

NCIT
The National Center for Intermodal Transportation

**DEVELOPMENT OF AN INTERMODAL TRAINING PROGRAM FOR DISASTER RELIEF
AGENCIES**

FINAL REPORT

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PRINCIPAL INVESTIGATORS:

Lesley Strawderman

Burak Eksioglu

1.0 Abstract

Natural disasters impact society on a broad level, often leading to both financial damage and the loss of human life. This project seeks to improve the design and operation of disaster relief chains by providing agencies with an intermodal transportation decision making and training tool, focusing on the use of air, rail, and trucks in providing aid (cargo and personnel) following a disaster. Building upon knowledge gained from a previous NCIT project regarding factors that impact choice of transportation modes in disaster relief, the product of the current project is an intermodal transportation training program for disaster relief agencies. The program, viewed as a Microsoft PowerPoint slideshow, allows users to investigate the benefits of intermodal transportation, allowing trainees to make informed transportation decision in disaster relief agencies.

2.0 Introduction

Several studies have made recommendations to improve the structure of humanitarian supply chains [1-4]. Studies have shown the existence of intermodal transportation in disaster relief though it may add complexity and delays to the supply chain [5]. Since relief cargos are distributed from resource staging centers to points of distribution and then to different destinations in different speeds, different modes of transportations are easily applied [6]. In the 2005 evacuation of New Orleans during Hurricane Katrina, there was a concerted effort to evacuate residents by means of multiple modes, including Amtrak trains, buses, aircraft, and ships [7], yet the transportation was still not sufficient to move all people out of the area.

The project team has completed a project that identifies the use of various transportation modes and technologies by disaster relief agencies. Results indicate that agencies primarily use single-mode transportation (truck) when delivering relief supplies [8]. The use of a single mode appears to be due to a lack of planning prior to disasters, as well as a lack of knowledge of other available modes. The selection of modes is based on numerous factors (e.g. cost, speed, capability) of the various modes. Multiple factors are considered jointly in making one decision. The impact of individual factors on the most effective mode has been clearly shown in the literature. For example, Rodrigue [9] developed guidelines for the most cost effective mode as a function of distance. In disaster relief situations, the availability of various modes and their routes becomes an additional consideration. For example, floods and earthquakes may make roadways unusable.

Based on the multiple factors and the uncertainty attributed to disaster relief, the process of choosing an effective and efficient transportation mode for supply and personnel delivery is complex. In the team's current study, it is clear that most disaster relief is transported using a single transportation mode. For disaster relief that is delivered internationally, however, multiple transportation modes are used. The use of multiple modes is done while also considering transfer cost and time [6]. If disaster relief on a regional or national scale were equipped with the knowledge of how to plan effective disaster relief chains, the negative impact of transfers, as well as other factors such as cost and distance, could be minimized.

3.0 Project Objectives

The main objective of this study was to develop a training program for disaster relief agencies. This was accomplished by collating information regarding intermodal transportation, the use of such transportation in disaster relief, and disaster relief chains. The project team collected information regarding mode usage, benefits of each mode, and cost and time estimates for various transportation options. The information was then used to present possible intermodal relief chains in a training program aimed at decision makers who design transportation systems for delivering relief supplies and personnel. Specific objectives for this project included (1) define how relief agencies train employees to make transportation decisions and (2) develop a training program to assist in personnel training.

4.0 Disaster Relief Training

4.1 Current Training Practices

Interviews were conducted with three disaster relief organizations to understand to what degree (if any) their employees are trained in selecting transportation modes. Based on the interviews, it is apparent that each of these organizations offers their employees some form of formal training but nothing with a focus on the selection of transportation modes. Most of the decisions about the transportation of supplies and volunteers are made by program directors or through previously established practices. Some of the key factors taken into consideration for their transportation mode selection include: road conditions, travel distances, and the supplies needing to be shipped.

Many disaster relief organizations utilize prepositioning and contractual agreements with shipping companies for effective allocation of supplies. One agency, for example, has agreements with US Foods and Cisco Foods to ship large quantities of food supplies from distribution centers located outside of disaster zones. This helps lower costs of transporting large trailer loads of supplies. In most cases these organizations exclusively use trucks (of varying sizes) and vans to transport personnel and supplies domestically. Another agency reported the use of boxed trucks, vans, and tractor trailers to ship much needed supplies to disaster victims across the nation.

4.2 Training Program

Screenshots from the training program are shown in Appendix A. The program itself is available as a Microsoft PowerPoint slideshow, as shown in Figure 1.



Figure 1. Training Program Title Slide

4.2.1 Content

The training program is divided into five major topics: Introduction, Emergency Supply Transportation, Transportation Modes, Single Mode Transportation Scenarios, and Intermodal Transportation Scenarios.

The program contains a written description of each topic, providing the user with details regarding the topic and its use in providing disaster relief supplies. Much of the information provided in the program is based on the project team's previous findings regarding transportation planning in disaster relief agencies [10].

Ten interactive scenarios were created based specifically for the program. Each scenario described a type of disaster (flood, hurricane, or wildfire), a disaster location, supply origin, and amount of supplies to be delivered. For example, scenario 1 reads "A flood in Iowa City, Iowa, damaged hundreds of homes and businesses. A small shipment of supplies will be needed from Denver, Colorado." Estimates for time and cost were calculated for each of the five most common single transportation modes: small truck, medium truck, large truck, rail, and air. For intermodal scenarios, estimates were provided for five common intermodal transportation combinations: large truck to small truck, large truck to medium truck, rail to medium truck, rail to large truck, and air to large truck. The time and cost estimates for each scenario were calculated using current mileage and usage rates.

