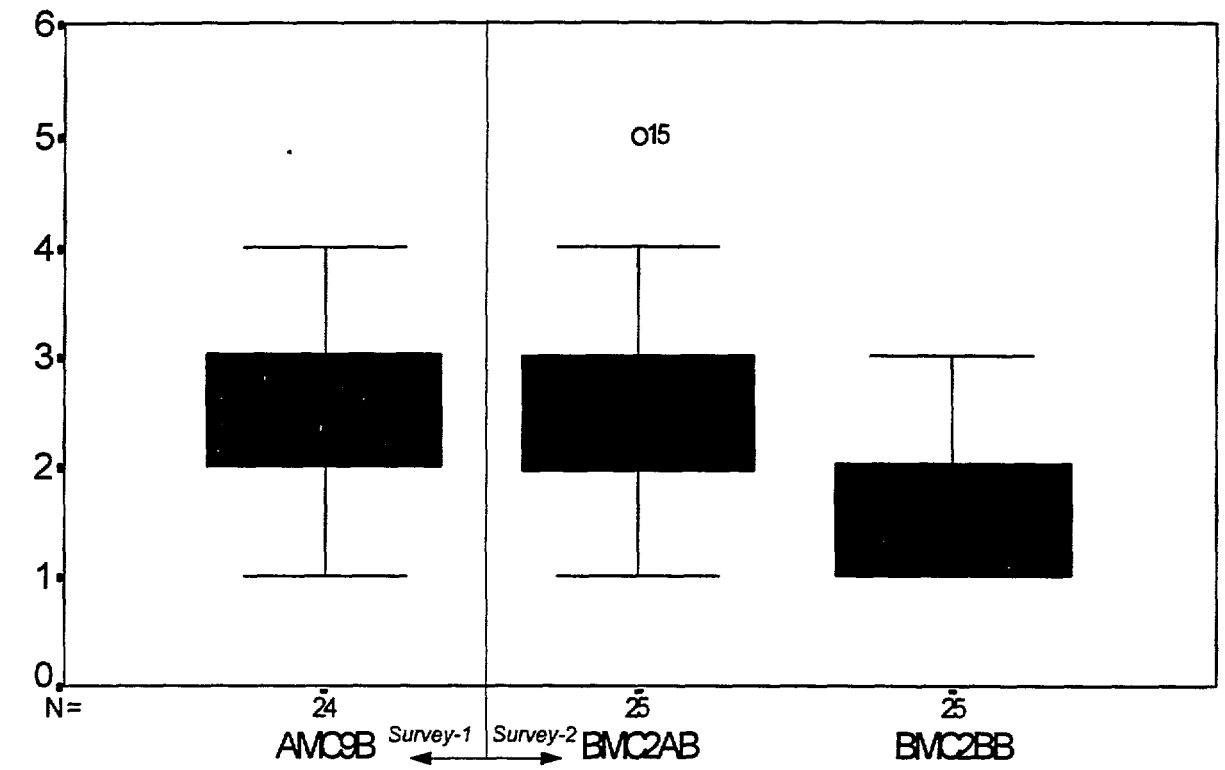
- Twenty-five participants rated Tranzit ***XPress*** in the second survey by responding to this question. The mean rating is 1.7. The median rating is 2.0.

- The mean ratings suggest that after the Tranzit ***XPress*** system demonstration the participants changed their perception of the existing system by giving it a better rating at significant levels (p-value 0.011).

- Tranzit ***XPress*** is perceived to be better than the existing system when compared with the existing system rating obtained before the system demonstration at high significance levels (MH p-value of 0.000)

- Tranzit ***XPress*** is also perceived to be better than the existing system when compared with the existing system rating obtained after the system demonstration, which is also significant (MH p-value 0.039).

Figure 4-37
The effectiveness of recordkeeping systems (Current and Tranzit *XPress*) at maintaining efficiency



AMC9B Existing System (Survey-1)

Valid cases:	24.0	Missing cases:	4.0	Percent missing:	14.3		
Mean	2.6250	Std Err	.1682	Min	1.0000	Skewness	-.1827
Median	3.0000	Variance	.6793	Max	4.0000	S E Skew	.4723
5% Trim	2.6389	Std Dev	.8242	Range	3.0000	Kurtosis	-.2409
95% CI for Mean	(2.2770, 2.9730)			IQR	1.0000	S E Kurt	.9178

BMC2AB Existing System (Survey-2)

Valid cases:	25.0	Missing cases:	3.0	Percent missing:	10.7		
Mean	2.4000	Std Err	.2000	Min	1.0000	Skewness	.7065
Median	2.0000	Variance	1.0000	Max	5.0000	S E Skew	.4637
5% Trim	2.3444	Std Dev	1.0000	Range	4.0000	Kurtosis	.6186
95% CI for Mean	(1.9872, 2.8128)			IQR	1.0000	S E Kurt	.9017

BMC2BB Tranzit *XPress* (Survey-2)

Valid cases:	25.0	Missing cases:	3.0	Percent missing:	10.7		
Mean	1.7200	Std Err	.1227	Min	1.0000	Skewness	.2238
Median	2.0000	Variance	.3767	Max	3.0000	S E Skew	.4637
5% Trim	1.6889	Std Dev	.6137	Range	2.0000	Kurtosis	-.4447
95% CI for Mean	(1.4667, 1.9733)			IQR	1.0000	S E Kurt	.9017

*The effectiveness of recordkeeping systems (Current and Tranzit **XPress**) at accurately tracking hazardous materials*

- This question provides information to evaluate Measure 1.2.1, 1.2.2 and 1.2.3.

- The descriptive summary is given in Figure 4-38.

- Twenty-three participants answered this question during the first survey by rating the existing/current system. The mean rating is 2.9. The median rating is 3.0.

- Twenty-four participants rated the existing system in the second **survey** by responding to this question. The mean rating is 2.3. The median rating is 2.0

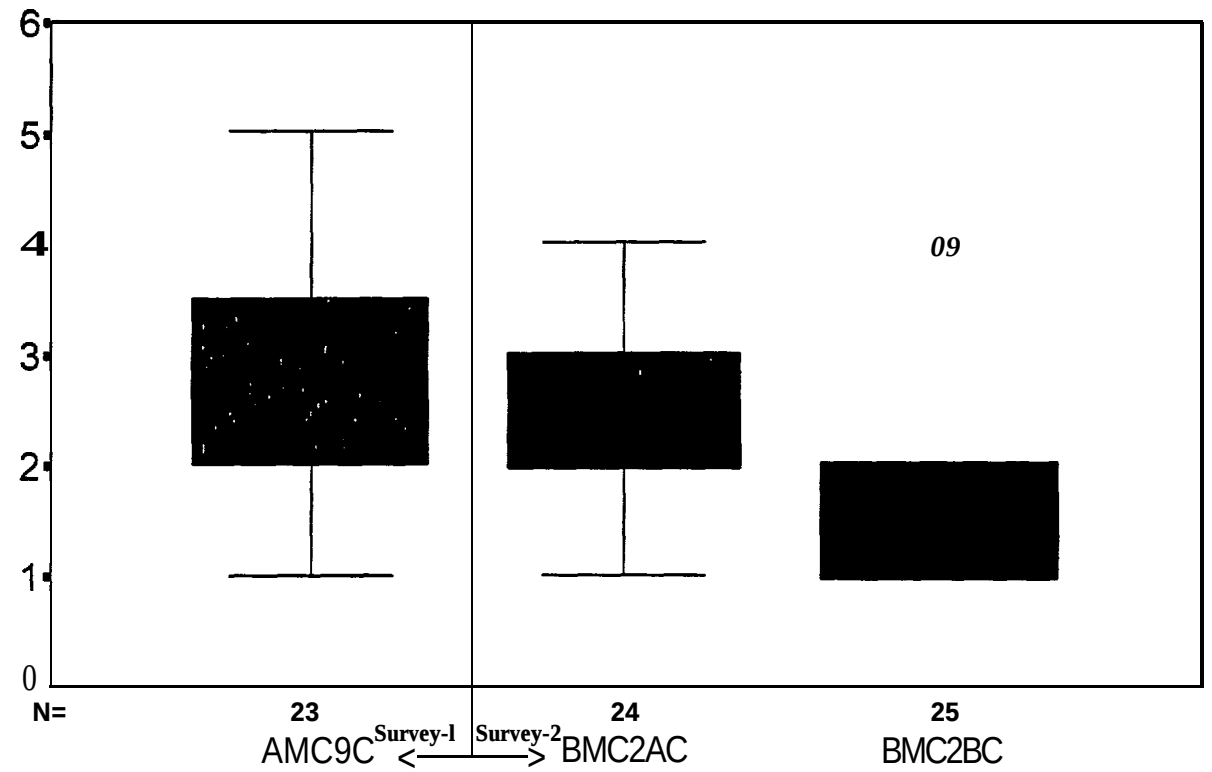
- Twenty-five participants rated Tranzit ***XPress*** in the second survey by responding to this question. The mean rating is 1.4. The median rating is 1.0

- The mean ratings suggest that after the Tranzit ***XPress*** system demonstration the participants changed their perception of the existing system by giving it a better rating. The medians show the same trend and the MH test produced a p-value of 0.008.

- Tranzit *Press* is perceived to be better than the existing system when compared with the existing system rating obtained before the system demonstration (MH p-value 0.000).

- Tranzit ***XPress*** is also perceived to be better than the existing system when compared with the existing system rating obtained after the system demonstration (MH p-value 0.020).

Figure 4-38
The effectiveness of recordkeeping systems (Current and Tranzit *XPress)* at accurately tracking hazardous materials



AMC9C Existing System (Survey-l)
Valid cases: 23.0 Missing cases: 5.0 Percent missing: 17.9

Mean	2.9130	Std Err	.2805	Min	1.0000	Skewness	.0491
Median	3.0000	Variance	1.8103	Max	5.0000	S E Skew	4813
5% Trim	2.9034	Std Dev	1.3455	Range	4.0000	Kurtosis	-.7769
95% CI for Mean (2.3312, 3.4949)				IQR	2.0000	S E Kurt	.9348

BMC2AC Existing System (Survey-21
Valid cases: 24.0 Missing cases: 4.0 Percent missing: 14.3

Mean	2.2500	Std Err	.2019	Min	1.0000	Skewness	.6250
Median	2.0000	Variance	.9783	Max	4.0000	S E Skew	.4723
5% Trim	2.2222	Std Dev	.9891	Range	3.0000	Kurtosis	-.4425
95% CI for Mean (1.8324, 2.6676)				IQR	1.0000	S E Kurt	.9178

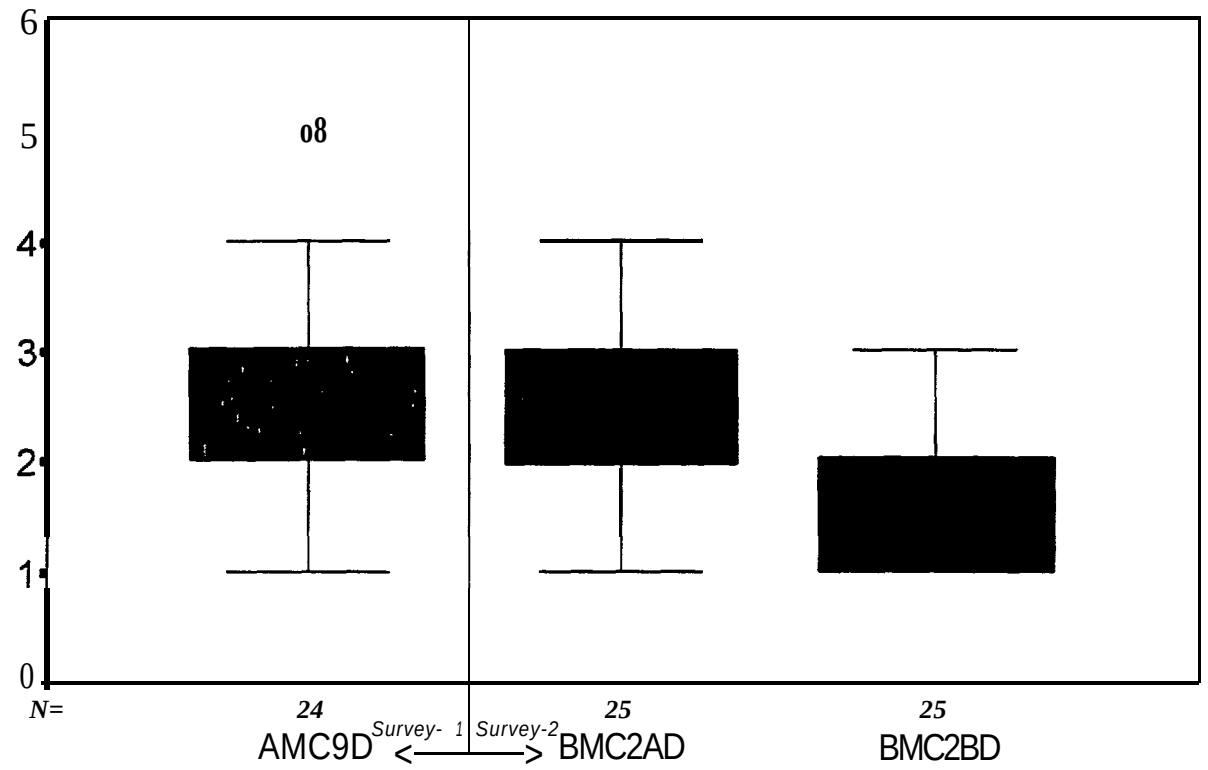
BMC2BC Tranzit ***XPress*** (Survey-2)
Valid cases: 25.0 Missing cases: 3.0 Percent missing: 10.7

Mean	1.4400	Std Err	.1424	Min	1.0000	Skewness	2.1121
Median	1.0000	Variance	.5067	Max	4.0000	S E Skew	.4637
5% Trim	1.3444	Std Dev	.7118	Range	3.0000	Kurtosis	5.8291
95% CI for Mean (1.1462, 1.7338)				IQR	1.0000	S E Kurt	.9017

*The effectiveness of recordkeeping systems (Current and Tranzit **XPress)** at assisting in meeting regulatory requirements*

- This question corresponds to Measures 1.4.1.
- The descriptive summary is given in Figure 4-39.
- Twenty-four participants answered this question during the first survey by rating the existing/current system. The mean rating is 2.6. The median rating is 3.0.
- Twenty-five participants rated the existing system in the second survey by responding to this question. The mean rating is 2.3. The median rating is 2.0.
- Twenty-five participants rated Tranzit *XPress* in the second survey by responding to this question. The mean rating is 1.68. The median rating is 2.0
- The mean ratings suggest that after the Tranzit *XPress* system demonstration some participants changed their perception of the existing system by giving it a better rating. The medians show the same trend. However, the MH test shows the answer to this question has been consistent (p-value 0.146).
- Tranzit *XPress* is perceived to be better than the existing system when compared with the existing system rating obtained before the system demonstration in a significant manner (p-value 0.000).
- Tranzit *XPress* is also perceived to be better than the existing system when compared with the existing system rating obtained after the system demonstration in a similar way as above with a p-value 0.039.

