ANL/DIS/02-1

ELIST 8 Transportation Model

Decision and Information
Sciences Division

Argonne National Laboratory

Operated by The University of Chicago,
under Contract W-31-109-Eng-38, for the

United States Department of Energy

Available electronically at http://www.doe.gov/bridge

Available for a processing fee to U.S. Department of Energy and its contractors, in paper, from:

U.S. Department of Energy
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831-0062
phone: (865) 576-8401
fax: (865) 576-5728

email: reports@adonis.osti.gov

ANL/DIS/02-1

ELIST 8 Transportation Model

by M.D. Braun and C.N. VanGroningen

Decision and Information Sciences Division
Argonne National Laboratory, 9700 South Cass Avenue, Argonne, Illinois 60439

13 February 2002

Prepared for U.S. Department of the Army, Military Traffic Management Command
Transportation Engineering Agency

NOTICE

This technical memorandum is an information product of Argonne's Decision and Information Sciences Division (DIS). It presents results of ongoing work or work that is more limited in scope and depth than that described in formal reports issued by DIS. This memorandum has undergone internal technical review and has been edited according to DIS's quality assurance requirements. In contrast to a formal technical report, this memorandum has not been externally peer reviewed.

For more information on the division's scientific and engineering activities, contact:

Director, Decision and Information Sciences Division
Argonne National Laboratory
Argonne, Illinois 60439
Telephone (630) 252-5464
http:www.dis.anl.gov

Publishing support services were provided by Argonne's Information and Publishing Division (for more information, see IPD's home page: http://www.ipd.anl.gov).

This report is printed on recycled paper.

CONTENTS

CONTENTS

TABLES

TABLES (Cont.)

ACRONYMS

The following is a list of the acronyms, initialisms, and abbreviations (including units of measure) used in this document.

Acronyms, Initialisms, and Abbreviations

APOD	air port of debarkation
DODX	designation for a type of railcar (designed to carry tanks)
ELIST	Enhanced Logistics Intratheater Support Tool
ETPFDD	Expanded Time Phase Force Deployment Data
FSS	fast sealift ship
HET	heavy equipment transport
ILOC	intermediate location
JOPES	Joint Operation Planning and Execution System
LIN	line item number
MGR	military grid reference
MHE	materiel handling equipment
MLC	military load class
MOG	maximum on ground
MSR	main supply route
PAX	personnel
POL	petroleum, oil, and lubricants
RDD	required delivery date
RLN	requirement line number
RORO	roll-on/roll-off
SA	staging area
TACS	Department of Defense-owned auxiliary crane ship
TPFDD	Time Phase Force Deployment Data
TSB	theater staging base
TTP	trailer transfer point
TUCHA	Type Unit Characteristics File

ULN	unit line number

Units of Measurement

cbbl	hundreds of barrels
deci-deg	deci-degree(s)
deg	degree(s)
ft	foot (feet)
ft^2	square foot (feet)
hr	hour(s)
in.	inch(es)
km	kilometer(s)
mi	mile(s)
mph	mile(s) per hour
mt	measurement-ton(s)
naut-mi	nautical-mile(s)
st	short ton(s)

ELIST 8 TRANSPORTATION MODEL

by

M.D. Braun and C.N. VanGroningen

ABSTRACT

The Enhanced Logistics Intratheater Support Tool (ELIST) Version 8 is a software tool designed to allow military analysts to model the deployment of cargo and personnel into theaters of operation from ports of debarkation through staging areas and theater-staging bases to in-theater destinations, usually tactical assembly areas. This document defines the parameters and heuristics to be modeled. All design and implementation decisions are derived from this document. Validation and verification of the model are based on this document.

1.0 INTRODUCTION

This document describes the operations of the Enhanced Logistics Intratheater Support Tool (ELIST) Version 8 model. All types of movements and activities modeled by the system are described as well as the way in which they are modeled. The data and parameters used are also provided. All of the data required for the model fall into the following categories, which are listed in detail in this document:

- Expanded Time Phase Force Deployment Data (ETPFDD) data,
- Network attributes,
- Asset attributes,
- Scenario parameters, and
- Reference data.

This document is the basis for the design of the model. Therefore, it is essential that any ambiguities or errors are identified and eliminated as soon as possible. Note that the parts of the model that have not been implemented in ELIST 8 are denoted as "*Not Implemented*."