4.2.2 Design

The design of the disaster relief training program incorporated an iterative process of developing an effective user interface for presenting, establishing, and reinforcing concepts of transportation modes used for disaster relief purposes. Initially several different methods for creating the training program were considered including: using pre-fabricated training templates, creating a training website, and constructing a macro-enabled PowerPoint slideshow. After sufficient investigation into each of these methods, it was decided that the training program would best be generated and distributed as a PowerPoint slideshow utilizing macros and user controls.

The format of the training program was established to give users intuitive navigation tools, informative concept highlights, and easy-to-use learning scenarios. Command buttons were placed at the bottom of each screen for the user to easily navigate through the program. Users may press the "Next" button to proceed through the program or press the "Previous" button to view information on prior screens. At any point during the training a user may exit the program by pressing the "Exit Training" button or by simply pressing the ESC key. In addition to the command buttons, a training index containing links to the different areas of the training program was placed on the right-hand side of each informational screen. These links can be used to navigate back and forth through the training program as users see fit.

The actual training information used in the program was broken into logical segments giving attention to important concepts through the use of bold and italicized font formats. Charts, listings, and clever images are also incorporated into the program to help illustrate key concepts. Once users navigate through the informational screens, they are presented with a series of disaster scenarios (floods, hurricanes, etc). A summary of each scenario is presented in the right-hand side of each scenario screen. Users are then given several transportation mode options. Each transportation option has a corresponding command button, which when pressed will display the cost and time of each option. After exploring the transportation options, the user presses the “Next” button emphasizing the suggested option(s) and presenting feedback as justification. The scenarios help reinforce concepts in selecting appropriate transportation options for single mode and intermodal cases.

4.3 Usability Evaluation

The usability evaluation consisted of two phases: expert heuristics evaluation and user testing. Results from each evaluation phase were used to modify the training program for improved usability. The final version of the program, which is shown in Appendix A and discussed in Section 5.2, incorporates the changes made as a result of the evaluation.

4.3.1 Expert Heuristics Evaluation Method

Nielsen’s ten usability heuristics [10] were used to guide expert evaluation. The heuristics are shown in Table 1. Two research assistants in the human systems engineering lab served as experts to evaluate the interface. Results were generated in the form of a report that detailed usability issues qualitatively.

4.3.2 User Testing Method

Five university students were recruited as participants to test the usability of the program. An overview of the training program’s purpose and content was given to the participants. Each participant was asked to imagine that they are a typical user for the program (e.g. that they work in a disaster relief agency). After completing the training program, users identified any usability problems within the interface. Time to complete the training and total functional errors were recorded for each participant. In addition,

participants completed a usability survey. The survey, shown in Appendix B, was used to collect participants' perceptions on the following aspects of the program:

- Simplicity: is the structure of the training simple for the user?
- Comfort: does the user feel comfortable using the training program?
- Control: does the user have a good control over the training?
- Readability: is the information in the training program easy to read?
- Consistency: consistency use of terms, icons
- Information adequacy: is there enough information to guide the training?
- Satisfaction: overall satisfaction with the interface.

Participants demonstrated an overall satisfaction towards the training program, with an average score of 4.2 (with 5 being the highest possible score). Among the 6 usability specifications, participants were most satisfied with the consistency of the training program (average score of 4.8), and least satisfied with the readability (average score of 3.8). Participants' additional comments covered the merits, drawbacks, and suggestion for improvement.

Table 1. Usability Heuristics for Expert Evaluation

Heuristic	Evaluation Questions
Visibility of system status	Is there a sign of the current status of training on each training page?
	Is there explicit feedback to users after certain actions?
Match between system and real world	When appropriate, some real world icons or metaphors could be used in the interfaces design
User control and freedom	Can users navigate through the training program easily?
Consistency and standards	Is the interface internally consistent?
	Is the interface externally consistent?
Error prevention	Are buttons designed to highlight primary selections?
Recognition rather than recall	Are quiz features based on multiple choice questions rather than fill in the blank?
Flexibility and efficiency of use	Are hotkeys and shortcuts available to the user?
Aesthetic and minimalist design	Is the interface clean and without redundant information?
	Is the color scheme appealing and fonts easy to read?
Help users recognize, diagnose, and recover from errors	Are error messages effectively used?
Help and documentation	Is there a method for users to obtain help?

5.0 Conclusions and Future Work

The training program developed during this project will provide disaster relief agencies with a low cost and accessible method to train employees on the selection of transportation for supply delivery. Relief agencies will be able to use the program to train personnel on developing effective relief chains, choosing transportation modes, and using intermodalism in the relief delivery process. The program will also be applicable to decision making within the agencies. When they are facing a transportation related decision, they will be able to use the program to aid in the decision making process and evaluate the potential outcome of their decision. This project will also contribute to the body of knowledge by presenting a coordinated view of disaster relief chain design and mode selection.

Future work includes testing the effectiveness of the program in terms of user learning and its practical impact on actual decisions made within relief agencies. Additional program modules can also be created to investigate other intermodal transportation opportunities. Finally, additional interactive scenarios that include other features such as staging locations can be added to expand the program.