Figure 4-39
The effectiveness of recordkeeping systems (Current and Tranzit *XPress)* at assisting in meeting regulatory requirements



AMC9D Existing System (Survey-l)
Valid cases: 24.0 Missing cases: 4.0 Percent missing: 14.3

Mean	2.6250	Std Err	.2155	Min	1.0000	Skewness	.1248
Median	3.0000	Variance	1.1141	Max	5.0000	S E Skew	.4723
5% Trim	2.5926	Std Dev	1.0555	Range	4.0000	Kurtosis	-.1805
95% CI for Mean (2.1793, 3.0707)				IQR	1.0000	S E Kurt	.9178

BMC2AD Existing System (Survey-2)
Valid cases: 25.0 Missing cases: 3.0 Percent missing: 10.7

Mean	2.3200	Std Err	.1977	Min	1.0000	Skewness	.4072
Median	2.0000	Variance	.9767	Max	4.0000	S E Skew	.4637
5% Trim	2.3000	Std Dev	.9883	Range	3.0000	Kurtosis	-.7088
95% CI for Mean (1.9121, 2.7279)				IQR	1.0000	S E Kurt	.9017

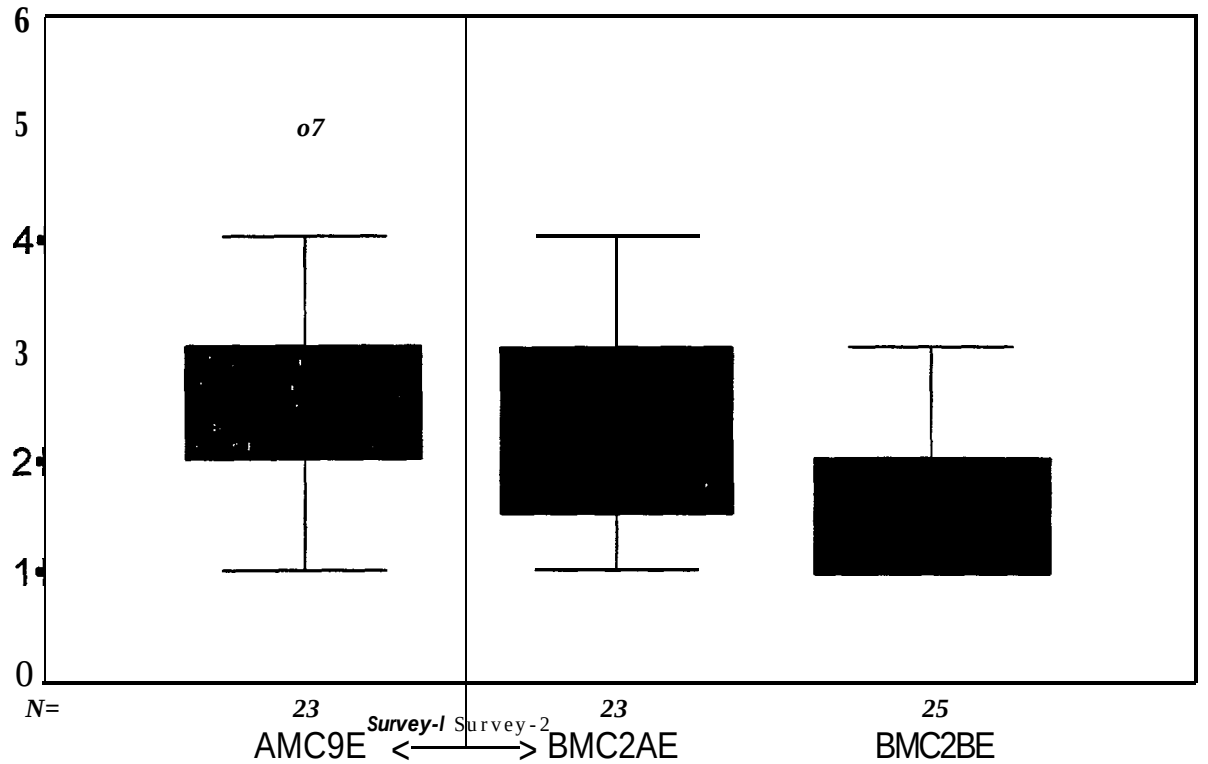
BMC2BD Tranzit ***XPress*** (Survey-2)
Valid cases: 25.0 Missing cases: 3.0 Percent missing: 10.7

Mean	1.6800	Std Err	.1254	Min	1.0000	Skewness	.3455
Median	2.0000	Variance	.3933	Max	3.0000	S E Skew	.4637
5% Trim	1.6444	Std Dev	.6272	Range	2.0000	Kurtosis	-.5275
95% CI for Mean (1.4211, 1.9389)				IQR	1.0000	S E Kurt	.9017

*The effectiveness of recordkeeping systems (Current and Tranzit **XPress**) at accurately reflecting mixed loads*

- This question corresponds to Measure 1.2.1 and 1.2.3.
- The descriptive summary is given in Figure 4-40.
- Twenty-three participants answered this question during the first survey by rating the existing/current system. The mean rating is 2.8. The median rating is 3.0.
- Twenty-three participants rated the existing system in the second survey by responding to this question. The mean rating is 2.4. The median rating is 2.0.
- Twenty-three participants rated Tranzit ***XPress*** in the second survey by responding to this question. The mean rating is 1.6. The median rating is 1.0.
- The mean ratings suggest that after the Tranzit ***XPress*** system demonstration the participants changed their perception of the existing system by giving it a better rating. The medians show the same trend. The MH test confirms this at a p-value of 0.025.
- Tranzit ***XPress*** is perceived to be better than the existing system when compared with the existing system rating obtained before the system demonstration at an MH p-value of 0.001.
- Tranzit ***XPress*** is also perceived to be better than the existing system when compared with the existing system rating obtained after the system demonstration at an MH p-value of 0.03 1.

Figure 4-40
The effectiveness of recordkeeping systems (Current and Tranzit *XPress)* at accurately reflecting mixed loads



AMC9E Existing System (Survey-l)
Valid cases: 23.0 Missing cases: 5.0 Percent missing: 17.9

Mean	2.8261	Std Err	.2052	Min	1.0000	Skewness	.0646
Median	3.0000	Variance	.9684	Max	5.0000	S E Skew	.4813
5% Trim	2.8140	Std Dev	.9841	Range	4.0000	Kurtosis	.0449
95% CI for Mean	(2.4005, 3.2516)			IQR	1.0000	S E Kurt	.9348

BMC2AE Existing System (Survey-21
Valid cases: 23.0 Missing cases: 5.0 Percent missing: 17.9

Mean	2.3913	Std Err	.2330	Min	1.0000	Skewness	.1913
Median	2.0000	Variance	1.2490	Max	4.0000	S E Skew	.4813
5% Trim	2.3792	Std Dev	1.1176	Range	3.0000	Kurtosis	-1.2813
95% CI for Mean	(1.9080, 2.8746)			IQR	2.0000	S E Kurt	.9348

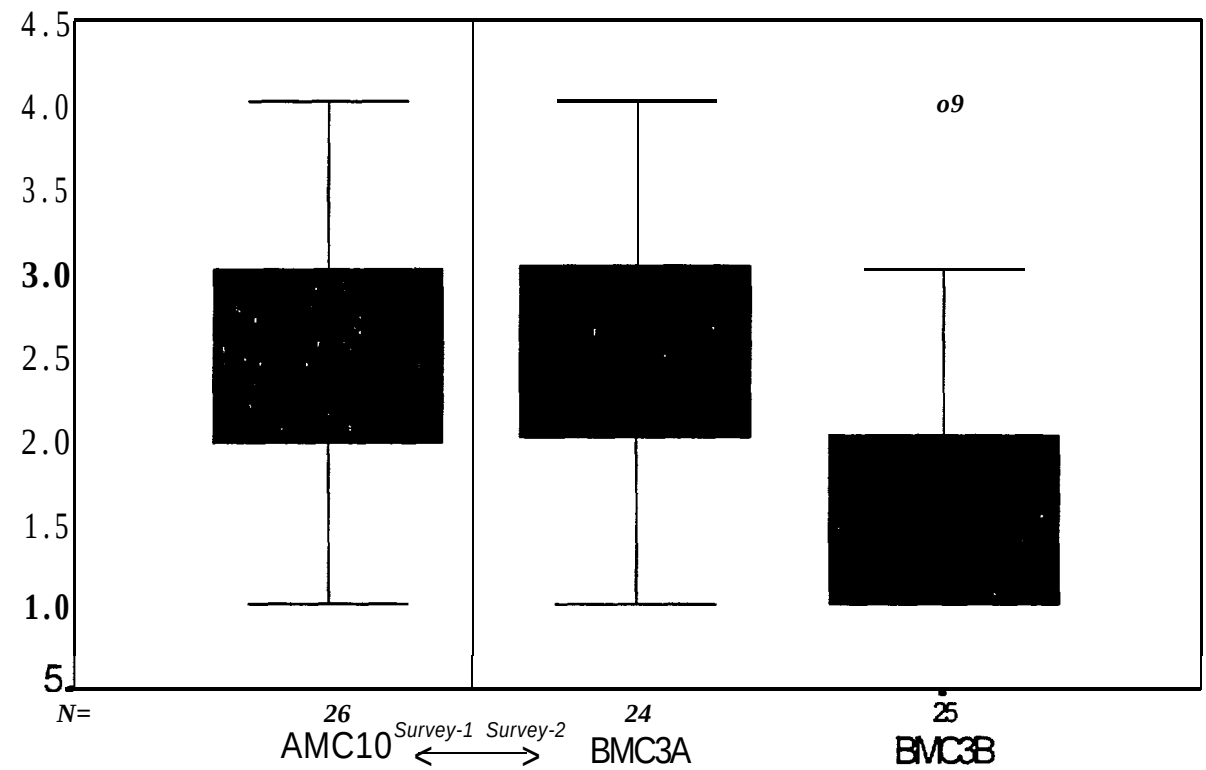
BMC2BE Tranzit ***XPress*** (Survey-2)
Valid cases: 25.0 Missing cases: 3.0 Percent missing: 10.7

Mean	1.5600	Std Err	.1301	Min	1.0000	Skewness	.7466
Median	1.0000	Variance	.4233	Max	3.0000	S E Skew	.4637
5% Trim	1.5111	Std Dev	.6506	Range	2.0000	Kurtosis	-.3528
95% CI for Mean	(1.2914, 1.8286)			IQR	1.0000	S E Kurt	.9017

Effectiveness of the placard system for identifying truck contents in determining optimal emergency response and cleanup strategies

- This question corresponds to Measures 1.2.1, 1.2.2, 1.2.3 and 1.3.1,
- The descriptive summary is given in Figure 4-41.
- Twenty-six participants answered this question during the first survey by rating the existing/current system. The mean rating is 2.4. The median rating is 2.0.
- Twenty-four participants rated the existing system in the second survey by responding to this question. The mean rating is 2.8. The median rating is 3.0
- Twenty-five participants rated Tranzit ***XPress*** in the second survey by responding to this question. The mean rating is 1.8. The median rating is 2.0
- The mean ratings suggest that after the Tranzit ***XPress*** system demonstration the participants changed their perception of the existing system by rating it less effective. The medians show the same trend. Similar trend is shown by the MH test with a p-value of 0.046.
- Tranzit ***XPress*** is perceived to be better than the existing system when compared with the existing system rating obtained before the system demonstration (MH p-value of 0.014).
- Tranzit ***XPress*** is also perceived to be better than the existing system when compared with the existing system rating obtained after the system demonstration (MH p-value 0.00 1).

Figure 4-41
Effectiveness of the placard system for identifying truck contents in determining optimal emergency response and cleanup strategies



AMC10 Existing System (Survey-l)
Valid cases: 26.0 Missing cases: 2.0 Percent missing 7.1

Mean	2.3846	Std Err	.1671	Min	1.0000	Skewness	-.0298
Median	2.0000	Variance	.7262	Max	4.0000	S E Skew	.4556
5% Trim	2.3718	Std Dev	. 8521	Range	3.0000	Kurtosis	-.5051
95% CI for Mean (2.0404, 2.7288)				IQR	1.0000	S E Kurt	.8865

BMC3A Existing System (Survey-2)
Valid cases: 24.0 Missing cases: 4.0 Percent missing 14.3

Mean	2.7500	Std Err	.1729	Min	1.0000	Skewness	.0585
Median	3.0000	Variance	.7174	Max	4.0000	S E Skew	.4723
5% Trim	2.7685	Std Dev	.8470	Range	3.0000	Kurtosis	-.7505
95% CI for Mean (2.3923, 3.1077)				IQR	1.0000	S E Kurt	.9178

BMC3B Tranzit ***XPress*** (Survey-2)
Valid cases: 25.0 Missing cases: 3.0 Percent missing 10.7

Mean	1.7600	Std Err	.1558	Min	1.0000	Skewness	1.0379
Median	2.0000	Variance	.6067	Max	4.0000	S E Skew	.4637
5% Trim	1.6889	Std Dev	.7789	Range	3.0000	Kurtosis	1.4250
95% CI for Mean (1.4385, 2.0815)				IQR	1.0000	S E Kurt	.9017

Effectiveness of the information available through the systems in determining optimal emergency response and cleanup strategies

. This question corresponds to Measure 1.3.1.

. The descriptive summary is given in Figure 4-42.

. Twenty-five participants answered this question during the first survey by rating the existing/current system. The mean rating is 2.6. The median rating is 2.0.

. Twenty-five participants rated the existing system in the second survey by responding to this question. The mean rating is 2.9. The median rating is 3.0.

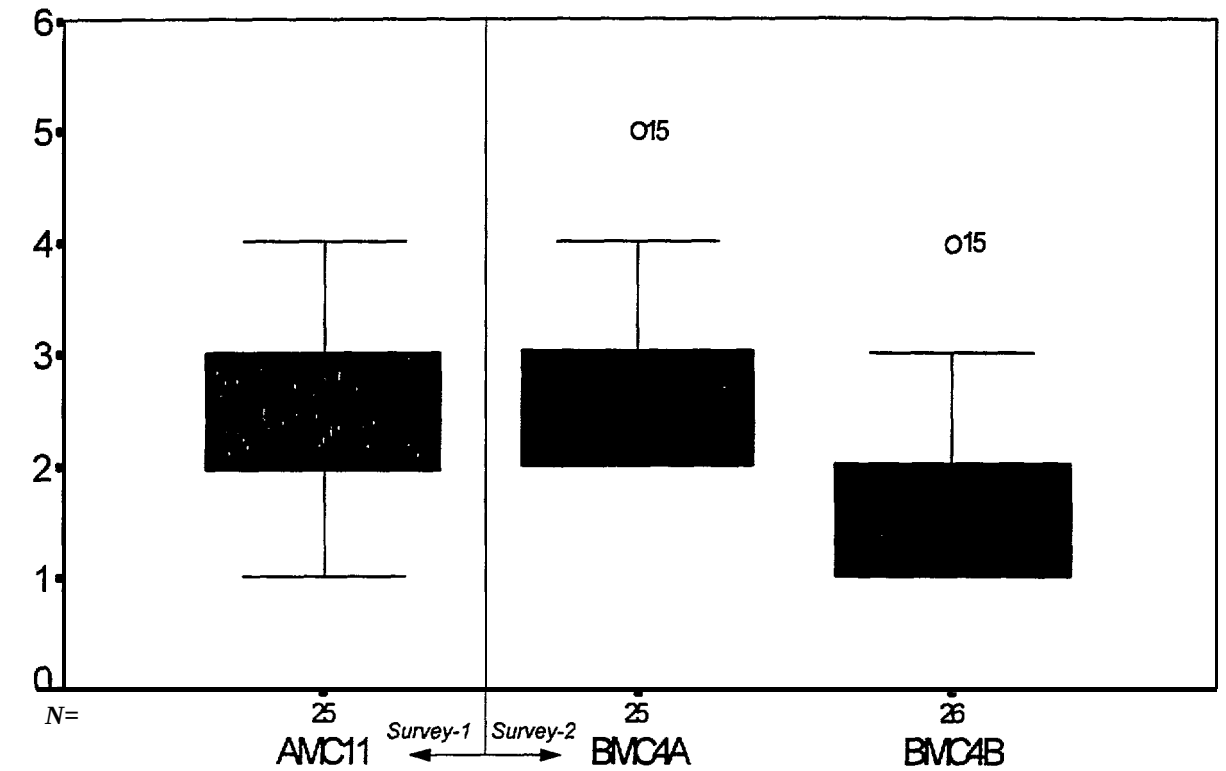
- Twenty-six participants rated Tranzit ***XPress*** in the second survey by responding to this question. The mean rating is 1.8. The median rating is 2.0.