2.0 COMMODITY TYPES

A *commodity* is a classification of cargo; personnel; or petroleum, oil, and lubricants (POL). A set of commodities is part of a larger "rule set," which is tied to each ETPFDD. A rule set includes rules for converting Time Phase Force Deployment Data (TPFDD) elements into ELIST 8 commodities and modes (in ETEdit), asset definitions, and carry preference rules. An ELIST 8 scenario includes an ETPFDD with its associated rule set, including commodity definitions.

Each item that is moved into an ELIST simulation must have a specified commodity. Within the simulation, commodity types determine what modes, assets, and onload/offload resources can be used to transport the item.

Each commodity has one of the five possible load types listed in Table 1. Commodity load types are static and have standard units of measure. In ELIST 8, breakbulk is generally modeled in short tons, except for ship operations where it is modeled in measurement-tons. Roll-on/roll-off (RORO) commodities are generally represented in numbers of vehicles. Breakbulk, RORO, and containers are listed in square feet for certain loading and storage operations.

Table 1 Commodity Load Types

Name	ELIST Unit	TPFDD Unit
PAX[a]	pax	pax
POL	cbbl	cbbl
Breakbulk	st/mt/ft^2	st
RORO	Vehicle/st/ft^2	st
Container	Container/ft^2	st

[a] PAX = personnel; cbbl = hundreds of barrels; st = short-ton; and mt = measurement-ton.

2.1 COMMODITY DATA

2.1.1 The attributes presented in Table 2 must be entered for each scenario commodity. The *square feet per short ton ratio* and *area stow factor* are only required for breakbulk and RORO commodities.

2.1.2 The *amount per vehicle ratio* is used to convert the commodity to vehicle equivalents in cases where that is required.

2.1.3 The *square feet per short ton ratio* is used to determine the area of cargo when an actual square-foot value is not available. Area is used for storage and vehicle loading.

Table 2 Commodity Attributes

Attribute	Unit
Name	NA
Load type	PAX, POL, breakbulk, RORO, container
Amount per vehicle ratio	TPFDD unit/vehicle
Square feet per short ton ratio (if breakbulk or RORO)	ft^2/st
Area stow factor (if breakbulk or RORO)	%
Heavy equipment transport (if RORO)	[true, false]
Forty foot (if container)	[true, false] (true if 40-ft container type; false if 20-ft container type)
Length overhang (if breakbulk or RORO) (*Not Implemented*)	in.
Width overhang (if breakbulk or RORO) (*Not Implemented*)	in.

NA = not applicable.

2.1.4 The *area stow factor* is used for determining the area required for loading the commodity onto transport vehicles. The stow factor is a percent of the total area that can actually be used when loading this type of commodity.

2.1.5 The heavy equipment transport (HET) attribute of a commodity can be set to “true” to indicate that the commodity is heavy equipment transportable. In the model, this setting is only used for routing. In a scenario, certain road routes can be designated as HET routes. If a HET route exists between two locations, it must be used for all HET cargo traveling by road between those locations.

2.1.6 Length overhang is the distance an individual item of cargo may extend past the length of a vehicle carrying it. (*Not Implemented*)

2.1.7 Width overhang is the distance an individual item of cargo may extend past the width of a vehicle carrying it. (*Not Implemented*)

2.2 CARRY PREFERENCE RULES

2.2.1 Associated with each commodity is a preference-ordered list of rules that describe the way in which the commodity can be transported. Each rule specifies either of the following:

- An *asset* (i.e., if it is a trailer asset, line-haul transport is implicitly required) or
- A *mode* (implies *self* movement that requires no asset).

2.2.2 Each rule can be constrained by the following:

- A minimum or maximum travel distance requirement. (This asset is used if the distance is less than 30 miles.)
- A late or on-time requirement. (This asset is used if the cargo is or will be on time.)

3.0 INTRATHEATER TRANSPORTATION ASSETS

ELIST 8 has three main objects for storing vehicle information. A set of vehicle types is stored globally for all scenarios. Vehicle types are the same in all scenarios.

Asset types are stored in a rule set. Part of an ELIST scenario definition consists of the rule set to be used. Multiple asset sets can be created for use in different scenarios.

Each ELIST scenario has a defined set of asset pools. An asset pool holds the specific vehicles, the location at which they are based, and the places to which they can travel.