6.0 References

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APPENDIX A

Training Program Images

Intermodal Transportation in Disaster Relief: A Training Program



START

Exit Training

Program Contents

- ✓ Introduction
- ✓ Emergency Supply Transportation
- ✓ Transportation Modes: Trucks, Rail, Air
- ✓ Single Mode Transportation
- ✓ Intermodal Transportation

Previous Next Exit Training

Training Index

- Introduction
- Emergency Supply Transportation
- Transportation Modes
- Single Mode Scenarios
- Intermodal Transportation
- Intermodal Scenarios
- Additional Information

Introduction

The global increase in the number of natural or man-made disasters highlights the need for a better planning on part of disaster relief agencies.

Examples of these disasters are hurricanes, transportation accidents, tornadoes, floods, cyclones, earthquakes, droughts, snow storms, tsunamis, food shortages, war, wildfires, volcanic eruptions, and many others.

These emergencies cause organizations to face issues in transporting varying amounts of different supplies including food, clothing, medicine, medical supplies, and machinery from different points of origin to different destinations in the disaster areas. The transportation of supplies and relief personnel must be done **quickly and efficiently** to maximize the benefit to victims while minimizing the cost of relief agencies.

Previous Next Exit Training

Training Index

- Introduction
- Emergency Supply Transportation
- Transportation Modes
- Single Mode Scenarios
- Intermodal Transportation
- Intermodal Scenarios
- Additional Information

Introduction

In the event of one of these types of disasters, federal and local agencies are responsible for transporting emergency relief supplies such as water, food rations, blankets, clothing, generators and medicine and any other needed items to victims of the disaster.

The major concern is how emergency relief supplies can be transported to disaster victims in a timely manner in order to protect the health and sustain the lives of the victims.

Emergency relief supplies may need to reach millions of people or as little as a few hundred people in different locations in as little as three days time. **Therefore careful planning of the transportation of relief supplies is necessary to save lives.**

Previous Next Exit Training

Training Index

- Introduction
- Emergency Supply Transportation
- Transportation Modes
- Single Mode Scenarios
- Intermodal Transportation
- Intermodal Scenarios
- Additional Information

Introduction

During disaster relief, several organizations come together, each with their own objective, expertise, experience, training, and resources to help with a single disaster.

One way to help decrease chaos and confusion of relief workers and victims is for the agencies to be prepared for a wide variety of disaster scenarios, through the help of training programs. These agencies should assess existing disaster response plans and policies, and identify better transportation approaches to deliver supplies.

The supply chain of relief supplies is difficult to model due to the fact that many of these disasters are unpredictable and can occur on short notice. These disaster events involve destroyed or congested roadways, limited transportation resources, inaccessible air strips and other unknowns.

Previous Next Exit Training

Training Index

- Introduction
- Emergency Supply Transportation
- Transportation Modes
- Single Mode Scenarios
- Intermodal Transportation
- Intermodal Scenarios
- Additional Information

Emergency Supply Transportation Planning

Transportation plays a key role in emergency planning and supply delivery. The movement of supplies is a vital component of any emergency response effort, shown in FEMA's All-Hazards Guide. Multiple modes of transportation are available to move supplies to and from areas where supplies are needed.

Therefore a major concern to relief agencies is which mode or combination of transportation modes is most efficient to move supplies into a disaster location.

By exploring a wide range of disaster transportation scenarios will help agencies quickly and effectively better identify better approaches for emergency transportation modes to respond during disaster events.

Previous Next Exit Training

Training Index

- Introduction
- Emergency Supply Transportation
- Transportation Modes
- Single Mode Scenarios
- Intermodal Transportation
- Intermodal Scenarios
- Additional Information

Emergency Supply Transportation Planning

The type and quantity of humanitarian relief supplies required is typically determined by two factors:
 (1) the type of disaster; and
 (2) the type and quantity of supplies available.

Transportation of supplies involves making predetermined agreements and contracts of readily available and alternative means of transportation for prompt and safe delivery of supplies.



Previous Next Exit Training

Training Index

- Introduction
- Emergency Supply Transportation
- Transportation Modes
- Single Mode Scenarios
- Intermodal Transportation
- Intermodal Scenarios
- Additional Information

Emergency Supply Transportation Planning

There are several strategies suggested for quick and efficient distribution during times of disaster.

Delivery of supplies depends on:

- Location
- Time sensitivity
- Availability of local supply levels

As part of disaster preparedness, sources of supplies should be identified, such as in national inventories in the case of a disaster, although excessive stockpiling of all supplies is not recommended due to incurring cost and shelf life of certain supplies.

Previous Next Exit Training

Training Index

- Introduction
- Emergency Supply Transportation
- Transportation Modes
- Single Mode Scenarios
- Intermodal Transportation
- Intermodal Scenarios
- Additional Information

Emergency Supply Transportation Planning

Relief agencies should use established pre-disaster arrangements, relationships and contracts with transportation shippers/carriers (e.g. FedEx, Penske, etc.) to deliver supplies into a disaster area. Many companies and businesses offer free or reduced rates services to relief Agencies.



Previous Next Exit Training

Training Index

- Introduction
- Emergency Supply Transportation
- Transportation Modes
- Single Mode Scenarios
- Intermodal Transportation
- Intermodal Scenarios
- Additional Information

Emergency Supply Transportation Planning

The pre-positioning of relief supply inventory is one way to establish quick transportation of supplies. One suggestion is that agencies set up RSS (Receiving, Storing and Staging) warehouses in key locations or PODs for medical supplies in case of an emergency. The use of local supplies and inventories can help offset the high costs of air freight. Expenditures of air freight are generally subtracted from the total amount a donor allocates for a given disaster.