. The mean ratings suggest that after the Tranzit ***XPress*** system demonstration a few participants changed their perception of the existing system by rating it less effective. The medians show the same trend. The MH test. however, shows consistency between survey 1 and survey 2 with a p-value 0.157.

. Tranzit *Press* is perceived to be significantly better than the existing system when compared with the existing system rating obtained before the system demonstration (MH p-value 0.005).

. Tranzit ***XPress*** is also perceived to be significantly better than the existing system when compared with the existing system rating obtained after the system demonstration (MH p-value 0.000).

Figure 4-42
Effectiveness of the information available through the systems in determining optimal emergency response and cleanup strategies



AMC11 Existing System (Survey-l)
Valid cases: 25.0 Missing cases: 3.0 Percent missing: 10.7

Mean	2.5600	Std Err	.l833	Min	1.0000	Skewness	.3377
Median	2.0000	Variance	.8400	Max	4.0000	S E Skew	.4637
5% Trim	2.5667	Std Dev	.9165	Range	3.0000	Kurtosis	-.7791
95% CI for Mean	(2.1817, 2.9383)			IQR	1.0000	S E Kurt	.9017

BMC4A Existing System (Survey-21
Valid cases: 25.0 Missing cases: 3.0 Percent missing: *10.7*

Mean	2.9200	Std Err	.1519	Min	*2.0000*	Skewness	.7585
Median	3.0000	Variance	.5767	Max	*5.0000*	*S* E Skew	*.4637*
5% Trim	2.8667	Std Dev	.7594	Range	*3.0000*	Kurtosis	1.0618
95% CI for Mean	(2.6065, 3.2335)			IQR	1.0000	S E Kurt	.9017

BMC4B Tranzit ***XPress*** *(Survey-2)*
Valid cases: 26.0 Missing cases: 2.0 Percent missing: 7.1

Mean	1.7692	Std Err	.1393	Min	1.0000	Skewness	1.0944
Median	2.0000	Variance	.5046	Max	4.0000	S E Skew	*.4556*
5% Trim	1.7009	Std Dev	.7104	Range	*3* .0000	Kurtosis	2.6468
95% CI for Mean	(1.4823, 2.0562)			IQR	1.0000	S E Kurt	.8865

Current Motor Carrier compliance with HazMat regulations

- This question provides information to evaluate Measure 1.4.1.

- The distribution of motor carrier participants, based on their rating of motor carrier compliance with HazMat regulations is given below:

Motor Carrier Compliance	Frequency	Percent
1. Satisfactory	8	28.6
2. Above Average	8	28.6
3. Average	6	21.4
4. Below Average	2	7.1
5. Unsatisfactory	1	3.6
No response	3	10.7
Total	28	100.0

- The descriptive summary of the survey responses is given below.

Descriptive Statistics

Mean	2.2000	Std Err	.2236	Min	1.0000	Skewness	.7389
Median	2.0000	Variance	1.2500	Max	5.0000	S E Skew	.4637
5% Trim	2.1222	Std Dev	1.1180	Range	4.0000	Kurtosis	.0626
95% CI for Mean (1.7385, 2.6615							

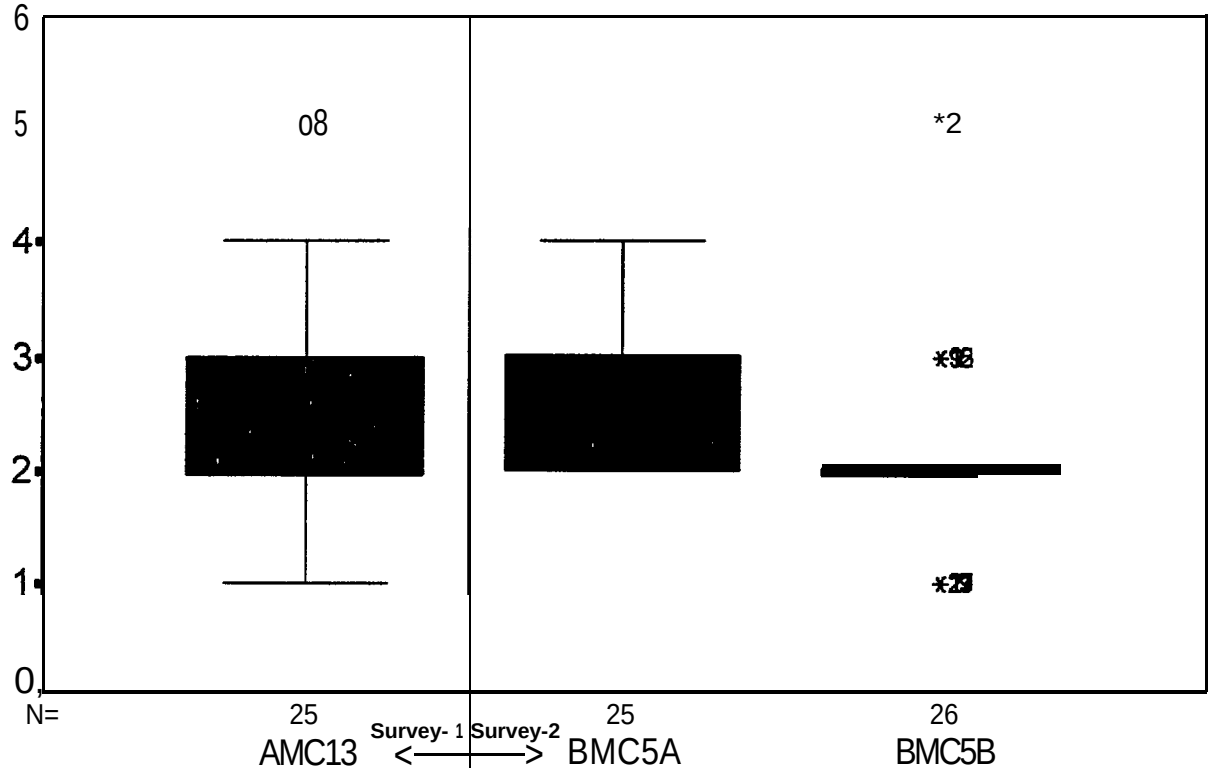
- Twenty five (89.3 percent) participants answered this question during the survey. The mean rating is 2.2. The median rating is 2.0. A total of sixteen participants (57.2 percent) rated the motor carrier compliance as above average or satisfactory.

- The mean ratings suggest that the motor carrier participants perceive their compliance of HazMat regulations as above average.

Effectiveness of the systems in assuring motor carrier compliance with HazMat regulations

- This question corresponds to Measure 1.4.1.
- The descriptive summary is given in Figure 4-43.
- Twenty-five participants answered this question during the first survey by rating the existing/current system. The mean rating is 2.5. The median rating is 2.0.
- Twenty-five participants rated the existing system in the second survey by responding to this question. The mean rating is 2.8. The median rating is 3.0.
- Twenty-six participants rated Tranzit ***XPress*** in the second survey by responding to this question. The mean rating is 2.0. The median rating is 2.0.
- The mean ratings suggest that after the Tranzit ***XPress*** system demonstration the participants changed their perception of the existing system by rating it less effective. The medians show the same trend, however, all these indications are at the border of the usual significance level (p-value 0.06 1).
- Tranzit ***XPress*** is not perceived to be better than the existing system when compared with the existing system rating obtained before the system demonstration (p-value 0.262).
- Tranzit ***XPress*** is perceived to be better than the existing system when compared with the existing system rating obtained after the system demonstration (p-value 0.005).

Figure 4-43
Effectiveness of the systems in assuring motor carrier compliance with HazMat regulations



AMC13 Existing System (Survey-l)

Valid cases:	25.0	Missing cases:	3.0	Percent missing:	10.7		
Mean	2.4800	Std Err	.2245	Min	1.0000	Skewness	.4384
Median	2.0000	Variance	1.2600	Max	5.0000	S E Skew	.4637
5% Trim	2.4333	Std Dev	1.1225	Range	4.0000	Kurtosis	- .4959
95% CI for Mean (2.0167, 2.9433)				IQR	1.0000	S E Kurt	.9017

BMC5A Existing System (Survey-2)

Valid cases:	25.0	Missing cases:	3.0	Percent missing:	10.7		
Mean	2.7600	Std Err	.1327	Min	2.0000	Skewness	.3024
Median	3.0000	Variance	.4400	Max	4.0000	S E Skew	.4637
5% Trim	2.7333	Std Dev	.6633	Range	2.0000	Kurtosis	-.6121
95% CI for Mean (2.4862, 3.0338)				IQR	1.0000	S E Kurt	.9017

BMC5B Tranzit ***XPress*** (Survey-2)

Valid cases:	26.0	Missing cases:	2.0	Percent missing:	7.1		
Mean	2.0385	Std Err	.1615	Min	1.0000	Skewness	1.7867
Median	2.0000	Variance	.6785	Max	5.0000	S E Skew	.4556
5% Trim	1.9573	Std Dev	.8237	Range	4.0000	Kurtosis	6.0304
95% CI for Mean (1.7058, 2.3712)				IQR	.OOOO	S E Kurt	.8865

Effectiveness of Tranzit XPress in providing information through links with other systems

- This question corresponds to Measure 1 .5. 1.

- The distribution of motor carrier participants, based on their rating of the effectiveness of the Tranzit ***XPress*** system in providing information through links with other systems is given below:

Information Through Links With Other Systems	**Frequency**	**Percent**
1. Very Effective	6	21.4
2. Effective	13	46.4
3. Average	0	0.0
4. Ineffective	0	0.0
5. Very Ineffective	0	0.0
No response	9	32.1
Total	28	100.0

- The descriptive summary of the survey responses is given below.

Descriptive Statistics

Mean	1.6842	Std Err	.1096	Min	1.0000	Skewness	-.8622
Median	2.0000	Variance	.2281	Max	2.0000	S E Skew	.5238
5% Trim	1.7047	Std Dev	.4776	Range	1.0000	Kurtosis	-1.4186
95% CI for Mean (1.4540, 1.9144)							

- Nineteen (67.9 percent) participants answered this question during the survey. The mean rating is 1.7. The median rating is 2.0. All the respondents rated the effectiveness of the Tranzit ***XPress*** system as above average.

- The Tranzit ***XPress*** system is perceived by the participants to be effective in providing information through links with other systems.

*Intention to use the Tranzit **XPress** system*

. This question corresponds to Measure 2.3.1.

. The distribution of motor carrier participants, based on their intention of using the Tranzit ***XPress*** system is given below:

Intention to use Tranzit *XPress*	**Frequency**	**Percent**
0. No	10	35.7
1. Yes	3	10.7
Cannot decide	6	21.4
No response	9	32.1
Total	28	100.0

. The descriptive summary of the survey responses is given below.

Descriptive Statistics

Mean	.2308	Std Err	.1216	Min	.0000	Skewness	1.4511
Median	.0000	Variance	.1923	Max	1.0000	S E Skew	.6163
5% Trim	.2009	Std Dev	.4385	**Range**	**1.0000**	Kurtosis	.0945
95% CI for Mean (-.0342, .4958)							

. Thirteen (46.4 percent) participants answered this question during the survey. The mean rating is 0.2. The median rating is 0.0. Only three participants (10.7 percent) expressed their intention to use the Tranzit ***XPress*** system.

. The Tranzit ***XPress*** system is not perceived as beneficial by the motor carrier participants.

*Intention to use individual components of the Tranzit **XPress** system*

- This question corresponds to Measure 2.4.1.

- The distribution of incident responders, based on their intention of using individual components of the Tranzit ***Press*** system is given below:

Intention to use Tranzit XPress	Frequency	Percent
0. No	1	3.6
1. Yes	1	3.6
Cannot decide	9	32.1
No response	17	60.7
Total	28	100.0

- The descriptive summary of the survey responses is given below.

Descriptive Statistics

Mean	.5000	Std Err	.5000	Min	.0000 Skewness .
Median	.5000	Variance	.5000	Max	1.0000 S E Skew .
5% Trim	.	Std Dev	.7071	Range	1.0000 Kurtosis .

95% CI for Mean (-5.8531, 6.8531).

- Only two (7.1 percent) participants answered this question during the survey. The mean rating is 0.5. The median rating is 0.5.

- Due to such a low response rate no reasonable conclusion can be made regarding the motor carrier participants' intentions to use individual components of the Tranzit ***XPress*** system.

Rating of HazMat systems with respect to the accessibility of information which facilitates incident response

- This question corresponds to Measure 2.5.1.
- The descriptive summary is given in Figure 4-44.
- The main HazMat systems considered by the motor carrier participants with respect to the accessibility of information are CHEMTREC and shipping papers. Other systems included 9 11, DOT Handbooks, Emergency Response Guide, HazMat teams, placard, shipping papers etc.
- The mean ratings suggest that after the Tranzit ***XPress*** system demonstration the participants changed their perception of most of the existing systems by giving them a slightly poorer rating in the second survey.
- Most of the existing HazMat systems are perceived to be better than Tranzit ***XPress*** when compared with the existing systems' ratings obtained before the system demonstration.
- Tranzit ***XPress*** is perceived to be better than the existing systems when compared with the existing systems' ratings obtained after the system demonstration.
- Due to smaller number of responses for each existing system the analysis is not statistically significant, but can be used to get an understanding of the trend in the ratings of HazMat systems.

Rating of HazMat systems with respect to the usefulness of information which facilitates incident response

- This question corresponds to Measure 2.5.1.
- The descriptive summary is given in Figure 4-44.
- The main HazMat systems considered by the motor carrier participants with respect to the usefulness of information are CHEMTREC and shipping papers. Other systems included DOT Handbooks, Emergency Response Guide, HazMat teams, placard, shipping papers etc.
- The mean ratings suggest that after the Tranzit ***XPress*** system demonstration the participants did not change their perception of most of the existing systems (except shipping papers).
- Tranzit ***XPress*** is perceived to be better than most of the existing systems when compared with the existing systems' ratings obtained before the system demonstration.
- Tranzit ***XPress*** is perceived to be better than the existing systems when compared with the existing systems' ratings obtained after the system demonstration.
- Due to smaller number of responses for each existing system the analysis is not statistically significant, but can be used to get an understanding of the trend in the ratings of HazMat systems.

Rating of HazMat systems with respect to the accuracy of information which facilitates incident response

- This question corresponds to Measure 2.5.1.
- The descriptive summary is given in Figure 4-44.
- The main HazMat systems considered by the motor carrier participants with respect to the accessibility of information are CHEMTREC and shipping papers. Other systems included DOT Handbooks, Emergency Response Guide, HazMat teams, placard, shipping papers etc.
- The mean ratings suggest that after the Tranzit ***XPress*** system demonstration the participants did not change their perception of most of the existing systems (except CHEMTREC).
- Tranzit ***XPress*** is perceived to be better than most of the existing systems when compared with the existing systems' ratings obtained before the system demonstration.
- Tranzit ***XPress*** is perceived to be better than the existing systems when compared with the existing systems' ratings obtained after the system demonstration.
- Due to smaller number of responses for each existing system the analysis is not statistically significant, but can be used to get an understanding of the trend in the ratings of HazMat systems.