3.1 VEHICLE TYPES

3.1.1 A vehicle type is a specific type of truck, tractor, trailer, railcar, fixed-wing aircraft, ship, or helicopter that is used to transport scenario items. The data associated with each type are shown in the attribute tables later in this document. Vehicle types are stored one time only for all scenarios.

3.1.2 Each vehicle type has a value for *default percent availability*. Availability is the percent of vehicles assigned to a scenario that is actually available for use at one time.

3.1.3 Each truck type must be defined as either *commercial* or *military*. These types have different movement requirements in the simulation.

3.1.4 Tractors and trailers are modeled separately for line-haul use only. In other cases, a tractor-trailer pair must be modeled as a truck type.

3.1.5 Data on specific ships, as well as ship types, are stored and used by the model.

3.2 ASSET TYPES

3.2.1 Transportation asset types are defined either for a scenario or for a theater. Asset types must be defined for each of the intratheater transportation modes (to be used in a scenario): road, rail, air, water, and rotary wing. The pipeline mode does not require assets. In ELIST 7, this information was stored in a parameters file, whereas in ELIST 8, it is stored in the database.

3.2.2 An asset type must have one or more vehicle types associated with it. Assets represent groups of vehicles that use the same mode, are tracked the same way in the simulation, and are used for the same purposes. They can have different characteristics, however, such as payload or curb weight. For example, the boxcar asset might include 50BOX, 60BOX, and KRNBX1 boxcars.

3.2.3 An asset that is composed of trucks (or trailers) can only have either *commercial* trucks or *military* trucks. It cannot have both types.

3.2.4 Asset types can be either completely tracked by the simulation (individual vehicles modeled, including all movements whether loaded or empty) or tracked only when in use (capability assets.) In this latter type of asset modeling, the asset is treated as an aggregate capability available anywhere covered by the pool. Generally, DODX railcars and military HET trucks are completely tracked, and other types of railcars and commercial motor vehicles are tracked when in use. *Ship assets are always modeled individually*.

3.3 ASSET POOLS

3.3.1 One or more *asset pool* must be defined for a scenario. An asset pool has a number of specific vehicles assigned to it.

3.3.2 Line-haul *tractors* must be in an asset pool that contains only tractors. Line-haul *trailers* must be in an asset pool that contains only trailers. All other asset pools are "direct delivery" pools that can contain any other types of assets.

3.3.3 The asset pools in ELIST 8 differ slightly from those in ELIST 7. A pool has a *home* node that is primarily an origin node. It also has an area of operation. The pool's assets can only make trips among nodes in this area.

3.3.4 An asset pool's area of operation can be a geographic region that includes all contained nodes, a set of nodes by name, or all nodes in the network. (*Not Implemented*)

3.3.5 Every vehicle in a scenario must belong to a specific asset pool.

3.3.6 Assets are specified for an asset pool by asset type, vehicle type, and number of vehicles. The initial location of a fully tracked asset vehicle is assumed to be the home node of its asset pool. Initial and/or final times of availability can also be specified if the vehicle or vehicles are not going to be available for the entire scenario. In the simulation, the time specified is considered to be the final time, but use of a vehicle can sometimes extend past this time (e.g., when a trip takes longer than expected).

3.3.7 The system ensures that the home node of each asset pool that contains fixed-wing aircraft is an airport, the home node of a ship is a port, the home node of a tractor or trailer is a trailer transfer point (TTP), and the home node of a railcar is a rail head. Otherwise, these assets are not used during the simulation.

3.3.8 When a fully tracked asset is finished with a trip, it becomes available. At that time, if it is not immediately needed at its current or another location, it travels to its home node.

3.4 ASSET SELECTION

To select assets for some amount of a commodity required to travel from an origin to a destination, it is necessary to keep in mind the following.

3.4.1 For each of the commodity’s asset preference rules in order of preference:

3.4.1.1 If an asset is available at the origin and it belongs to an asset pool whose home node is the destination, use that asset (i.e., return the asset to its home).

3.4.1.2 If an asset is available at the origin and it belongs to an asset pool that serves the destination, use that asset.

3.4.2 If no possible asset is available at the origin, trip activity goes into queues for all possible assets. If a possible asset is available at another location, and the asset’s pool serves both the origin and the destination, that asset is sent to the origin location.