Previous Next Exit Training

Training Index

- Introduction
- Emergency Supply Transportation
- Transportation Modes
- Single Mode Scenarios
- Intermodal Transportation
- Intermodal Scenarios
- Additional Information

Transportation Modes

Choosing a Transportation Mode

Here are the options we will explore:

- Trucks
 - Small, Medium, and Large
- Railroad
- Airplanes



Previous Next Exit Training

Training Index

- Introduction
- Emergency Supply Transportation
- Transportation Modes
- Single Mode Scenarios
- Intermodal Transportation
- Intermodal Scenarios
- Additional Information

Transportation Modes

TRUCKS

Truck is the most commonly used mode of transportation. For this training program, truck is defined into three categories: small, medium, and large. Small trucks refer to pickup trucks and have the capacity of four pallets. Medium truck referring to 22' -26' trucks commonly used to move 3-4 rooms of furniture; these trucks have a capacity of 20 pallets. Large trucks, 53' trailer trucks, have a capacity of 52 pallets.



Previous Next Exit Training

Training Index

- Introduction
- Emergency Supply Transportation
- Transportation Modes
- Single Mode Scenarios
- Intermodal Transportation
- Intermodal Scenarios
- Additional Information

Transportation Modes

Truck Size	Advantages	Disadvantages
Small	Only includes fuel costs	Very limited capacity, Probable need for multiple vehicles
Medium	Only includes fuel costs	Limited capacity, Probable need for multiple vehicles
Large	Can carry a large capacity	Includes costs of driver fee, fuel surcharge, and insurance
All	Cost effective for moderate distances	If roads are damaged shipments may become unavailable

Previous Next Exit Training

Training Index

- Introduction
- Emergency Supply Transportation
- Transportation Modes
- Single Mode Scenarios
- Intermodal Transportation
- Intermodal Scenarios
- Additional Information

Transportation Modes

RAILROAD

Rail transport is used for moving large quantities of items when time constraints are not demanding. Rail shipments are made using rail yard owned containers that store a maximum of 5400 cu ft per container. Rail containers are used in relief when immediate supply relief has been met, but continuous relief is still needed. Rail shipments offer cost effective results when shipping large quantities as the range of cu ft covered by the set cost does not vary; thus, the cost of a shipment via rail is not affected whether a full load or less.



Previous Next Exit Training

Training Index

- Introduction
- Emergency Supply Transportation
- Transportation Modes
- Single Mode Scenarios
- Intermodal Transportation
- Intermodal Scenarios
- Additional Information

Transportation Modes

Railroad	
Advantages	Disadvantages
Cost effective for large shipments	Slow delivery speeds up to 7 days for cross country shipments
Effective for intermodal transportation	Limited access/drop-off points



Previous Next Exit Training

Training Index

- Introduction
- Emergency Supply Transportation
- Transportation Modes
- Single Mode Scenarios
- Intermodal Transportation
- Intermodal Scenarios
- Additional Information

Transportation Modes

AIRPLANE

Air transportation is a very time efficient mode of transportation. For this training program, air shipments are assumed to be made by a major package carrier (e.g. UPS). These air shipments may be delivered as early as next day. One shipment carries the maximum capacity of 52 pallets of supplies; Lower capacity shipments provide for lower shipping costs



Previous Next Exit Training

Training Index

- Introduction
- Emergency Supply Transportation
- Transportation Modes
- Single Mode Scenarios
- Intermodal Transportation
- Intermodal Scenarios
- Additional Information

Transportation Modes

Air	
Advantages	Disadvantages
Covers long distances in a short amount of time	Very high shipment costs
Useful in intermodal transportation	Access points are limited



Previous Next Exit Training

Training Index

- Introduction
- Emergency Supply Transportation
- Transportation Modes
- Single Mode Scenarios
- Intermodal Transportation
- Intermodal Scenarios
- Additional Information

Single Mode Scenarios

Instructions

The following scenarios will help you investigate the advantages and disadvantages of each transportation mode. Each scenario provides information on the size of shipment for relief supplies, as well as the location of the disaster and the origin of the supplies. The following information should be considered when exploring scenario.



Previous Next Exit Training

Single Mode Scenarios

Instructions

Four shipment sizes are used in the scenarios, as shown in the following table. For example, a medium shipment would consist of 50 pallets of supplies.

Shipment Size	Number of Pallets
Small	10
Medium	50
Large	200
Extra Large	1000

Previous Next Exit Training

Single Mode Scenarios

Instructions

Each transportation mode has a limited capacity, as shown in the table below. If the shipment size exceeds the capacity of a mode, multiple vehicles are used. For example, if small trucks are used to transport a small shipment, 3 small trucks would be used.

Mode	Capacity (pallets)
Small Truck	4
Medium Truck	20
Large Truck	52
Rail Car	108
Airplane	108

START SINGLE MODE SCENARIOS

Previous Next Exit Training

Scenario Summary

Scenario 1: Flood

Destination: Iowa City, IA

Origin: Denver, CO

Shipment Size: Small

Explore the options below:

Small Truck	Cost: \$1200	Time: 0.75 day
Medium Truck	Cost: \$400	Time: 0.75 day
Large Truck	Cost: \$6100	Time: 0.75 day
Rail	Cost: \$3500	Time: 3 days
Air	Cost: \$81,300	Time: 1 day

To navigate between scenarios [CLICK HERE](#)

Previous Next Exit Training

Scenario Summary

Scenario 1: Flood

Destination: Iowa City, IA

Origin: Denver, CO

Shipment Size: Small

For this scenario, medium truck is the best option. These trucks would deliver the supplies quickly at a very low cost. Small trucks are another feasible option, particularly if they are readily available for delivery.