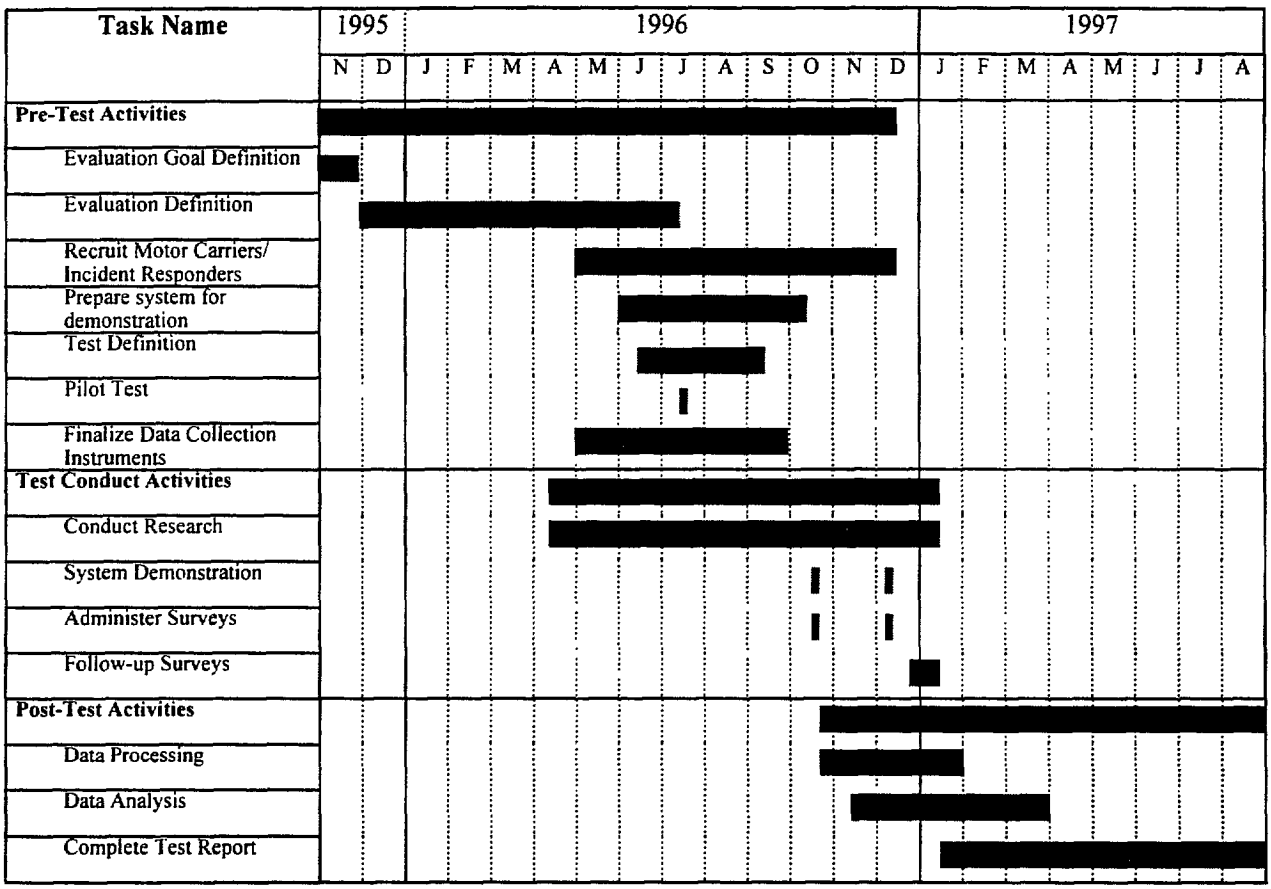
Figure 4-44
HazMat System Rating by Motor Carriers
With Respect to Information That Facilitates Incident Responses)

HazMat Systems and Services	Survey	Total Responses	System Rating 1 (Very Effective)	2 (Effective)	3 (Average)	4 (Ineffective)	5 (Very Ineffective)	Mean Rating
Accessibility of Information								
911	1	2	1	1				1 50
	2	0						-
CAMEO	1	0						-
	2	0						-
CHEMTREC	1	5	2	2	1			1 80
	2	4	1	1	2			2.25
DOT Handbooks	1	1	1					1 00
	2	1			1			3 00
Emergency Response Guide	1	2	2					1.00
	2	1		1				2 00
HazMat Teams	1	3	1		2			2 33
	2	0						-
Placard	1	1	1					1 00
	2	1	1					1 00
Shipping Papers	1	2	2					1 00
	2	3	1	1		1		2.33
Other Existing HazMat Systems	1	12	2	4	4	1	1	2 58
	2	3		2	1			2.33
Tranzit XPress	*2*	*18*	*6*	*10*	*1*		*1*	*1.89*
Usefulness of Information								
911	1	0						-
	2	0						-
CAMEO	1	0						-
	2	0						-
CHEMTREC	1	3	1		2			2 33
	2	3		2	1			2 33
DOT Handbooks	1	1	1					1 00
	2	1	1					1 00
Emergency Response Guide	1	2	2					1 00
	2	1		1				2 00
HazMat Teams	1	2	1		1			2 00
	2	0						-
Placard	1	1			1			3 00
	2	1			1			3 00
Shipping Papers	1	2	2					1 00
	2	2	1		1			2 00
Other Existing HazMat Systems	1	10	3	2	5			2 20
	2	4		2	2			2 50
Tranzit XPress	*2*	*19*	*8*	*10*		*1*		*1.68*
Accuracy of Information								
911	1	0						-
	2	0						-
CAMEO	1	0						-
	2	0						-
CHEMTREC	1	2	1		1			2 00
	2	3		2	1			2 33
DOT Handbooks	1	1		1				2 00
	2	1	1					1 00
Emergency Response Guide	1	2	2					1 00
	2	1	1					1 00
HazMat Teams	1	2	1		1			2 00
	2	0						-
Placard	1	1		1				2 00
	2	1		1				2 00
Shipping Papers	1	2	2					1 00
	2	2	2					1 00
Other Existing HazMat Systems	1	10	3	3	4			2 10
	2	4	1	1	2			2 25
Tranzit XPress	*2*	*19*	*8*	*10*	*1*			*1.63*

5. TEST SCHEDULE

The schedule followed during the Tranzit *XPress* Operational Test evaluation is outlined in Figure 5-1. The schedule indicates the specific tasks completed under the motor carrier and incident responder tests. Activities are segregated into pre-test, test conduct, and post-test requirements.

Figure 5-1
Detailed Test Schedule



6. INSTITUTIONAL/LEGAL ISSUES DOCUMENTATION

The appealing ITS concept, promising reduced accidents, increased highway capacity, faster trips and reduced stress for drivers, lessening of dependence on the slow, imprecise and erratic reactions of drivers, all should be examined in light of particularly sensitive issues such as equity and efficiency, potential benefits, privacy, safety and liability, and increasing environmental concern. The objective of this section is to identify, describe, and assess possible non-technical issues in developing the proposed HazMat system, Tranzit ***XPress*** in light of its deployment. To do this, first a broad view to the public/private partnership is taken (in the next section) where a detailed account of ITS non-technical issues is offered. This is a critical examination of the ITS as it arises from the literature and related national workshops. The objective is to arrive to the definition of specific project issues and the ways to address them following the themes of deployment strategies, taxation, financing and funding, liability, partnerships, standards and protocols, intellectual property, user's behavior, monopolies, legislation, jurisdiction, enforcement, and education.

6.1.1. Deployment Strategies and Partnership Models

Experience with past technological innovations shows that in many cases an interplay of these private participation models, i.e., a mixture or hybrid models, could prove to be the most successful operating model. A general consensus is that a well coordinated, public-private participation model will produce the desired results. This model is in reality a mixture of models, which combines advantages from all the three types of deployment models. The requirements and detailed characteristics for such a deployment strategy can be deduced from past and ongoing experiences in transportation and elsewhere.

In a recent attempt to reach consensus in the roles public and privates should play, with regard to the possible models of partnership, the FHWA organized a workshop in which the partnership models were grouped into four categories expanding the previous three-category classifications:

1. purely public domination where the privates are limited to the construction of ITS infrastructure and the supply of products and equipment;

2. purely privately driven model where market mechanisms dictate the deployment of ITS;

3. traditional public/private partnerships where crucial sectors of the deployment are controlled by the public; and

4. unconventional approaches where the privates participate in research, development, deployment, and operation of ITS technologies.

Based on the four fundamental models of public/private participation one may begin to build other more descriptive models. There are infinite possibilities for public/private partnerships and they vary depending on a variety of circumstances. In this section, the actors involved in ITS potential partnerships are presented in terms of their characteristics, their potential roles are defined, and changes needed for successful partnerships are outlined. The commonalties and differences in role playing by private industry and consulting, public agencies, and academic institutions across the globe have also been identified in the past. The common elements is the formation of consortia (which is a de facto proof of the importance of the public/private partnership), multidisciplinarity in the scientific and operational approaches (which is an indication of the complexity and newness of ITS issues), and common vision of future scenarios for ITS (which is probably due to competition rather than to forecasting certainty). Most importantly, however, a map of the various roles the actors involved in a partnership could play and a list of the factors affecting private industry's decisions may provide some additional insights (Figure 6-l). These factors are divided into company-specific factors such as: organizational mission, technological competence, marketing ability, manufacturing capability, vertical integration, investment policy, strategic alliances, competition, management commitment, timing of decisions; and external factors such as: national economy, international economy, government policy on ITS, national deficit and priorities, legal barriers, institutional barriers, market size, market uncertainty, ITS impacts, ITS effectiveness, and alternative (non-ITS) transport solutions.

The major findings are that several possible business models might be used to select roles. Assuming the authors financial analysis is correct and that public funds are inadequate to support the installation of ITS systems, the possible business models are: cellular telephone franchise model, utility, laissez faire, public corporation. The laissez faire approach, according to the author is the most likely one to be taken, yet does not provide a mechanism for private funding of public infrastructure and encourages the competitive installation of private infrastructure.

The selection of a business model and definition of public/private roles must be sensitive to several points:

- Models and roles should be consistent throughout the US,
- If franchise or utility models are used, they should be awarded for large geographic areas,
- Public agencies should be prepared to take advantage of the improved surveillance information they are likely to receive.

It is advisable to study the successes and failures of the communications industry to learn from its experience. The relationships and the possible interactions among the various actors taking part in the partnership may also prove crucial for the success of the endeavor. The individual partners contribute only a small part of the activities they are involved with. However, activities that are not integral part of the partnership, as the basic research performed by Universities, contribute substantially in an indirect manner, supporting applied research. There are a number of bilateral relations not depicted in the figure such as the exchange of funds and technology between private manufactures and federal government and the training performed for private consultants by the research institutes. These may also be considered useful vehicles for the partnerships.

Figure 6-1
Roles of Public, Private, and University in a Partnership for ITS Research, Development, and Deployment

Actors	Roles
Private	
Automotive Industry	Provide vehicle technology and vehicles, integrate with smaller manufacturers, participate in funding and technology support
Automotive Supplier	Provide components for navigation. communications, and software, provide some funds for initial R&D
Communications Industry	Convert communications technology into transportation technology
Computer Industry	Convert computer technology into transportation technology
Materials Industry	Convert materials technology into transportation technology
Defense Industry	Convert military technology into transportation technology
Traffic Consultants	Provide transportation systems development and support, provide technical support to non-transportation partners
Communications and Systems Providers	Provide the communications infrastructure
Travel and transportation business	Provide and update travel information
The "System" Users UPS, Carriers, AAA	Provide funding, knowledge, and facilities
The Single System Users	React against congestion, require fast solutions, answer to attitudinal and behavioral questionnaires, purchase the new equipment
Public	
Federal Agencies	Provide guidance and funding for research, development, and deployment, translate policies into proposals, collect and disseminate technology and information. address their missions, i.e. FHWA - congestion relief, NHTSA - safety, FTA - multi-modal trip making
State Agencies	Provide guidance and funding for research. development, and deployment, translate policies into proposals, collect and disseminate technology and information, cooperate with the federal agencies in defining priorities in funding between congestion relief, safety, demand management etc., provide guidance and funds for local agencies
Traffic Management	Provide traffic information, data collection, synthesis, dissemination, address agencies/public concerns
Other local planning	Provide traffic information, data collection, maintain equipment, coordinate Agencies with other transportation activities, dissemination, addresses public concerns
Local Communications Systems Providers	Provide the local communications infrastructure
Police	Use and test technologies, provide information and data
Universities	
Academic Departments	Organize new curricula tuned to ITS, basic research, provide laboratories, libraries, and the environment for idea creation, provide knowledge
Research Institutes	Perform applied research, facilitate interactions among partners, organize and conduct training

The major partnership related issue associated with Tranzit ***XPress*** is the lack of vision for the future in a public domain. The first phase project, based on market research targeting fleet management of the private sector, was designed to develop and test these new technologies and not to test the deployability of the end system. In addition, given the funding mechanism followed, the project did not emerge directly from FHWA's ITS vision but as a unique opportunity to strengthen the HazMat ITS applications and operational tests program. In spite of this, project development is a strong partnership between a private defense company (PAR) and a not-for-profit organization (NIER). Political support for this partnership is strengthened by focusing the application/operational test at a location where new job opportunities are needed dearly (the Scranton/Wilkes Barre area in Pennsylvania).

One difficulty in expanding this partnership has been the lack of active participation by the motor carrier industry. This inevitably resulted in a small number of truck operators becoming part of the phase I experiment and difficulties in recruiting potential system users for the operational test and the evaluation survey(s). This has been mainly due to lack of a general commitment to work cooperatively and create a system that will eventually benefit the motor carrier industry. In addition, first responders have expressed a desire to actively participate in at least the survey component in phase I. However, due to unexpected events such as an emergency they did not participate when the team needed their presence at specific sites. There are many actions to be undertaken in order to rectify the situation in the forthcoming phases on Tranzit ***XPress.*** To do this, however, Tranzit ***XPress*** will need to engage FHWA, PennDOT, enforcement and incident responding agencies, and motor carriers in such a way that a feeling of ownership and partnership is developed in the agencies and companies that participate. In addition, instead of expecting a few volunteering individuals to participate in the meetings, surveys, and experiments, Tranzit ***XPress*** participation needs to be made an explicit policy of each agency and part of the participating individuals' duties.

6.1.2. Pricing and Taxation

Pricing is the set of procedures and schedules following which an amount of money is associated with the purchase or exchange of objects and/or services.

Taxation is the procedure(s) and regulation(s) surrounding the demand for moneys by the government for support, use of facilities, income earned, property owned, or sales performed. Taxation arrangements should change when, for example, the government provides opportunities for economic activities in new directions or increases activity in old directions. Specific private businesses are more likely to benefit from advanced technology applications included in congestion reduction, energy savings, improved safety, higher mobility and accessibility, and provision of low cost transportation. Since the entire private business spectrum does not benefit equally the question of "equity" should be considered. Similarly, for travelers, under uniform taxation regulations everybody contributes for the creation of ITS. However, not everybody benefits from ITS at the same rate (i.e. the benefits are not uniformly distributed across the population). It is much more efficient and inexpensive to implement simple "blanket" type of policies instead of population segment oriented pricing strategies. Hence, the problem of "equity versus efficiency" arises. Everybody contributes to investments from which not everybody will benefit.

These issues are becoming more pressing because of recent legislative changes. Pricing and taxation issues are under scrutiny by the FHWA because of the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 which is calling for five cooperative agreements across the nation to establish congestion pricing programs, and the NEXTEA, which is fundamentally similar to ISTEA. ISTEA/NEXTEA, however, are raising more general issues surrounding pricing of roads.

Issues open to discussion concerning pricing and taxation are:

- Distributional issues (who pays for what and when?)
- Pricing and costs (what is the right price?)
- Collection of fees, and taxes (how are the fees collected?)
- Uses of revenues from pricing (how are taxes and fees used?)
- Regulations for pricing (what is the regulatory frame for ITS pricing?)
- Market issues (what is the users' willingness to pay?)
- Technologies and cost of technologies for taxation
- Technologies and cost of technologies for pricing
- Interaction of pricing and environment

Pricing and taxation have never been raised during the operational test by the developers or agencies representing the public. These issues were raised, however, by the survey participants who at the first opportunity given asked similar questions as the nine above. Their main concerns, as noted in their survey responses, are listed below:

- Initial cost of different components of the system can be very high.
- High operating cost of the system and the supporting services will make the system unfeasible for most of the motor carriers.
- Acquiring radar guns for the deployment of the system will cost a substantial amount to the incident responders.