4.0 UNIT PRIORITIZATION AND TRANSPORT MODE SELECTION

4.0.1 ELIST attempts to move all elements of a single requirement line number (RLN) or split unit line number (ULN) via the same mode unless otherwise specified in the input requirements or unless it is impossible (e.g., an entire unit travels by road). (*Not Implemented*)

4.0.2 If multiple items require movement at a node during a simulation interval, the movements are scheduled in order of RLN priority.

4.0.3 The following prioritization rules are applied. This strategy incorporates required delivery date (RDD), travel time, staging and delay times, and unit cohesiveness. Note that a lower value means a higher priority. The rules are applied in the following order:

4.0.3.1 A unit's priority is initially: RDD – (total delays) – estimated travel time. Take, for example, a unit with RDD = 20 that must marshall for 2 days, stage for 3 days, and travel 300 miles. To determine priority, apply the formula given above: RDD = 20 – 2 – 3 – (300 mi/300mi/day) = 14.

4.0.3.2 The priority of items that are part of a unit that has already begun a movement (such as offloading a ship or traveling to a node) is lowered by 3 until all items complete the same move. This rule ensures unit integrity during movement unless a significantly higher priority item needs to be transported. (*Not Implemented*)

4.0.3.3 Offload requirements are given higher priority than onload requirements.

4.0.3.4 Return of *requested* empty transport assets has the same priority as the unit for which they were requested.

4.0.3.5 Return of unrequested empty transport has low priority.

4.0.4 Mode selection is performed at the RLN level. Given multiple modes for achieving the required move, the following rules are used to select a mode:

4.0.4.1 Use the mode specified in movement requirement, unless not required by the user or scenario.

4.0.4.2 If part of the same RLN has started to move, use the same mode as previously used (if possible, for item commodity, size, and weight). *Note that this rule has been implemented only for RLN details, not for the entire RLN*.

4.0.4.3 Find the unit commodity with the most tonnage. Use the mode selection preferences for this commodity to assign a mode for the unit as a whole. When selecting a mode, verify that infrastructure capability exists for the mode (e.g., the route exists) and appropriate assets exist. (*Not Implemented*)

4.0.5 Transportation asset selection uses the commodity preference rules to determine what assets could be used. Use the most preferred vehicle that is available immediately. Otherwise, use the first vehicle available.

5.0 AIRPORTS AND PLANE TRANSPORTATION

5.1 AIRPORT DATA

The attributes for airports are provided in Table 3.

5.1.1 Each airport must have one or more parking areas defined for it.

Table 3 Airport Attributes

Attribute	Unit
Hours of operation, start	NA
Hours of operation, end	NA

NA = not applicable.

5.2 AIRPORT PARKING AREA DATA

5.2.1 The *parking maximum on ground (MOG)* and the *working MOG* of an airport parking area are represented in terms of three airframe types: wide body, narrow body, and small body. Each parking area can handle either *X* wide-body, *Y* narrow-body, or *Z* small-body aircraft. When one type of aircraft is parked, it reduces the remaining capability for other types of aircraft. Table 4 provides the attributes for parking areas.

5.2.2 *Parking MOG* depends on the physical characteristics of the airport. *Working MOG* represents the number of planes for which cargo processing resources are available.

5.2.3 Limited parking MOG does not constrain movement in the system.

Table 4 Parking Area Attributes

Attribute	Unit
Parking area name	NA
Parking MOG Wide body Narrow body Small body	No. of planes
Working MOG Wide body Narrow body Small body	No. of planes
Fuel hydrants	No. of hydrants

NA = not applicable.

5.3 AIRCRAFT DATA (FIXED WING, STRATEGIC, OR INTRATHEATER)

5.3.1 The percent availability of aircraft is not included in the database, but it is displayed on the aircraft edit window as a function of *use rate*:

$$\% \text{ Availability} = \textit{Use Rate} / 24 \times 100.$$

5.3.2 The number of aircraft used by the simulation is the number assigned in each asset pool reduced by the percent availability (or the *use rate* described above.)

5.3.3 Fixed-wing aircraft can be modeled either as individual assets or as aggregate capability assets. If individual modeling is chosen, the home node of the asset pool to which the aircraft are assigned must have sufficient parking MOG for all planes. If capability modeling is chosen, however, the aircraft will not consume MOG while not in use. Table 5 provides the attributes for aircraft.