Explore the options below:

Small Truck	Cost: \$1200	Time: 0.75 day
Medium Truck	Cost: \$400	Time: 0.75 day
Large Truck	Cost: \$6100	Time: 0.75 day
Rail	Cost: \$3500	Time: 3 days
Air	Cost: \$81,300	Time: 1 day

To navigate between scenarios [CLICK HERE](#)

Previous Next Exit Training

Scenario Summary

Scenario 2: Hurricane

Destination: New Orleans, LA

Origin: Richmond, VA

Shipment Size: Medium

Explore the options below:

Small Truck	Cost: \$6600	Time: 0.75 day
Medium Truck	Cost: \$1500	Time: 0.75 day
Large Truck	Cost: \$1700	Time: 1 day
Rail	Cost: \$3100	Time: 6 days
Air	Cost: \$162,100	Time: 1 day

To navigate between scenarios [CLICK HERE](#)

Previous Next Exit Training

Scenario Summary

Scenario 2: Hurricane

Destination: New Orleans, LA

Origin: Richmond, VA

Shipment Size: Medium

Medium trucks would deliver the supplies for the lowest cost and in the shortest amount of time.

Explore the options below:

Small Truck	Cost: \$6600	Time: 0.75 day
Medium Truck	Cost: \$1500	Time: 0.75 day
Large Truck	Cost: \$1700	Time: 1 day
Rail	Cost: \$3100	Time: 6 days
Air	Cost: \$162,100	Time: 1 day

To navigate between scenarios [CLICK HERE](#)

Previous Next Exit Training

Scenario Summary

Scenario 3: Wildfire

Destination: Ramona, CA

Origin: Memphis, TN

Shipment Size: Large

Scenario 3: A wildfire breaks out in Ramona, CA destroying hundreds of homes along with several hundred acres of forest. A large shipment of supplies will be needed from Memphis, TN.

Explore the options below:

Small Truck	Cost: \$45,700	Time: 1.5 days
Medium Truck	Cost: \$9100	Time: 1.5 days
Large Truck	Cost: \$11,000	Time: 1.5 days
Rail	Cost: \$13,300	Time: 6.5 days
Air	Cost: \$883,700	Time: 1 day

To navigate between scenarios [CLICK HERE](#)

Previous Next Exit Training

Scenario Summary

Scenario 3: Wildfire

Destination: Ramona, CA

Origin: Memphis, TN

Shipment Size: Large

Both medium and large trucks are good transportation options for this scenario in terms of cost and time.

Explore the options below:

Small Truck	Cost: \$45,700	Time: 1.5 days
Medium Truck	Cost: \$9100	Time: 1.5 days
Large Truck	Cost: \$11,000	Time: 1.5 days
Rail	Cost: \$13,300	Time: 6.5 days
Air	Cost: \$883,700	Time: 1 day

To navigate between scenarios [CLICK HERE](#)

Previous Next Exit Training

Scenario Summary

Scenario 4: Hurricane

Destination: New Orleans, LA

Origin: Denver, CO

Shipment Size: Large

Scenario 4: A hurricane in New Orleans, LA destroys hundreds of homes and leaves thousands without power. A large shipment of supplies will be needed from Denver, CO.

Explore the options below:

Small Truck	Cost: \$36,000	Time: 1.25 days
Medium Truck	Cost: \$7200	Time: 1.25 days
Large Truck	Cost: \$7800	Time: 1.25 days
Rail	Cost: \$8600	Time: 4.5 days
Air	Cost: \$763,400	Time: 1 day

To navigate between scenarios [CLICK HERE](#)

Previous Next Exit Training

Scenario Summary

Scenario 4: Hurricane

Destination: New Orleans, LA

Origin: Denver, CO

Shipment Size: Large

Both medium and large trucks are good transportation options for this scenario. Using large trucks may be preferred to minimize the coordination between multiple vehicles.

Explore the options below:

Small Truck	Cost: \$36,000	Time: 1.25 days
Medium Truck	Cost: \$7200	Time: 1.25 days
Large Truck	Cost: \$7800	Time: 1.25 days
Rail	Cost: \$8600	Time: 4.5 days
Air	Cost: \$763,400	Time: 1 day

To navigate between scenarios [CLICK HERE](#)

Previous Next Exit Training

Scenario Summary

Scenario 5: Wildfire

Destination: Ramona, CA

Origin: Denver, CO

Shipment Size: Extra Large

Scenario 5: A wildfire breaks out in Ramona, CA destroying hundreds of homes along with several hundred acres of forest. An extra large shipment of supplies will be needed from Denver, CO.

Explore the options below:

Small Truck	Cost: \$151,000	Time: 1 day
Medium Truck	Cost: \$30,200	Time: 1 day
Large Truck	Cost: \$8600	Time: 1 day
Rail	Cost: \$45,000	Time: 3 days
Air	Cost: \$3,317,100	Time: 1 day

To navigate between scenarios [CLICK HERE](#)

Previous Next Exit Training

Scenario Summary

Scenario 5: Wildfire

Destination: Ramona, CA

Origin: Denver, CO

Shipment Size: Extra Large

Due to the extra large shipment size, the use of large trucks is the best option for this scenario. Using a different transportation mode would not result in any cost or time savings.