Given the preliminary nature of the system developed here it would have been premature to examine distributional issues when the Tranzit ***XPress*** services provided and system limitations and are not yet clearly defined.

6.1.3. Financing and Funding

The terms financing and funding are used to indicate the management of funds, the transactions taking place, the resource allocation (particularly money), the time sequenced flow (cash flow) of money, the provision of capital and the procurement of capital for ITS research, development, and deployment. One of these issues receiving increasing attention is procurement. Private industry claims that public agency traditional procurement methods should be modified to encourage a more active private sector participation in ITS research, development, and deployment. A variety of authors in ITS literature, in the past, indicate that procurement procedures aiming at an entire project (turn key approach) may be more desirable for private companies such as large defense contractors. Two basic models of procurement are available at the federal level: the DoD (turn key approach) and the FHWA (competitive RfP approach with many RfP's creating a project) models. Alternative procurement procedures, to the procedures of today, consider the possibility of a firm completing the entire project may be needed. This "new" way of doing business may allow for technology integration with the design process and maintain financial integrity

and continuity for the system to be developed. This maybe particularly appropriate for Tranzit ***XPress.***

Financing and funding issues in need of further examination are:

- Procurement procedures (is the FHWA or State procedure appropriate for ITS?)
- Use of alternative funding procedures (how should ITS and non-ITS revenues be translated into ITS projects?)
- Financing using matching and combined funds (how are tolls, fees, taxes, and other moneys used in financing the infrastructure?)
- Partnership contributions to funding (what are the shares of the partners?)

The recent debate on the Trust Fund and the NEXTEA funding related issues may provide for clear guidance. In addition, in PA the new regulations and the gas tax voted on in 1997 may also provide for a different setting within which procurement practices will be defined. At this point of evaluation procurement of funding for phase II and phase III is a mute issue (the evaluators understand funding has been allocated via appropriations).

The survey responses show that both the incident responders and motor carriers expect some sort of additional funding/financial support for the deployment of the Tranzit *XPress* system.

6.1.4. Liability

The loss of sovereign immunity (which is the legal mandate stating that the government can do no wrong) in the area of highway defects has created significant tort liability (exposure to monetary loss due to civil wrong) problems, with accompanying significant losses in lawsuits for local governments. In the previous surveys to states it has been noted that the percentage of tort claims have rapidly increased in the recent past and continue climbing. The sovereign immunity the states have historically had is almost

nonexistent with most states currently being self-insured. There is a consistent difference in tort claims across various states and most states have reacted to these tendencies by constantly increasing their legal staffs.

Liability is an extremely sensitive area for any partnership between public agencies and private industries. Early removal of the confusion on tort liability issues is widely recognized to be the best strategy to follow in forming partnerships. For example, Michigan uses risk analysis to detail the potential for safety improvements and reduced accidents with an ITS traffic management system. The contention states that safety is significantly increased as the result of the ITS technology. In support of this, the concept and practice of intergovernmental cooperation among highway agencies have been long recognized and successfully implemented. However, the legal contractual language that may ordinarily be found in cooperative arrangements is not found in such arrangements that have been successfully implemented. He also states that the legal duty is and remains to make sure that the directives to the agreement are consistent with safety considerations and established traffic engineering guidelines. It appears that if liability containment is an agency policy then agreements among public agencies are not needed. This lack of legalities can be effectively counterbalanced by cooperation among government entities. It is obvious, however, that ITS opens new facets in tort liability for public agencies and privates participating in research, development, and deployment. There are, however, tendencies in opposite directions. While public agencies are moving toward limiting or eliminating their sovereign immunity, ITS interested privates are lobbying for limiting the liability risks a private operator and/or supplier may face. These opposing tendencies should be reconciled in a public/private partnership.

A brief list of the ITS-related tort liability issues follows:

- Methods for risk assessment (what are the methods to evaluate risk?)
- Identification of the liability distribution in a partnership (who is liable for what?)
- Coordination among the various agencies involved (how is liability associated with each of a number of system components?)

- Assessment of possible conflict of interests (can a public agency regulate and participate in a partnerships?)

- Identify when and how operational tests can function as leading indicators of liability issues (can operational studies be used to identify possible liability issues before deployment?)

- Identify the legislative framework needed

- Analyze liability doctrines and practices to determine if they inhibit private sector participation

- Make policy recommendations on which liability laws or legal practices are problems and how to resolve them

- Review application of sovereign immunity principles to both government contractors and suppliers.

However these issues have never been raised during the Tranzit ***XPress*** Operational Test. However,

6.1.5. Standards and Protocols

Standards are defined norms according to an object's function. For example, a standard interface is the joining place of two systems, subsystems, or components that has a form (previously agreed upon) which allows the two to be connected together or communicate to each other readily. Protocols are sets of information that allow the communicative linkages among hardware, software and humans. When a system of ITS/Tranzit ***XPress*** is defined, standards and protocols allow the individual components to work together.

Implementation standards are needed for ITS with regard to communication, databases, and human factors. Early warnings about possible disagreements between the public and private are coming from U.K. where the public defines the standards and the privates are attempting to apply different ones based on claims of inadequacy. Communication standards are needed to ensure that equipment installed in a vehicle can be used wherever a vehicle travels.

Database standards are needed to encourage the development of new functions and features for ITS equipment and enhance the communication across software. Human factor standards are needed to ensure the safe operation of ITS equipment and to minimize the education of motorists. For example, standards and protocols aiming at uniformity allow compatibility in communication, database use, and human factors among the various system components. A consensus is currently been build in the U.S. on the need fir initiating the communications standards process, to identify the types of communication standards that are needed, to define research required to support the process of developing standards, to determine whether compatibility with the standards being developed in other countries was desirable, and to identify organizations that might lead these activities. One such stream of work is the CVSN by John Hopkins University on the CVO information infrastructure. Currently a number of professional societies are promoting conferences and workshops on standards and protocols. These are the ITS America (standards and protocol committee, international liaison committee, and systems architecture committee), IEEE (ITS standards coordinating committee), SAE (ITS division), and discussions organized by AASHTO, ITE, and TRB.

Given the premature stage of Tranzit ***XPress*** it may be too early to discuss standards and protocols in this report. It has been noted however that the system has been designed to use existing hardware, software, and communications. This in the sort term is a major advantage because the system is not attempting to create new protocols. Exception to this may be represented by the tag design, which is claimed to be also using existing technology, which the evaluation team is unable to examine in depth.

6.1.6. Intellectual Property

When a research institute or private consultant is performing work for the FHWA, the research outcome (project results, data, software, testing facilities, etc.) become property of FHWA and available to any interested person, organization, or institution. This positions the FHWA funded products in the "public domain." When private companies perform R&D and they discover new products then they usually prefer retaining any right to exploit their discovery. In a partnership, when private and public funds are used jointly, a

problem may arise regarding intellectual property. This is further complicated by the presence of universities that may present hybrid behavior regarding intellectual property.

The importance of this issue is recognized by the various actors. However, solutions to issues about intellectual property are believed to become an obvious result when clarity in the roles within a partnership and the shares of funding will be defined. Following the "areas" in which intellectual property may arise are listed:

- New hardware
- New software
- System architecture
- Methods/models for specific transportation problems
- Use of existing patented hardware and software
- Consensus on intellectual issues

Tranzit ***XPress*** is using public funds for specific components of the developed system, which are placed in the public domain. Other components such as the "fleet and cargo management" capability of the system are retained as privately owned intellectual property.

6.1.7. User's Behavior

The users' issues can be summarized as:

- Privacy, security, and personal freedom concerns
- Willingness to pay
- Perception of technologies' usefulness
- Perception of risk
- Market definition and private uncertainty reduction
- Derived assessment and prediction

In earlier sections of this report we have examined selectively some of these issues in depth. One main issue that has not been discussed in detail yet is the security of information handled by Tranzit ***XPress.*** It should be noted that for budgetary purposes we have excluded the shippers from the survey. This has

eliminated a party that is sensitive to data security. For example, if shipping data are made available (willingly or by a system error) to competitors the market advantage of a shipping company may be lost.

6.1.8. Monopolies/Antitrust

In general, research activity with respect to antitrust concerns is regulated under the National Cooperative Research Act of 1984. However, depending on the degree of the partnership innovation the need for changes may vary. Macdonald (1988) discusses U.S. antitrust law relating to the treatment of joint research ventures to develop intellectual property, and draws comparisons between the US National Co-operative Research Act 1984 and the EEC Regulation on Research and Development Agreements. The paper sets out the basic US antitrust statutes (Sherman Act, Clayton Act, Federal Trade Commission Act), explains the difference between 'per se violations' and 'rule of reason', and explains the application of the rule of reason in US law to joint research and development ventures under EEC Regulation No. 4 18/85. According to ITS America (1992) "if a joint R & D venture has no anti-competitive effects, or if any such effects are outweighed by the pro-competitive effects, then the venture does not violate the antitrust laws."

Areas for further research and areas that need to be addressed are:

- Research antitrust concerns to identify constraints in ITS development

- Define appropriate roles for industry and government on delineation of pre-competitive and competitive activity.

We believe that monopolies and antitrust do not apply for Tranzit ***XPress.***

6.1.9. Legislation

With respect to personal privacy the courts decided on the installation or attachment of electronic transponders on vehicles or aircrafts, or their subsequent use to monitor the location of such vehicles or aircraft. The use of the transponders constitutes a "search" within the meaning of the Fourth

Amendment to the Constitution of the United States that protects the right of the people to be secure in their persons, houses, papers, and the effects against unreasonable searches and seizures.

Excluded from the scope of this annotation are cases in which a transponder or "beeper" has been placed in packages or containers to monitor the location and hence the course of possession thereof, even though such location may be aboard or within aircraft or motor vehicle. In such cases, the location of the vehicle itself is considered for present purpose to be merely incidental to the primary issue of the location of the materials in question and such cases often present questions as to property and privacy rights in such containers and materials different from those presented by direct attachment of a transponder to a vehicle or aircraft. Tranzit ***XPress*** uses a hybrid system with tags containing key information and the transmittal of information to the center is done using vehicle electronics. The legal nature of this type of system is unknown at present.

Clearly each of the issues presented in this report contains a legal issue part. Specific legislative action is needed for the definition of product and system tort liability allocation, antitrust safeguarding, privacy concerns and maintenance, fair procurement procedures, defense of intellectual property, and so forth.

Legislative activity needs to address the following areas:

- Liability in partnerships
- Standards guidelines and enforcement
- Monitoring guidelines and procedures
- Property regulations
- Jurisdictional regulations

6.1.10. Jurisdiction

One of the problems many transportation policy efforts faced in the past is the fragmentation of jurisdictions. ITS technologies and especially ITS networks cross geographical and legislative jurisdictional boundaries bringing together agencies operating at the federal, state, regional, county, city, township, and

borough levels. Moreover, departments that are usually separated by traditional jurisdictions have to cooperate not only because of ITS technology diffusion but also because of recent legislative "revolutions" like the ISTEA/NEXTEA and the Clean Air Act Amendments of 1990.

A number of issues are unresolved with respect to jurisdictions. For example, who is going to collect the ITS revenues? How are these funds going to be allocated to various geographical locations? Which ITS technologies and systems should follow the traditional public revenue flow? (E.g., the present taxation made up by Federal-State-Local components) Which technologies are to be used for local revenue?

Collaboration at many levels and by various partners means contracting responsibilities and contracting risks. The following need further examination:

- Geographical jurisdictions and ITS technology applications
- Institutional/regulatory jurisdictions and ITS technology applications
- Identification of the optimum jurisdictional level to deploy ITS/Tranzit ***XPress*** technologies

6.1.11. Enforcement

Enforcement of policies and monitoring of compliance have always been difficult problems to solve. In transportation, enforcement and compliance with air quality requirements is one of the most important steps in meeting the Clean Air Act amendments. It is important to identify the measures of compliance and the measures of standards early in the ITS implementation. Moreover, it is very important to identify an accurate monitoring procedure and the legislation needed.

Tranzit ***XPress*** offers a unique opportunity to monitor shipping of HazMat and enforcing associated laws. The system, however, is envisioned to protect private company information and does not allow for enforcement monitoring at the control center. It allows monitoring, to verify agreement between shipping data and placard information, using the radar gun.

A major concern, raised by the motor carriers, is due to the ability of Tranzit ***XPress*** to provide information to incident responders, without informing the motor carriers, in event of an incident. A significant percentage of the truck drivers do not inform the incident responders immediately about incidents. Instead, they inform their employers and the motor carriers often handle the HazMat containment/clean-up themselves. Motor carriers feel that if Tranzit ***XPress*** facilitates in the enforcement of regulations, and the incident responders learn about the incidents immediately, cost of incident management incurred by the motor carriers will increase substantially. On the other hand, the incident responders reported that the motor carriers do not always report HazMat incidents. To ensure safety, the incident responders consider it absolutely necessary that they are informed about the incident without any delay. This is not only a legislation/enforcement issue, but a user behavior issue as well.

6.1.12. Education

For convenience one can identify two sectors in which educational issues should receive attention. First, the participants in a consortium, coalition, or partnership should understand the motivations, objectives, and capabilities of everybody else. Second, since ITS is promoting itself as a strong solution to transportation problems (and economic growth in the U.S. or an opportunity for collaboration in Europe) the participants should be informed about transportation problems and the transportation-related methods for problem solution/analysis.

The educational component of ITS partnerships is repeatedly stressed by ITS promoters who claim that public agencies know little about business practices and they ignore the conditions under which most interested to ITS privates have been operating. One example is the procurement practices of FHWA and the incompatibility with the technologies to be implemented and/or deployed and the past private experience. Another educational component calls for activities in transportation-related diffusion of information and exchange of information among disciplines to achieve integrated ITS systems. NIER is undertaking efforts to increase education in HazMat transportation.

Some issues raised by the test participants in their survey responses are listed below:

- Truck drivers are not trained to efficiently handle the system. Reliability and effectiveness of the system depends on the correct input of information by the drivers.
- Truck drivers are not properly trained for HazMat incident situations.
- Other carrier and shipper personnel need training as well.
- Incident responders also need additional training to use the system.

6.1.13. Action Timing

In this section we offer an alternate vision to Tranzit ***XPress*** development that is consistent with current business development practice in the U.S. Unlike the first phase, which was characterized by PAR/NIER initiative and government oversight, we outline a process in which we see more active public agency participation. We have also identified sectors were universities and national laboratories can play key roles for Tranzit ***XPress*** to become a useful system.

6.1.13. 1.Business Practices and Timing Issues

The competitive nature of business today is forcing companies to examine and re-align their products and processes to ensure that they are keeping up with the newest technology trends and market demands. This is a focus on the customer and product development in areas of business operations that will help companies compete in the fast changing marketplace. This increased competition and tougher market demands have initiated the creation of new business tools and relationships that have blurred the traditional form of business practices. The traditional form of business was designed around strong adversarial competition where each company in competing areas had a self reliance and self determination. To combat the changing business environment many companies have adopted new approaches to examine their products and processes to ensure that they are managed efficiently.

Some of these approaches that are used in business maybe applicable to the ITS setting. Three of these approaches to business practices; the product life cycle, project mapping, and innovative relationships are discussed below. These three approaches offer specific insight into the attempts by private industry to reduce uncertainty and increase their market success. Private industry often begins a new product introduction project by first examining the entire cycle the product will follow before it is introduced to the market. This thorough identification of any problems and foreseen limitations or newly found benefits will be included in the design, development and implementation of that product thus making it more competitive. These three approaches are now offered.