Table 5 Aircraft Attributes

Attribute	Unit
Type	NA
Line item number (LIN)	NA
Parking type	W(ide), N(arrow), S(mall)
Door height	in.
Door width	in.
Cargo bay width	in.
Cargo bay length	in.
PAX capacity	pax
Weight capacity	st
Container capacity	Container
Onload time	hr
Offload time	hr
Expedited time (quick load/unload)	hr
Use rate	hr/day
Block speed for distance, at 500, 1,000, or 1,500 nautical-miles	naut-mi/hr
Strategic	[true, false]

NA = not applicable.

5.3.4 An aircraft can carry any cargo assigned to it in the commodity carry rules as long as it also meets the following rules:

- It fits through the aircraft's door.
- It fits in the cargo bay.
- It is within the aircraft's capacity limits for, depending on the cargo, the type, weight, number of containers, and number of people.

5.4 STRATEGIC AIR OPERATIONS

5.4.1 Strategic aircraft arrivals require *working MOGs* in order to be offloaded. The duration of the offload activity depends on the aircraft's *offload time*. After the offload time, all cargo is available to continue movements.

5.4.2 If no w*orking MOG* capability is available at any parking areas, the plane consumes a parking spot. If no *parking MOG* is available, the plane waits in an airport queue until a MOG becomes available.

5.4.3 Landing, taxiing, and parking times are included in the transport event and are not explicitly modeled.

5.4.4 All cargo is stored at the airport after it is offloaded from a plane unless the airport is the cargo's final destination in the scenario. See "Storage" on page 37. If the scenario parameter, *storage constrains flow*, is true, cargo (except PAX) cannot be offloaded when no storage space is available.

5.4.5 All breakbulk, RORO, and container cargo must be documented as it is taken off a plane. See "Documentation" on page 39. If the scenario parameter, *documentation constrains movement*, is set to true, documentation capability must be available in order to offload these types of cargo.

5.4.6 As soon as offloading of the strategic aircraft has been completed, the plane departs (not modeled), and the parking area becomes available. No refueling is modeled.

5.4.7 Strategic and intratheater air movements (load/unload) use the same airport resources.

5.5 INTRATHEATER AIR MOVEMENT METHODOLOGY

5.5.1 Aircraft at a location (APOD) always use *parking MOG* (if it is available) even when empty or not in use.

5.5.2 Aircraft require *working MOG* capabilities in order to be loaded or offloaded. If no working MOG is available, the plane cannot be loaded or offloaded.

5.5.3 Fixed-wing aircraft are sent to a destination unless a *working MOG* is expected to be available (based on aircraft at the airport and aircraft en route to the airport.)

5.5.4 Fixed-wing air transport requires an airport at the origin and the destination, but no route or link capability. The duration of the trip is the distance divided by the appropriate *block speed* for the distance. Block speeds incorporate take-off, landing and taxi time, so these are not explicitly modeled.

5.5.5 All cargo is stored at the airport after it is offloaded from a plane unless the airport is the cargo's final destination in the scenario. See "Storage" on page 37. If the scenario parameter, *storage constrains flow*, is true, cargo (except PAX) cannot be offloaded when no storage space is available.

5.5.6 All breakbulk, RORO, and container cargo must be documented as it is taken off a plane. See "Documentation" on page 39. If the scenario parameter, *documentation constrains movement*, is true, documentation capability must be available in order to offload these types of cargo.

5.5.7 As soon as offloading of an aircraft has been completed, it no longer requires *working MOG*. If no cargo is waiting for transport from the airport, the plane departs for its home node. No refueling is modeled.

5.6 STAR ROUTES (*Not Implemented*)

5.6.1 STAR routes or channels can be set up as part of a scenario. This activity will be modeled by consuming MOG capability at regular intervals at selected airports.

5.6.2 Scenario inputs for a STAR route will include the following:

- APOD;
- Aircraft body type (i.e., wide, narrow, or small);
- Number of aircraft;
- Start time;
- End time;
- Frequency (e.g., every 8 hr from start time to end time); and
- Duration, which may be equal to the aircraft's *expedited time*.

6.0 SEAPORTS AND SHIP TRANSPORTATION

6.1 PORT DATA

Table 6 lists the port on-/offload attributes.