Explore the options below:

Small Truck	Cost: \$151,000	Time: 1 day
Medium Truck	Cost: \$30,200	Time: 1 day
Large Truck	Cost: \$8600	Time: 1 day
Rail	Cost: \$45,000	Time: 3 days
Air	Cost: \$3,317,100	Time: 1 day

To navigate between scenarios [CLICK HERE](#)

Previous Next Exit Training

Single Mode Summary

Training Index

- [Introduction](#)
- [Emergency Supply Transportation](#)
- [Transportation Modes](#)
- [Single Mode Scenarios](#)
- [Intermodal Transportation](#)
- [Intermodal Scenarios](#)
- [Additional Information](#)

- In most situations, using **trucks** to deliver relief supplies will be the best option.
- Selecting the type of truck to use can include many factors beyond cost and time. For example, availability of vehicles, number of available drivers, and roadway conditions and congestion should also be taken into account.
- While using rail is often financially beneficial, it takes a **long time for delivery**. However, rail remains a good option for the pre-positioning or staging of supplies if advanced warning of a disaster is provided.
- The use of air should be reserved for situations **where time is critical and cost is not prohibitive**. Air is also necessary when providing international disaster relief.

[Previous](#) [Next](#) [Exit Training](#)

Intermodal Transportation

Training Index

- [Introduction](#)
- [Emergency Supply Transportation](#)
- [Transportation Modes](#)
- [Single Mode Scenarios](#)
- [Intermodal Transportation](#)
- [Intermodal Scenarios](#)
- [Additional Information](#)

Intermodal transportation is the shipment of cargo and the movement of people involving more than one mode of transportation during a single journey.

In disaster relief, supplies are often distributed from resource staging centers to points of distribution and dispersed to site locations with varying time and cost requirements; therefore requiring different modes of transportation.

Transporting evacuees, volunteers, agency personal and other people involved in disaster relief also requires different modes of transportation.

[Previous](#) [Next](#) [Exit Training](#)

Intermodal Transportation

Training Index

- [Introduction](#)
- [Emergency Supply Transportation](#)
- [Transportation Modes](#)
- [Single Mode Scenarios](#)
- [Intermodal Transportation](#)
- [Intermodal Scenarios](#)
- [Additional Information](#)

Intermodal transportation can play a key role in transporting people and cargo during disaster relief operations to reduce cost and shorten transportation time of relief supplies. During the 2005 evacuation of New Orleans during Hurricane Katrina, residents were evacuated by multiple modes, including trains, buses, aircraft, and ships, yet the transportation was still robust enough to move all people out of the affected area.



[Previous](#) [Next](#) [Exit Training](#)

Intermodal Transportation

Training Index

- [Introduction](#)
- [Emergency Supply Transportation](#)
- [Transportation Modes](#)
- [Single Mode Scenarios](#)
- [Intermodal Transportation](#)
- [Intermodal Scenarios](#)
- [Additional Information](#)

The use of intermodal transportation is an important component to disaster relief transportation efforts, because the strength of each individual mode can be maximized for optimal use.

For example, railway can be utilized for long distance land transportation, since it has an advantage of having a relatively low cost. Air transport is especially useful when roadways are not available, with an added advantage of faster transport times.

Disaster relief agencies that utilize intermodal transportation are not restricted by the drawbacks of a selected transportation mode. Rather, they are able to combine the advantages of various modes to create an **effective transportation plan**.

[Previous](#) [Next](#) [Exit Training](#)

Intermodal Scenarios

Training Index

- [Introduction](#)
- [Emergency Supply Transportation](#)
- [Transportation Modes](#)
- [Single Mode Scenarios](#)
- [Intermodal Transportation](#)
- [Intermodal Scenarios](#)
- [Additional Information](#)

Instructions

The following scenarios will help you investigate the advantages and disadvantages of using intermodal transportation to deliver relief supplies. Each scenario provides information on the size of shipment for relief supplies, as well as the location of the disaster and the origin of the supplies. You will also be given information on a transfer location. This is the city where supplies will be transferred from one mode of transportation to another.

[Previous](#) [Next](#) [Exit Training](#)

Intermodal Scenarios

Training Index

- [Introduction](#)
- [Emergency Supply Transportation](#)
- [Transportation Modes](#)
- [Single Mode Scenarios](#)
- [Intermodal Transportation](#)
- [Intermodal Scenarios](#)
- [Additional Information](#)

Instructions

Five intermodal combinations are shown for each scenario. As an example, "Rail to Large Truck" would indicate that supplies would leave the origin using Rail, then be transferred to Large Truck at the transfer city in order to be delivered to the disaster location.

After you explore the intermodal transportation options, single mode options will also be provided. This will allow you to explore the use of a single mode for the entire scenario rather than multiple modes.

[START INTERMODAL SCENARIOS](#)

[Previous](#) [Next](#) [Exit Training](#)

Scenario Summary

Scenario 1: Wildfire

Destination: Ramona, CA

Origin: Memphis, TN

Transfer: Phoenix, AZ

Shipment Size: Medium

Type: Intermodal

Scenario1: A wildfire breaks out in Ramona, CA destroying hundreds of homes along with several hundred acres of forest. A medium shipment of supplies will be needed from Memphis, TN with a transfer in Phoenix, AZ.