The "Product Life Cycle" (PLC) is a marketing approach used to illustrate the fundamental stages of product development and product evolution. The new product is described in relative position to its age and life span projection. The PLC stages are defined as the introduction (birth) stage, the growth stage, the maturity stage and the saturation (decline) stage. A curve that depicts the cycle defines the course that the product will take over its life. In the beginning or introduction stage the product will develop at a slow incline. Then in the growth stage the product enjoys tremendous expansion and has a strong incline. The next stage (maturity) growth levels off as does the curve. Finally, during the last stage (decline), the curve falls slowly which describes the tailing off of sales.

The connection between the product life cycle and ITS can be seen with the course that ITS may take regarding the market development. As the introductory stages of ITS are initiated the curve may be similar to that of the product life cycle. As new generations of technology are developed to enhance or replace the original technology, this life cycle will be repeated and redefined. This holds true with the PLC in business practices because of changing market driven forces where consumers require the newest, fastest and best products available. With ITS, the advancement of research, knowledge and experience will become the driver for advancements in technology and the resulting products.

The timing of ITS may also be compared to the product life cycle from a critical view point. As ITS implementations occur, the logical sequential progression of advanced technology will follow as ITS technologies become

more mature. The phasing of advanced technologies, including Tranzit ***XPress,*** will occur as the technology in general grows, matures as public acceptance increases and as successful products are generated. This ITS life cycle may take similar form as the product life cycle is currently used in private industry today. Phase I of Tranzit ***XPress,*** however, is at a stage of R&D. The subsequent phases are more likely to be considered as the initial phases of PLC.

The "Project Mapping" approach to new business projects is also a staged approach to developing projects. To help reduce the risks associated with new project/product introduction private industry has established ways to keep the financial and timing constraints under control by virtually mapping projects. Project mapping is used to optimize various projects so they can be managed more efficiently and differentiated equally by their project type. The mapping of projects provides useful information about how resources should be allocated, when they should be allocated, what management style should be used, what parties (people) should be involved at specific development periods and what combination of these resources, management, and involvement are needed.

The understanding of the purpose and intention of project mapping allows the introduction of a format for the roles of the private, public and university partnerships for Tranzit ***XPress*** specific issues. The developing of project maps allows the timing and implementation constraints to be clearly represented on a time-line. The project map described here breaks the development of Tranzit ***XPress*** specific issues into five areas: research and development (being two), breakthrough, platform, and derivative projects. The five areas represent projects that are progressive stages of development.

Development of these five areas follows a path from research and development through to full implementation as the time-line increases. The newest project is taken directly from the research and development area and brought to the "breakthrough" projects area. The breakthrough project area involves changes to the current products and introduction of new products that are currently being made. Breakthrough projects establish the future direction and the "core" products of the firm. Core products create the actual new product lines for a firm. These are the few essential products that will be the base for all future platform and derivative products.

The platform products of a firm are those that products lines are expanded from the breakthrough projects. Platform products offer fundamental improvements in cost, quality, and performance over preceding generations of breakthrough products. Derivative products are those products that are cost reduced versions of existing platform products. Derivative products can be add-on parts or enhancements to the product. These products are expansions from the existing product lines and occur far down the product's life cycle. The presence of development projects that are inefficient and chaotic is possible and the goal of the new project development is to focus on areas that are efficient. The product and process changes increase and decrease according to the project. The breakthrough project requires a new core process and results in new core processes. As the project reaches the derivative level the need for new processes/products does not support itself. Rather, less process and product change are used with incremental changes and enhancements becoming the common form.

The use of mapping development projects and describing each stage through five different projects is very useful in detailing the ITS specific issues. This map can be drawn for each of the public, private, not-for-profit, and university components of ITS development. The direction of ITS development can be visually evaluated and compared while being objectively analyzed. The benefit that is gained fi-om mapping the development of a new project is its visual and descriptive nature. Projects can be easily defined as to the specific stage of development. As ITS development progresses, it may follow through from the R & D stage to breakthrough and ultimately to derivative projects. The timing of these different projects will logically follow a timing sequence (see for example mapping attempts to ITS made by FHWA in the past). The R & D projects will naturally be the first area of development, therefore relevant to the timing element, it will be the nearest timing element. The other projects may follow this sequence where the derivative projects will occur the farthest out into the future.

The use of "Innovative Business Relationships" is a third area where traditional business practices have taken a new direction. A new approach to innovative business relations is viewed under the approach where every division within the business plays an important role in the success of the new project. This approach gathers its strength from the cross-functional

management style in which work is performed by teams until the project is completed. This approach is called the concurrent engineering approach where all functions are involved with the project concurrently throughout its duration.

Concurrent engineering incorporates all areas of the business under a cross-functional approach from each area within the business (including engineering, business, and administration/management) as well as other functional areas depending on the specific nature of the business. This new approach incorporates overlapping functional areas that act as one unit to reduce the time delays required for all stages of project completion. The new approach takes the view that technology development is evolutionary and thus is continually progressing. This is carried through to include close relations between product and process innovation. Finally, the new approach takes the philosophy that progress occurs through organized effort and teamwork, where collaboration across functional bounds is crucial.

This approach is not limited to the boundaries of one organization and can actually be improved if outside partners are established. These partners can be suppliers, industry specialists, consultants, governmental agencies, and regulatory bodies.

One specific example of the innovative relations can be seen with the use of suppliers as part of the above stated structure. Operationally, the innovative relationship will start with the suppliers becoming part of the cross-fimctional team. The suppliers will have a dependent responsibility for every aspect of what they produce. Suppliers will have direct input as to what ways the manufacturing of these designed parts can be performed most efficiently. Their role will be maintained throughout the development cycle. This will mean that the company-supplier relationship will take the form of a “co-destiny” relationship that has been proven effective in Japanese industry. Co-destiny relates to the success of one company is dictated by the success of the combined efforts. The actual dedication and time involvement will be dependent, in this example, on the percentage the suppliers’ products are needed in relation to the company (e.g., asset tags versus the entire system).

The supplier input will effect not only the planning, design and output of the product but also improve quality and help to reduce the total cycle time (from product design to implementation). The quality will be improved through the

best design for each component that the supplier makes being properly defined at the beginning of the design effort. The quality assurance that can be performed by the direct supplier involvement will minimize if not eliminate any design that could otherwise be found later in the cycle. Since the new innovative relations will include the suppliers from the beginning, the total cycle time from concept to finished product will be reduced. This example offers some insight into the benefits that exist for ITS development. More innovative relationships can be established everywhere and the result will be a faster introduction, higher reliability and quality, as well as shorter times from development to deployment. By involving all parties early on in the process then the resulting benefit will be improved development throughout. The concept of innovative business relationships may be simplistic and not really advanced but its application is much harder to implement than it is to accept the concept. The attempt by many private industries to successfully use this approach is limited. Many companies fall short in their efforts because of a short-term focus on financial driven concerns and not the overall long-term benefit. Following the evaluator offers a suggestion for an orderly way of development.

6.1.13.2. Timeline of Barrier Removal

The implementation of Tranzit ***XPress*** specific technologies must be defined in an orderly manner for the successful partnership arrangements between the private, public and not-for-profit/university sectors. This implementation must follow a timeline that includes the respective players and their roles.

The private, public, not-for-profit, and university roles in the development of Tranzit ***XPress*** can be as follows. The development process for the private sector will follow the time-line cycle as discussed above. The private sector's research and development needs will include areas of communications, hardware, and software. All of these technical R & D needs will be conditional on the funding aspect to help support them. The R & D projects will be combined with that of the public (e.g., National laboratories such as the Oak Ridge National Laboratory work on HazMat monitoring) and university research (e.g., safety research, evacuation planning, marketing research) and development to arrive at the breakthrough project. This breakthrough will be the initial market penetration for the Tranzit ***XPress*** technology in the public

market domain. This implies that once the research and development are fully complete across all sectors and when the Tranzit ***XPress*** technology is fully tested and evaluated both theoretically and operationally that the result will be a usable breakthrough project. The initial breakthrough relates to market development and supply. The private sector is introducing their products to the general public for wide spread sale and distribution. As the breakthrough project develops over time the breakthrough falls into a platform project and finally one or more derivative projects. This progression occurs over the life cycle of the project and has no specific predetermined length.

As with the private sector, the public sectors' support in Tranzit ***XPress*** will start from the research and development level as it did in a very small scale based on volunteers. This parallels the private sectors R & D progression. This R & D includes the establishment of initial legislation and funding to direct such efforts as standards and protocols, necessary tolerances, data integrity and jurisdictional determinations. To do this, however, public agencies need to go beyond the initial volunteer mechanism and move into the definition of specific policies in support of Tranzit ***XPress.*** However, as the breakthrough project hits the market place the public sectors initiatives differ from those of the private sector. The institutional and policy issues development need to be well established. At the breakthrough stage, the initial legislation set forth in the "R & D" stage is overseen. This public sector input will be reviewed at the beginning of the platform stage institutional and policy development to ensure that the liability and property laws are supportive and strong enough for the continued development of the platform projects. The importance for this public sector involvement is to determine the correct level of legislation and the implications the private sector needs to compete in the market place. This must be carried out in a fairly and equitably manner. The public sector involvement ends after the platform stage and will reappear when the next generation of Tranzit ***XPress*** is developed.

The not-for-profit and university sectors follow the private and public sectors with their own research and development. The differences in the university sector are seen at all levels where the research and development will continue throughout the entire life cycle of the Tranzit ***XPress*** development. The importance of this R & D is the future direction of the research. The development of new ideas and knowledge are ascertained at the university sector and for many aspects government laboratories that are also able to create

new technologies or transfer technologies from other industries. This is supported by faculty and analysts through applied research and laboratory research and equipment/operational tests. The R & D is not just a research support for the private sector but also a basis for future projects development. This is routinely done in the Universities as "assessment for the next generation" areas. In this sector the progress of the entire Tranzit ***XPress*** development is assessed, which complements the current role and target given to the evaluation idea. Instead of a sterile independent and objective evaluation it should be an independent and objective assessment with a view into the future developments and an integral part of the entire development cycle. The intention surrounds the partnership goal for all four private, public, not-for-profit, and university sectors.

The Tranzit ***XPress*** development effort needs to take this collective approach to become successful. The project mapping approach to new product development is one form of timing device that can be both easily described and visually seen. Similar models have been developed to help map such new project developments. These other models may take different conditional stances and they may have different goals. However, for the purposes set forth by the partnership this model is a benefit because its inclusiveness among these four unique groups is realized. The specific determinations on this timing plan with regard to the issues still need much more thought and development. This model offers insight to how the ultimate Tranzit ***XPress*** plan may take form. The model can only guide the thoughts for such development.

Appendix A - REFERENCES

1. Tranzit ***XPress*** Evaluation Plan, Document #96 1 0.XPRS.00 Center for Intelligent Transportation System, July 1996.

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Appendix B - DATA COLLECTION INSTRUMENTS

Tranzit *XPress* Survey

(Incident Responders)

Questionnaire #1

Name _____
Co. Name _____
Phone # _____
Fax # _____
Email _____

This survey is designed to gather information about your experiences with accidents and incidents involving the transportation of hazardous materials by motor carriers. This form should take about 10 minutes to complete. Al1 of your responses will be kept confidential. Your cooperation is appreciated.

1. Please indicate your age group:

[] Under 21 [] 21-30 [] 31-40 ❑ 41-50 [] 51-64 [] 65 and over

2. **Please indicate your occupation/employer:**

[] Police Dept.
❑ Paid Fire Dept.
[] Volunteer Fire Dept.
❑ Paid Ambulance / Rescue Squad
[] Volunteer Ambulance / Rescue Squad
Other Public Safety Agency:
[] Federal [] State [] Local
[] Special Hazmat Response Team

3. **What is your position within this organization?** _____

4. **How long have you been at your present occupation?**

[] Less than 1 yr. ❑ l-2 yrs [] 3-5 yrs. [] 6-10 yrs. [] 11-20 yrs. [ ] More than 20 yrs.

5. **How long have you been involved in hazardous materials transportation?**

[] N/A ❑ Less than 1 yr. [] l-2 yrs. [] 3-5yrs.
[] 6-10 yrs. [] 11-20 yrs. ❑ More than 20 yrs.

6. **How many incidents involving hazardous materials transportation have you responded to:**

In your career? _____ In the last 3 years? _____ [] Not applicable

7. **Please indicate your current level of hazardous materials training (check all that apply):**

[] None
[] Technician (40 hrs./yr.)
[] Other formal training. Specify: _____
[] Basic recognition (2 hrs./yr.)
❑ Specialist (More than 40 hrs./yr.)
[] Operations (16 hrs./yr.)
[] 49 C.F.R. Training

Please respond to the following questions as appropriate, based on your personal experience with *hazardous materials* incidents/accidents involving motor carriers only.

8. **Please rate the effectiveness of the current recordkeeping system (i.e. shipping papers) at:**

	Very Effective 1	2	Average 3	4	Very Ineffective 5
maintaining safety	[ ]	[ ]	[ ]	[ ]	[ ]
maintaining efficiency	[ ]	[ ]	[ ]	[ ]	[ ]
accurately tracking hazardous materials	[ ]	[ ]	[ ]	[ ]	[ ]
accurately reflecting mixed loads (e.g. herbicides, minimum toxic quantities, toxic combinations etc.)	[ ]	[ ]	[ ]	[ ]	[ ]

Continue on the next pag

9. How effective is the current placard system for identifying truck contents in determining optimal emergency response and cleanup strategies?

Very Effective		Average		Very Ineffective
1	2	3	4	5
❑	❑	❑	❑	❑

10. How effective is the currently available information in determining optimal emergency response and cleanup strategies?

Very Effective		Average		Very Ineffective
1	2	3	4	5
❑	❑	❑	❑	❑

11. How would you rate current motor carrier compliance with HazMat regulations?

Satisfactory		Average		Unsatisfactory
1	2	3	4	5
❑	❑	❑	❑	❑

12. How effective are the current systems in assuring motor carrier compliance with HazMat regulations?

Very Effective		Average		Very Ineffective
1	2	3	4	5
[ ]	[ ]	[ ]	[ ]	[ ]

13. On average, for the incident described in your handout, how much time is typically required for the:

Vehicle operator to realize that a problem exists	_____	min.	[] Don't know
Vehicle operator to call 9 11 or other emergency number	_____	min.	❑ Don't know
Vehicle operator to properly identify vehicle location	_____	min.	❑ Don't know
First responder to reach the incident site	_____	min.	❑ Don't know
Cargo recognition and identification by first responder	_____	min.	❑ Don't know
Notification of fire department / rescue squad	_____	mm.	❑ Don't know
Notification of HazMat team and/or emergency management agency	_____	min.	❑ Don't know
Determination of what equipment is needed (incl. additional crews)	_____	min.	❑ Don't know
Secondary responders to reach the site with proper equipment	_____	min.	❑ Don't know
Passive containment and stabilization (e.g. fire dept. digging trenches)	_____	min.	❑ Don't know
Containment and stabilization by specialists (HazMat crews)	_____	min.	❑ Don't know
Evacuation of persons from the affected area (if necessary)	_____	min.	❑ Don't know
Clean up of the accident/incident site	_____	min.	❑ Don't know

14. List and rate existing HazMat systems that you have used with respect to information that facilitates incident response:

a. The accessibility of information	Readily Accessible		Average		Not Accessible
	1	2	3	4	5
_____	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]

Continue on the next page

b. The usefulness of information	Very Useful		Average		Not Useful
	1	2	3	4	5
_____	❑	❑	❑	❑	❑
_____	❑	❑	[]	❑	❑
_____	❑	❑	❑	❑	[]

c. The accuracy of information	Very Accurate		Average		Not Accurate
	1	2	3	4	5
_____	❑	❑	❑	❑	❑
_____	❑	❑	❑	[]	❑
_____	❑	❑	❑	❑	❑

15. Please list the three things you like most about the current HazMat incident response system:

1. _____

2. _____

3. _____

16. Please list the three things you dislike most about the current HazMat incident response system:

1. _____

2. _____

3. _____

17. Provide additional comments below. Indicate if your comments are in response to a particular question.

_____

_____

_____

_____

_____

_____

_____

_____

THANK YOU!

Tranzit *XPress* Survey

(Motor Carriers)

Questionnaire #1

Name _____
Co. Name _____
Phone # _____
Fax # _____
Email _____

This survey is designed to gather information about your experiences with accidents and incidents involving the transportation of hazardous materials by motor carriers. This form should take about 10 minutes to complete. All of your responses will be kept confidential. Your cooperation is appreciated.

1. Please indicate your age group:

[] Under21 [] 21-30 [] 31-40 ❑ 41-50 [] 51-64 [] 65 and over

2. Please indicate your occupation/employer:

[] Shipping Company [] Carrier [] Recipient

3. What is your position within this organization? _____

4. How long have you been at your present occupation?

[] Less than 1 yr. [] 1-2 yrs ❑ 3-5 yrs. [] 6-10 yrs. [] 11-20 yrs. [] More than 20 yrs.

5. How long have you been involved in hazardous materials transportation?

[] N/A [] Less than 1 yr. [] 1-2 yrs. [] 3-5 yrs.
[] 6-10 yrs. [] ll-20 yrs. [ ] More than 20 yrs.

6. Experience as a professional truck driver:

Total experience: _____ years. Last experience ended _____ years ago. [] Not applicable

7. How many incidents involving hazardous materials transportation have you been involved with:

a. As a driver: In your career? _____ In the last 3 years? _____ [] Not applicable
b. As a respondent: In your career? _____ In the last 3 years? _____ [] Not applicable

8. In the case of a hazardous material incident, whom does the driver most often contact first?

[] Police [] Fire Department [] Rescue Squad
[] Public Safety Agency [] Employer ❑ 9 11 or other emergency phone number
[] Other: _____

Please respond to the following questions as appropriate, based on your personal experience with *hazardous materials* incidents/accidents involving motor carriers only.

9. Please rate the effectiveness of the current recordkeeping system (i.e. shipping papers) at:

	Very Effective 1	2	Average 3	4	Very Ineffective 5
maintaining safety	[ ]	[ ]	[ ]	[ ]	[ ]
maintaining efficiency	[ ]	[ ]	[ ]	[ ]	[ ]
accurately tracking hazardous materials	[ ]	[ ]	[ ]	[ ]	[ ]
assisting in meeting reglatory requirements	[ ]	[ ]	[ ]	[ ]	[ ]
accurately reflecting mixed loads (e.g. herbicides, minimum toxic quantities, toxic combinations etc.)	[ ]	[ ]	[ ]	[ ]	[ ]

Continue on the next page..

10. How effective is the current placard system for identifying truck contents in determining optimal emergency response and cleanup strategies?

Very Effective		Average		Very Ineffective
1	2	3	4	5
❑	❑	[]	[]	[]

11. How effective is the currently available information in determining optimal emergency response and cleanup strategies?

Very Effective		Average		Very Ineffective
1	2	3	4	5
❑	❑	❑	❑	❑

12. How would you rate current motor carrier compliance with HazMat regulations?

Satisfactory		Average		Unsatisfactory
1	2	3	4	5
❑	❑	❑	❑	❑

13. How effective are the current systems in assuring motor carrier compliance with HazMat regulations?

Very Effective		Average		Very Ineffective
1	2	3	4	5
❑	❑	❑	❑	❑

14. On average, for the incident described in your handout, how much time is typically required for the:

Vehicle operator to realize that a problem exists	_____	min.	❑ Don't know
Vehicle operator to call 9 11 or other emergency number	_____	min.	❑ Don't know
Vehicle operator to properly identify vehicle location	_____	min.	❑ Don't know
First responder to reach the incident site	_____	mm.	❑ Don't know
Cargo recognition and identification by first responder	_____	min.	❑ Don't know
Notification of fire department / rescue squad	_____	min.	❑ Don't know
Notification of HazMat team and/or emergency management agency	_____	min.	❑ Don't know
Determination of what equipment is needed (incl. additional crews)	_____	mm.	❑ Don't know
Secondary responders to reach the site with proper equipment	_____	min.	❑ Don't know
Passive containment and stabilization (e.g. tire dept. digging trenches)	_____	min.	❑ Don't know
Containment and stabilization by specialists (HazMat crews)	_____	min.	❑ Don't know
Evacuation of persons from the affected area (if necessary)	_____	mm.	❑ Don't know
Clean up of the accident/incident site	_____	min.	❑ Don't know

15. List and rate existing HazMat systems that you have used with respect to information that facilitates incident response:

a. The accessibility of information

	Readily Accessible		Average		Not Accessible
	1	2	3	4	5
_____	❑	❑	❑	❑	❑
_____	❑	❑	❑	❑	❑
_____	❑	❑	❑	❑	[]

Continue on the next page...

b. The usefulness of information

	Very Useful		Average		Not Useful
	1	2	3	4	5
_____	❑	❑	❑	❑	❑
_____	❑	❑	❑	❑	❑
_____	❑	❑	❑	❑	❑

c. The accuracy of information

	Very Accurate		Average		Not Accurate
	1	2	3	4	5
_____	❑	❑	❑	❑	❑
_____	❑	❑	❑	❑	❑
_____	❑	❑	❑	❑	❑

16. Please list the three things you like most about the current HazMat incident response system:

1. _____

2. _____

3. _____

17. Please list the three things you dislike most about the current HazMat incident response system:

1. _____

2. _____

3. _____

18. Provide additional comments below. Indicate if your comments are in response to a particular question.

_____

_____

_____

_____

_____

_____

_____

_____

THANK YOU!

Tranzit *XPress* Survey

(Incident Responders)

Questionnaire #2

Name _____
Co. Name _____
Phone # _____
Fax# _____
Email _____

You have observed the system demonstration of the Tranzit ***XPress*** system. The main objective of this second questionnaire is to get feedback on system. Your answer will provide us with valuable data that will help in evaluating the system. Please respond to the following questions as appropriate, based on the demonstration. This survey will take approximately 15 minutes. Your cooperation is appreciated.

1. For the incident described in your handout, if Tranzit *XPress* system is used, how much time is required for the:

Vehicle operator to realize that a problem exists	_____ min.	[] Don't know
Vehicle operator to call 9 11 or other emergency number	_____ min.	❑ Don't know
Vehicle operator to properly identify vehicle location	_____ min.	[] Don't know
First responder to reach the incident site	_____ min.	[] Don't know
Cargo recognition and identification by first responder	_____ min.	[] Don't know
Notification of fire department / rescue squad	_____ min.	[] Don't know
Notification of HazMat team and/or emergency management agency	_____ min.	[] Don't know
Determination of what equipment is needed (incl. additional crews)	_____ min.	[] Don't know
Secondary responders to reach the site with proper equipment	_____ min.	[] Don't know
Passive containment and stabilization (e.g. fire dept. digging trenches)	_____ min.	[] Don't know
Containment and stabilization by specialists (HazMat crews)	_____ min.	[] Don't know
Evacuation of persons from the affected area (if necessary)	_____ min.	[] Don't know
Clean up of the accident/incident site	_____ min.	[] Don't know

2. Please rate the effectiveness of the:

a. Current recordkeeping system (i.e. shipping papers) at:

	Very Effective 1	2	Average 3	4	Very Ineffective 5
maintaining safety	[ ]	[ ]	[ ]	[ ]	[ ]
maintaining efficiency	[ ]	[ ]	[ ]	[ ]	[ ]
accurately tracking hazardous materials	[ ]	[ ]	[ ]	[ ]	[ ]
accurately reflecting mixed loads (e.g. herbicides, minimum toxic quantities, toxic combinations etc.)	[ ]	[ ]	[ ]	[ ]	[ ]

b. Tranzit *XPress* recordkeeping system at:

	Very Effective 1	2	Average 3	4	Very Ineffective 5
maintaining safety	[ ]	[ ]	[ ]	[ ]	[ ]
maintaining efficiency	[ ]	[ ]	[ ]	[ ]	[ ]
accurately tracking hazardous materials	[ ]	[ ]	[ ]	[ ]	[ ]
accurately reflecting mixed loads (e.g. herbicides, minimum toxic quantities, toxic combinations etc.)	[ ]	[ ]	[ ]	[ ]	[ ]

3. How effective is the placard system for identifying truck contents in determining optimal emergency response and cleanup strategies?

	Very Effective 1	2	Average 3	4	Very Ineffective 5
Current System	[ ]	[ ]	[ ]	[ ]	[ ]
Tranzit ***XPress*** System	[ ]	[ ]	[ ]	[ ]	[ ]

Continue on the nextpage...

4. How effective is the information available through the following systems in determining optimal emergency response and cleanup strategies?

	Very Effective		Average		Very Ineffective
	1	2	3	4	5
Current System	❑	❑	❑	❑	❑
Tranzit ***XPress*** System	❑	❑	❑	❑	❑

5. How effective are the following in assuring motor carrier compliance with HazMat regulations?

	Very Effective		Average		Very Ineffective
	1	2	3	4	5
Current System	❑	❑	❑	❑	❑
Tranzit ***XPress*** System	❑	❑	❑	❑	❑

6. List and rate Tranzit *XPress* and existing HazMat systems that you have used with respect to information which facilitates incident response:

a. The accessibility of information

	Readily Accessible		Average		Not Accessible
	1	2	3	4	5
Tranzit ***XPress*** System	❑	❑	❑	❑	❑
_____	❑	❑	❑	❑	❑
_____	❑	❑	❑	❑	❑
_____	❑	❑	❑	❑	❑

b. The usefulness of information

	Very Useful		Average		Not Useful
	1	2	3	4	5
Tranzit ***XPress*** System	❑	❑	❑	❑	❑
_____	❑	❑	❑	❑	❑
_____	❑	❑	❑	❑	❑
_____	❑	❑	❑	❑	❑

c. The accuracy of information

	Very Accurate		Average		Not Accurate
	1	2	3	4	5
Tranzit ***XPress*** System	❑	❑	❑	❑	❑
_____	❑	❑	❑	❑	❑
_____	❑	❑	❑	❑	❑
_____	❑	❑	❑	❑	❑

7. How effective is Tranzit *XPress* in providing information through links with other systems?

Very Effective		Average		Very Ineffective
1	2	3	4	5
❑	❑	❑	❑	❑

8. Please list the three things you like most about the Tranzit *XPress* incident response system:

1. _____

2. _____

3. _____

Continue on the next page.

9. Please list the three things you dislike most about the Tranzit *XPress* incident response system:

1. _____

2. _____

3. _____

10. Would you use Tranzit *XPress* incident response system?

[] Yes Why? _____

[] No Why? _____

[] Cannot decide

11. Would you use any individual components of Tranzit *XPress* incident response system?

[] Yes Useful components: _____

Why? _____

[] No why? _____

[] Cannot decide

12. Provide additional comments below. Indicate if your comments are in response to a particular question.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

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THANK YOU!

Tranzit *XPress* Survey
(Motor Carriers)
Questionnaire #2

Name _____
Co. Name _____
Phone # _____
Fax# _____
Email _____

You have observed the system demonstration of the Tranzit ***XPress*** system. The main objective of this second questionnaire is to get feedback on system. Your answer will provide us with valuable data that will help in evaluating the system. Please respond to the following questions as appropriate, based on the demonstration. This survey will take approximately 15 minutes. Your cooperation is appreciated.

1. For the incident described in your handout, if Tranzit *XPress* system is used, how much time is required for the:

Vehicle operator to realize that a problem exists	_____ min.	[] Don't know
Vehicle operator to call 9 11 or other emergency number	_____ min.	[] Don't know
Vehicle operator to properly identify vehicle location	_____ min.	[] Don't know
First responder to reach the incident site	_____ min.	[] Don't know
Cargo recognition and identification by first responder	_____ min.	[] Don't know
Notification of fire department / rescue squad	_____ min.	[] Don't know
Notification of HazMat team and/or emergency management agency	_____ min.	[] Don't know
Determination of what equipment is needed (incl. additional crews)	_____ min.	❑ Don't know
Secondary responders to reach the site with proper equipment	_____ min.	[] Don't know
Passive containment and stabilization (e.g. fire dept. digging trenches)	_____ min.	[] Don't know
Containment and stabilization by specialists (HazMat crews)	_____ min.	[] Don't know
Evacuation of persons from the affected area (if necessary)	_____ min.	[] Don't know
Clean up of the accident/incident site	_____ min.	[] Don't know

2. Please rate the effectiveness of the:

a. Current recordkeeping system (i.e. shipping papers) at:

	Very Effective 1	2	Average 3	4	Very Ineffective 5
maintaining safety	[ ]	[ ]	[ ]	[ ]	[ ]
maintaining efficiency	[ ]	[ ]	[ ]	[ ]	[ ]
accurately tracking hazardous materials	[ ]	[ ]	[ ]	[ ]	[ ]
assisting in meeting regulatory requirements	[ ]	[ ]	[ ]	[ ]	[ ]
accurately reflecting mixed loads (e.g. herbicides, minimum toxic quantities. toxic combinations etc.)	[ ]	[ ]	[ ]	[ ]	[ ]

b. Tranzit *XPress* recordkeeping system at:

	Very Effective 1	2	Average 3	4	Very Ineffective 5
maintaining safety	[ ]	[ ]	[ ]	[ ]	[ ]
maintaining efficiency	[ ]	[ ]	[ ]	[ ]	[ ]
accurately tracking hazardous materials	[ ]	[ ]	[ ]	[ ]	[ ]
assisting in meeting regulatory requirements	[ ]	[ ]	[ ]	[ ]	[ ]
accurately reflecting mixed loads (e.g. herbicides, minimum toxic quantities, toxic combinations etc.)	[ ]	[ ]	[ ]	[ ]	[ ]

3. How effective is the placard system for identifying truck contents in determining optimal emergency response and cleanup strategies?

	Very Effective 1	2	Average 3	4	Very Ineffective 5
Current System	[ ]	[ ]	[ ]	[ ]	[ ]
Tranzit *XPress* System	[ ]	[ ]	[ ]	[ ]	[ ]

Continue on the next page.

4. How effective is the information available through the following systems in determining optimal emergency response and cleanup strategies?

	Very Effective 1	2	Average 3	4	Very Ineffective 5
Current System	[ ]	[ ]	[ ]	[ ]	[ ]
Tranzit ***XPress*** System	[ ]	[ ]	[ ]	[ ]	[ ]

5. **How effective are the following in assuring motor carrier compliance with HazMat regulations?**

	Very Effective 1	2	Average 3	4	Very Ineffective 5
Current System	[ ]	[ ]	[ ]	[ ]	[ ]
Tranzit ***XPress*** System	[ ]	[ ]	[ ]	[ ]	[ ]

6. **List and rate Tranzit *XPress* and existing HazMat systems that you have used with respect to information which facilitates incident response:**

a. The accessibility of information

	Readily Accessible 1	2	Average 3	4	Not Accessible 5
Tranzit ***XPress*** System	❑	❑	❑	❑	❑
_____	❑	❑	❑	❑	❑
_____	❑	❑	❑	❑	❑
_____	❑	❑	❑	❑	❑

b. The usefulness of information

	Very Useful 1	2	Average 3	4	Not Useful 5
Tranzit ***XPress*** System	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]

c. The accuracy of information

	Very Accurate 1	2	Average 3	4	Not Accurate 5
Tranzit ***XPress*** System	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]

7. **How effective is Tranzit *XPress* in providing information through links with other systems?**

Very Effective 1	2	Average 3	4	Very Ineffective 5
[ ]	[ ]	[ ]	[ ]	[ ]

8. **Please list the three things you like most about the Tranzit *XPress* incident response system:**

1. _____

_____

3. _____

Continue on the nextpage...