Explore the options below:

Large Truck to Small Truck	Cost: \$4600	Time: 1.5 days
Large Truck to Medium Truck	Cost: \$2900	Time: 1.5 days
Rail to Medium Truck	Cost: \$7700	Time: 8.25 days
Rail to Large Truck	Cost: \$7900	Time: 8.5 days
Air to Large Truck	Cost: \$192,400	Time: 1.5 days

To navigate between scenarios [CLICK HERE](#)

Previous Next Exit Training

Scenario Summary

Scenario 1: Wildfire

Destination: Ramona, CA

Origin: Memphis, TN

Transfer: Phoenix, AZ

Shipment Size: Medium

Type: Intermodal

Using large trucks, followed by a transfer to medium trucks, is the best option for this scenario in terms of cost and time. If only small trucks are available to delivery supplies to the disaster site, the cost will increase slightly, but time will not be hindered.

Explore the options below:

Large Truck to Small Truck	Cost: \$4600	Time: 1.5 days
Large Truck to Medium Truck	Cost: \$2900	Time: 1.5 days
Rail to Medium Truck	Cost: \$7700	Time: 8.25 days
Rail to Large Truck	Cost: \$7900	Time: 8.5 days
Air to Large Truck	Cost: \$192,400	Time: 1.5 days

To navigate between scenarios [CLICK HERE](#)

Previous Next Exit Training

Scenario Summary

Scenario 1: Wildfire

Destination: Ramona, CA

Origin: Memphis, TN

Shipment Size: Medium

Type: Single Mode

Scenario 1: A wildfire breaks out in Ramona, CA destroying hundreds of homes along with several hundred acres of forest. A medium shipment of supplies will be needed from Memphis, TN.

Explore the options below:

Small Truck	Cost: \$11,900	Time: 1.5 days
Medium Truck	Cost: \$2700	Time: 1.5 days
Large Truck	Cost: \$2700	Time: 1.5 days
Rail	Cost: \$6700	Time: 6.5 days
Air	Cost: \$220,900	Time: 1 day

To navigate between scenarios [CLICK HERE](#)

Previous Next Exit Training

Scenario Summary

Scenario 1: Wildfire

Destination: Ramona, CA

Origin: Memphis, TN

Shipment Size: Medium

Type: Single Mode

If only one mode is used, medium truck presents the best option. However, the cost and time is nearly equal to the best intermodal option.

Explore the options below:

Small Truck	Cost: \$11,900	Time: 1.5 days
Medium Truck	Cost: \$2700	Time: 1.5 days
Large Truck	Cost: \$2700	Time: 1.5 days
Rail	Cost: \$6700	Time: 6.5 days
Air	Cost: \$220,900	Time: 1 day

To navigate between scenarios [CLICK HERE](#)

Previous Next Exit Training

Scenario Summary

Scenario 2: Hurricane

Destination: New Orleans, LA

Origin: Denver, CO

Transfer: Oklahoma City, OK

Shipment Size: Medium

Type: Intermodal

Scenario2: A hurricane in New Orleans, LA destroys hundreds of homes and leaves thousands without power. A medium shipment of supplies will be needed from Memphis, TN with a transfer in Oklahoma City, OK.

Explore the options below:

Large Truck to Small Truck	Cost: \$5600	Time: 1.25 days
Large Truck to Medium Truck	Cost: \$2100	Time: 1.25 days
Rail to Medium Truck	Cost: \$5700	Time: 6.5 days
Rail to Large Truck	Cost: \$6000	Time: 6.75 days
Air to Large Truck	Cost: \$147,500	Time: 1.75 days

To navigate between scenarios [CLICK HERE](#)

Previous Next Exit Training

Scenario Summary

Scenario 2: Hurricane

Destination: New Orleans, LA

Origin: Denver, CO

Transfer: Oklahoma City, OK

Shipment Size: Medium

Type: Intermodal

Using large trucks, followed by a transfer to medium trucks, is the best option for this scenario in terms of cost and time.

Explore the options below:

Large Truck to Small Truck	Cost: \$5600	Time: 1.25 days
Large Truck to Medium Truck	Cost: \$2100	Time: 1.25 days
Rail to Medium Truck	Cost: \$5700	Time: 6.5 days
Rail to Large Truck	Cost: \$6000	Time: 6.75 days
Air to Large Truck	Cost: \$147,500	Time: 1.75 days

To navigate between scenarios [CLICK HERE](#)

Previous Next Exit Training

Scenario Summary

Scenario 2: Hurricane

Destination: New Orleans, LA

Origin: Denver, CO

Shipment Size: Medium

Type: Single Mode

Scenario2: A hurricane in New Orleans, LA destroys hundreds of homes and leaves thousands without power. A medium shipment of supplies will be needed from Memphis, TN.

Explore the options below:

Small Truck	Cost: \$9400	Time: 1.25 days
Medium Truck	Cost: \$2200	Time: 1.25 days
Large Truck	Cost: \$1900	Time: 1.25 days
Rail	Cost: \$4300	Time: 4.5 days
Air	Cost: \$190,900	Time: 1 day

To navigate between scenarios [CLICK HERE](#)

Previous Next Exit Training

Scenario Summary

Scenario 2: Hurricane

Destination: New Orleans, LA

Origin: Denver, CO

Shipment Size: Medium

Type: Single Mode

The use of either large or medium trucks (separately, not in combination) presents the same results as the intermodal option for cost and time.