9. **Please list the three things you dislike most about the Tranzit *XPress* incident response system:**

1. _____

2. _____

3. _____

10. Would you use Tranzit *XPress* incident response system?

[] Yes **why?** _____

[] No **why?** _____

[] Cannot decide

11. Would you use any individual components of Tranzit *XPress* incident response system?

[] Yes Useful components: _____

Why? _____

[] No why? _____

❑ Cannot decide

12. Provide additional comments below. Indicate if your comments are in response to a particular question.

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THANK YOU!

Tranzit *XPress* Survey

(Incident Responders)

Questionnaire #3

Name _____
Co. Name _____
Phone # _____
Fax # _____
Email _____

Thank you for participating in the evaluation of Tranzit ***XPress*** system. This follow-up questionnaire is intended to gather information about changes in the participant's perception of the system with time Your answer will provide us with valuable data that will help in evaluating the system. This survey will take approximately 15 minutes. Your cooperation is appreciated.

1. **For the incident described in your handout, if Tranzit *XPress* system is used, how much time is required for the:**

Vehicle operator to realize that a problem exists	_____ min.	❑ Don't know
Vehicle operator to call 911 or other emergency number	_____ min.	[] Don't know
Vehicle operator to properly identify vehicle location	_____ min.	❑ Don't know
First responder to reach the incident site	_____ min.	[] Don't know
Cargo recognition and identification by first responder	_____ min.	[] Don't know
Notification of fire department / rescue squad	_____ min.	[] Don't know
Notification of HazMat team and/or emergency management agency	_____ min.	[] Don't know
Determination of what equipment is needed (incl. additional crews)	_____ min.	[] Don't know
Secondary responders to reach the site with proper equipment	_____ min.	[] Don't know
Passive containment and stabilization (e.g. fire dept. digging trenches)	_____ min.	❑ Don't know
Containment and stabilization by specialists (HazMat crews)	_____ min.	[] Don't know
Evacuation of persons from the affected area (if necessary)	_____ min.	[] Don't know
Clean up of the accident/incident site	_____ min.	[] Don't know

2. **Please rate the effectiveness of the:**

a. Current recordkeeping system (i.e. shipping papers) at:

	Very Effective 1	2	Average 3	4	Very Ineffective 5
maintaining safety	[ ]	[ ]	[ ]	[ ]	[ ]
maintaining efficiency	[ ]	[ ]	[ ]	[ ]	[ ]
accurately tracking hazardous materials	[ ]	[ ]	[ ]	[ ]	[ ]
accurately reflecting mixed loads (e.g. herbicides, minimum toxic quantities, toxic combinations etc.)	[ ]	[ ]	[ ]	[ ]	[ ]

b. Tranzit *XPress* recordkeeping system at:

	Very Effective 1	2	Average 3	4	Very Ineffective 5
maintaining safety	[ ]	[ ]	[ ]	[ ]	[ ]
maintaining efficiency	[ ]	[ ]	[ ]	[ ]	[ ]
accurately tracking hazardous materials	[ ]	[ ]	[ ]	[ ]	[ ]
accurately reflecting mixed loads (e.g. herbicides, minimum toxic quantities, toxic combinations etc.)	[ ]	[ ]	[ ]	[ ]	[ ]

3. **How effective is the placard system for identifying truck contents in determining optimal emergency response and cleanup strategies?**

	Very Effective I	2	Average 3	4	Very Ineffective 5
Current System	[ ]	[ ]	[ ]	[ ]	[ ]
Tranzit ***XPress*** System	[ ]	[ ]	[ ]	[ ]	[ ]

Continue on the next page...

4. **How effective is the information available through the following systems in determining optimal emergency response and cleanup strategies?**

	Very Effective 1	2	Average 3	4	Very Ineffective 5
Current System	[ ]	[ ]	[ ]	[ ]	[ ]
Tranzit ***XPress*** System	[ ]	[ ]	[ ]	[ ]	[ ]

5. **How effective are the following in assuring motor carrier compliance with HazMat regulations?**

	Very Effective 1	2	Average 3	4	Very Ineffective 5
Current System	[ ]	[ ]	[ ]	[ ]	[ ]
Tranzit ***XPress*** System	[ ]	[ ]	[ ]	[ ]	[ ]

6. **List and rate Tranzit *XPress* and existing HazMat systems that you have used with respect to information which facilitates incident response:**

a. The accessibility of information

	Readily Accessible 1	2	Average 3	4	Not Accessible 5
Tranzit ***XPress*** System	[ ]	☐	[ ]	[ ]	[ ]
_____	☐	☐			
_____	☐	☐			
_____	☐	☐			

b. The usefulness of information

	Very Useful 1	2	Average 3	4	Not Useful 5
Tranzit ***XPress*** System	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]

c. The accuracy of information

	Very Accurate 1	2	Average 3	4	Not Accurate 5
Tranzit ***XPress*** System	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]

7. **How effective is Tranzit *XPress* in providing information through links with other systems?**

Very Effective 1	2	Average 3	4	Very ineffective 5
[ ]	[ ]	[ ]	[ ]	[ ]

8. **Please list the three things you like most about the Tranzit *XPress* incident response system:**

1. _____

2. _____

3. _____

Continue on the next page.

9. Please list the three things you dislike most about the Tranzit *XPress* incident response system:

1. _____

2. _____

3. _____

10. Would you use Tranzit *XPress* incident response system?

[] Yes why? _____

[] No why? _____

[] Cannot decide

11. Would you use any individual components of Tranzit *XPress* incident response system?

[] **Yes** Useful components: _____

why? _____

[] No why? _____

[] Cannot decide

12. Provide additional comments below. Indicate if your comments are in response to a particular question.

_____

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THANK YOU!

Tranzit *XPress* Survey

(Motor Carriers)

Questionnaire #3

Name _____
Co. Name _____
Phone # _____
Fax# _____
Email _____

Thank you for participating in the evaluation of Tranzit ***XPress*** system. This follow-up questionnaire is intended to gather information about changes in the participant's perception of the system with time Your answer will provide us with valuable data that will help in evaluating the system. This survey will take approximately 15 minutes. Your cooperation is appreciated.

1. For the incident described in your handout, if Tranzit *XPress* system is used, how much time is required for the:

Vehicle operator to realize that a problem exists	_____ min.	[] Don't know
Vehicle operator to call 911 or other emergency **number**	_____ min.	[] Don't know
Vehicle operator to properly identify vehicle location	_____ min.	❑ Don't know
First responder to reach the incident site	_____ min.	[] Don't know
Cargo recognition and identification by first responder	_____ min.	[] Don't know
Notification of fire department / rescue squad	_____ min.	[] Don't know
Notification of HazMat team and/or emergency management agency	_____ min.	[] Don't know
Determination of what equipment is needed (incl. additional crews)	_____ min.	[] Don't know
Secondary responders to reach the site with proper equipment	_____ min.	[] Don't know
Passive containment and stabilization (e.g. fire dept. digging trenches)	_____ min.	[] Don't know
Containment and stabilization by specialists (HazMat crews)	_____ min.	[] Don't know
Evacuation of persons from the affected area (if necessary)	_____ min.	[] Don't know
Clean up of the accidentiincident site	_____ min.	[] Don't know

2. Please rate the effectiveness of the:

a. Current recordkeeping system (i.e. shipping papers) at:

	Very Effective 1	2	Average 3	4	Very ineffective 5
maintaining safety	❑	❑	❑	❑	❑
maintaining efficiency	❑	❑	❑	❑	❑
accurately tracking hazardous materials	❑	❑	❑	❑	❑
assisting in meeting regulatory requirements	❑	❑	❑	❑	❑
accurately reflecting mixed loads (e.g. herbicides, minimum toxic quantities, toxic combinations etc.)	❑	❑	[]	❑	❑

b. Tranzit *XPress* recordkeepinq system at:

	Very Effective 1	2	Average 3	4	Very Ineffective 5
maintaining safety	❑	❑	❑	❑	❑
maintaining efficiency	❑	❑	❑	❑	❑
accurately tracking hazardous materials	❑	❑	❑	❑	❑
assisting in meeting regulatory requirements	❑	❑	❑	❑	❑
accurately reflecting mixed loads (e.g. herbicides, minimum toxic quantities, toxic combinations etc.)	❑	❑	❑	❑	❑

3. How effective is the placard system for identifying truck contents in determining optimal emergency response and cleanup strategies?

	Very Effective 1	2	Average 3	4	Very Ineffective 5
Current System	❑	❑	❑	❑	❑
Tranzit ***XPress*** System	❑	❑	❑	❑	❑

Continue on the next page..

4. How effective is the information available through the following systems in determining optimal emergency response and cleanup strategies?

	Very Effective 1	2	3	4	Very Ineffective 5
Current System	[ ]	[ ]	[ ]	[ ]	[ ]
Tranzit ***XPress*** System	[ ]	[ ]	[ ]	[ ]	[ ]

5. How effective are the following in assuring motor carrier compliance with HazMat regulations?

	Very Effective 1	2	3	4	Very ineffective 5
Current System	[ ]	[ ]	[ ]	[ ]	[ ]
Tranzit ***XPress*** System	[ ]	[ ]	[ ]	[ ]	[ ]

6. List and rate Tranzit *XPress* and existing HazMat systems that you have used with respect to information which facilitates incident response:

a. The accessibility of information

	Readily Accessible	2	Average 3	4	Not Accessible 5
Tranzit ***XPress*** System	[ ]	[ ]	[ ]	[ ]	[ ]
_____	☐	[ ]	[ ]	[ ]	[ ]
_____	☐	[ ]	[ ]	[ ]	[ ]
_____	☐	[ ]	[ ]	[ ]	[ ]

b. The usefulness of information

	Very Useful 1	2	Average 3	4	Not Useful 5
Tranzit ***XPress*** System	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]

c. The accuracy of information

	Very Accurate 1	2	Average 3	4	Not Accurate 5
Tranzit ***XPress*** System	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]
_____	[ ]	[ ]	[ ]	[ ]	[ ]

7. How effective is Tranzit *XPress* in providing information through links with other systems?

Very Effective 1	2	3	4	Very Ineffective 5
[ ]	[ ]	[ ]	[ ]	[ ]

8. Please list the three things you like most about the Tranzit *XPress* incident response system:

1. _____
2. _____
3. _____

Continue on the next page...

9. Please list the three things you dislike most about the Tranzit *XPress* incident response system:

1. _____

2. _____

3. _____

10. Would you use Tranzit *XPress* incident response system?

[] Yes why? _____

[] No why? _____

[] Cannot decide

11. Would you use any individual components of Tranzit *XPress* incident response system?

[] Yes Useful components: _____

why? _____

[] No Why? _____

[] Cannot decide

12. Provide additional comments below. Indicate if your comments are in response to a particular question.

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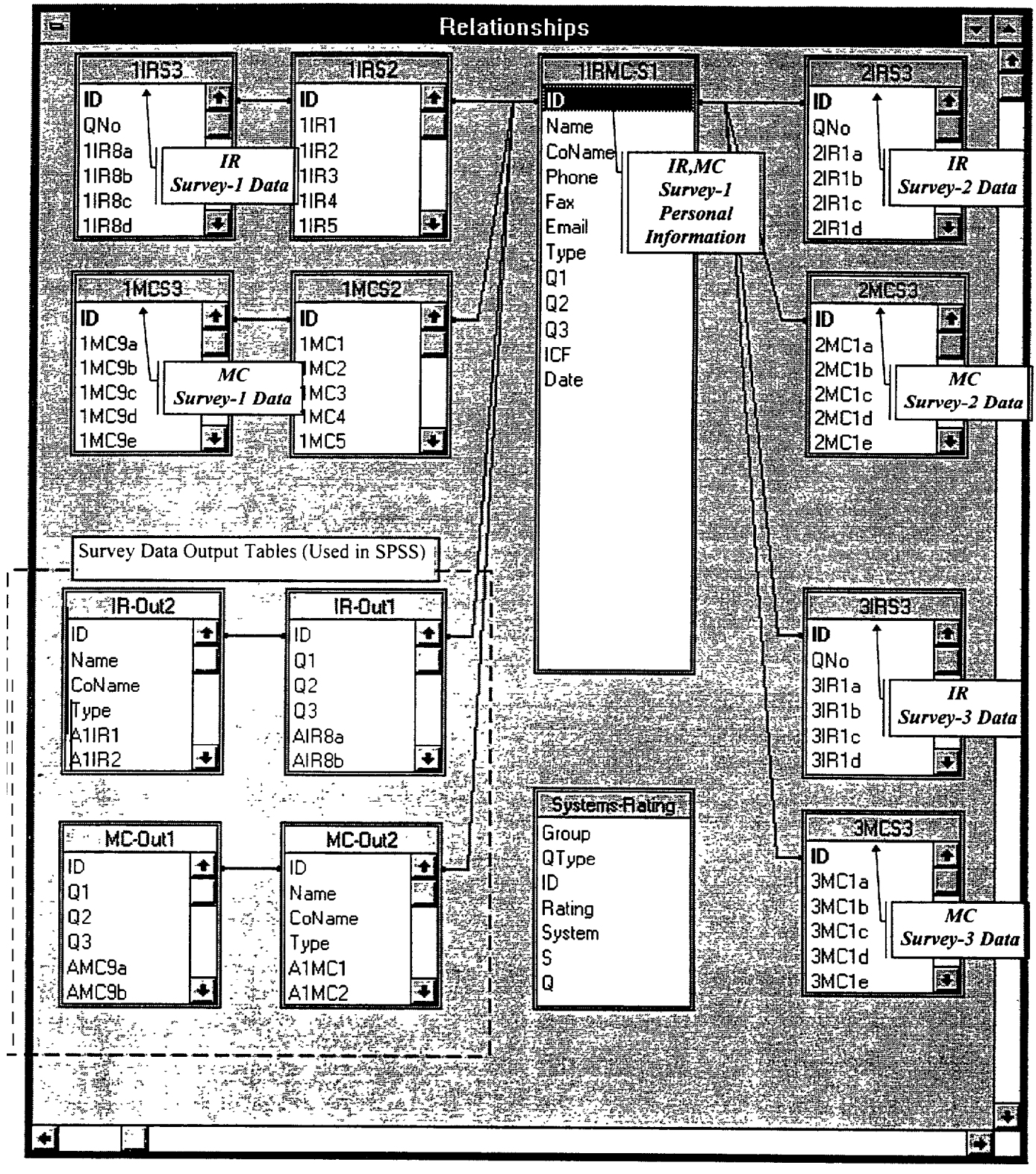
THANK YOU!

Appendix C - DATABASE MANAGEMENT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ID
QNo
1IR8a
1IR8b
1IR8c
1IR8d
IR
Survey-1 Data
1IRS2
ID
1IR1
1IR2
1IR3
1IR4
1IR5
1IRMCS1
ID
Name
CoName
Phone
Fax
Email
Type
Q1
Q2
Q3
ICF
Date
IR,MC
Survey-1
Personal
Information
2IRS3
ID
QNo
2IR1a
2IR1b
2IR1c
2IR1d
IR
Survey-2 Data
1MCS3
ID
1MC9a
1MC9b
1MC9c
1MC9d
1MC9e
MC
Survey-1 Data
1MCS2
ID
1MC1
1MC2
1MC3
1MC4
1MC5
2MCS3
ID
2MC1a
2MC1b
2MC1c
2MC1d
2MC1e
MC
Survey-2 Data
Survey Data Output Tables (Used in SPSS)
IR-Out2
ID
Name
CoName
Type
A1IR1
A1IR2
IR-Out1
ID
Q1
Q2
Q3
AIR8a
AIR8b
3IRS3
ID
QNo
3IR1a
3IR1b
3IR1c
3IR1d
IR
Survey-3 Data
MC-Out1
ID
Q1
Q2
Q3
AMC9a
AMC9b
MC-Out2
ID
Name
CoName
Type
A1MC1
A1MC2
Systems Rating
Group
QType
ID
Rating
System
S
Q
3MCS3
ID
3MC1a
3MC1b
3MC1c
3MC1d
3MC1e
MC
Survey-3 Data