Explore the options below:

Small Truck	Cost: \$9400	Time: 1.25 days
Medium Truck	Cost: \$2200	Time: 1.25 days
Large Truck	Cost: \$1900	Time: 1.25 days
Rail	Cost: \$4300	Time: 4.5 days
Air	Cost: \$190,900	Time: 1 day

To navigate between scenarios [CLICK HERE](#)

Previous Next Exit Training

Scenario Summary

Scenario 3: Flood

Destination: Iowa City, IA

Origin: Richmond, VA

Transfer: Chicago, IL

Shipment Size: Medium

Type: Intermodal

Scenario3: A flood in Iowa City, IA damages hundreds of homes and businesses. A large shipment of supplies will be needed from Memphis, TN with a transfer in Chicago, IL.

Explore the options below:

Large Truck to Small Truck	Cost: \$2700	Time: 1 day
Large Truck to Medium Truck	Cost: \$1500	Time: 1 day
Rail to Medium Truck	Cost: \$3300	Time: 5.25 days
Rail to Large Truck	Cost: \$3700	Time: 5.25 days
Air to Large Truck	Cost: \$163,700	Time: 1.25 days

To navigate between scenarios [CLICK HERE](#)

Previous Next Exit Training

Scenario Summary

Scenario 3: Flood

Destination: Iowa City, IA

Origin: Richmond, VA

Transfer: Chicago, IL

Shipment Size: Medium

Type: Intermodal

Using large trucks, followed by a transfer to medium trucks, is the best option for this scenario in terms of cost and time.

Explore the options below:

Large Truck to Small Truck	Cost: \$2700	Time: 1 day
Large Truck to Medium Truck	Cost: \$1500	Time: 1 day
Rail to Medium Truck	Cost: \$3300	Time: 5.25 days
Rail to Large Truck	Cost: \$3700	Time: 5.25 days
Air to Large Truck	Cost: \$163,700	Time: 1.25 days

To navigate between scenarios [CLICK HERE](#)

Previous Next Exit Training

Scenario Summary

Scenario 3: Hurricane

Destination: Iowa City, IA

Origin: Richmond, VA

Shipment Size: Medium

Type: Single Mode

Scenario3: A flood in Iowa City, IA damages hundreds of homes and businesses. A large shipment of supplies will be needed from Memphis, TN.

Explore the options below:

Small Truck	Cost: \$6600	Time: 0.75 day
Medium Truck	Cost: \$1500	Time: 0.75 day
Large Truck	Cost: \$1500	Time: 1 day
Rail	Cost: \$6500	Time: 7 days
Air	Cost: \$147,200	Time: 1 day

To navigate between scenarios [CLICK HERE](#)

Previous Next Exit Training

Scenario Summary

Scenario 3: Hurricane

Destination: Iowa City, IA

Origin: Richmond, VA

Shipment Size: Medium

Type: Single Mode

For this scenario, using only medium trucks presents a good option in terms of both cost and time.

Explore the options below:

Small Truck	Cost: \$6600	Time: 0.75 day
Medium Truck	Cost: \$1500	Time: 0.75 day
Large Truck	Cost: \$1500	Time: 1 day
Rail	Cost: \$6500	Time: 7 days
Air	Cost: \$147,200	Time: 1 day

To navigate between scenarios [CLICK HERE](#)

Previous Next Exit Training

**Training
Index**

- [Introduction](#)
- [Emergency Supply
Transportation](#)
- [Transportation
Modes](#)
- [Single Mode
Scenarios](#)
- [Intermodal
Transportation](#)
- [Intermodal
Scenarios](#)
- [Additional
Information](#)

Intermodal Scenarios

Select a scenario to explore:

SCENARIO 1

SCENARIO 2

SCENARIO 3

Previous

Exit Training

Appendix B
Usability Survey

Usability Questions

For the following statements, please circle the number that most closely matches your answer regarding the training program you just completed. A “1” means **strongly disagree** and a “5” means **strongly agree**.

1. The structure of the training was simple to understand.

<i>Strongly Disagree</i>	<i>Disagree</i>	<i>Neutral</i>	<i>Agree</i>	<i>Strongly Agree</i>
1	2	3	4	5

2. I felt comfortable using the training program.

<i>Strongly Disagree</i>	<i>Disagree</i>	<i>Neutral</i>	<i>Agree</i>	<i>Strongly Agree</i>
1	2	3	4	5

3. While completing the training, I had good control over the training program.

<i>Strongly Disagree</i>	<i>Disagree</i>	<i>Neutral</i>	<i>Agree</i>	<i>Strongly Agree</i>
1	2	3	4	5

4. The information in the training program was easy to read.

<i>Strongly Disagree</i>	<i>Disagree</i>	<i>Neutral</i>	<i>Agree</i>	<i>Strongly Agree</i>
1	2	3	4	5

5. The use of terms and icons was consistent throughout the training program.

<i>Strongly Disagree</i>	<i>Disagree</i>	<i>Neutral</i>	<i>Agree</i>	<i>Strongly Agree</i>
1	2	3	4	5

6. I was given enough information to work through and complete the training.

<i>Strongly Disagree</i>	<i>Disagree</i>	<i>Neutral</i>	<i>Agree</i>	<i>Strongly Agree</i>
1	2	3	4	5

7. Overall, I am satisfied with the training program.

<i>Strongly Disagree</i>	<i>Disagree</i>	<i>Neutral</i>	<i>Agree</i>	<i>Strongly Agree</i>
1	2	3	4	5