6.1.1 One or more berths must be assigned for each seaport.

6.1.2 The cargo processing rates for a seaport (as well as the port's berths) are based on a full 24-hr day. If a seaport's hours of operation are less than 24 hr, the processing rates will not be fully attainable. Effective rates will be calculated as the *given rate* × hours in operation/24 hr.

6.1.3 Each personnel rate (e.g., *breakbulk offload rate, personnel; breakbulk onload rate, personnel; container offload rate, personnel*) can be interpreted as the maximum capability of all port personnel assigned to the specific type of cargo, assuming that infinite infrastructure and materiel handling equipment (MHE) capabilities are available.

These rates are interdependent such that if one rate is consumed, it consumes the capability from all three rates. For example, a given port has the following capabilities:

- Breakbulk offload rate, personnel: 1,000 st/day,
- Container offload rate, personnel: 200 container/day, and
- Vehicle offload rate, personnel: 1,000 vehicle/day.

If, on a given day, 60 containers are offloaded, then 30% of the personnel offload capability at the port is consumed (60/200). In addition, if 500 st of breakbulk cargo is offloaded, an additional 50% of the offload personnel offload capability is consumed (500/1,000). In effect, this leaves 20% of the personnel offload resources remaining, which could be used to unload 200 st of breakbulk, 40 containers, or 200 vehicles.

6.1.4 *Breakbulk offload rate*, *personnel* and *breakbulk onload rate, personnel* are different rates for the same "resource." These personnel can operate at any berth and are dependent on the container and RORO personnel.

6.1.5 *Container offload rate*, *personnel* and *container onload rate, personnel* are different rates for the same resource. These personnel can work at any berth and are dependent on the breakbulk and RORO personnel.

Table 6 Port On-/Offload Attributes

Attribute	Value	Unit
Hours of operation, start	NA	NA
Hours of operation, end	NA	NA
Breakbulk Offload rate, personnel Onload rate, personnel	NA	st/day
Container Onload rate, personnel Offload rate, personnel	NA	Container/day
RORO Offload rate, personnel Onload rate, personnel	NA	Vehicle/day
Number of mobile cranes	NA	No. of cranes

NA = not applicable.

6.1.6 *RORO offload rate, personnel* and *RORO onload rate, personnel* are different rates for the same resource. These personnel can work at any berth and are dependent on the breakbulk and container personnel.

6.1.7 Incoming unit personnel (enablers) are assigned to a port and a cargo type (for use at any appropriate berth). (*Not Implemented*)

6.1.8 The mobile cranes at a port can work at any berth.

6.2 BERTH DATA

Table 7 lists the attributes for berths.

6.2.1 A berth is considered a continuous straight side of a dock or wharf along which ships can dock while unloading and loading cargo. The entire length of a berth has one value for each attribute, such as *depth*.

6.2.2 Two or more berths can be contiguous along a straight side of a dock or wharf such that a ship can be secured against parts of two (or more) berths. Berths can be defined in this way to allow the modeling of differing depths or other berth attributes. (*Not Implemented*)

6.2.3 To be used in a scenario, a berth must be "available." The value of *available for military use* is the default availability for a berth. A scenario can either override this value or make a berth available for a specific span of time. (The port's hours of operation also affect berth availability.)

Table 7 Berth Attributes

Attribute	Unit
Name	NA
Class (used for default values)	NA
Length	ft
Ship spacing	ft
Depth	ft
Width	ft
Apron width (for RORO ships)	ft
Available for military use	[true, false]
RORO, on-/offload rate per ship, infrastructure	NA
Tanker on-/offload rate per ship, infrastructure	cbbl/day
No. of container cranes	No. of container cranes
No. of gantry cranes	No. of gantry cranes
No. of TACS cranes	No. of TACS cranes

NA = not applicable.

6.3 SHIP DATA (STRATEGIC OR INTRATHEATER)

Table 8 lists the ship attributes.

6.3.1 The four capacity attributes of a ship (container, RORO, breakbulk, and tanker) are assumed to be mutually exclusive such that if nonzero values exist for more than one attribute, the ship can hold the full capacity for all cargo types. Generally, only one or two of the capacities are nonzero.

6.3.2 If *capacity, RORO* is nonzero, the ship is a RORO ship, which requires ramp space at a berth.

6.3.3 Ship capacities for RORO and breakbulk cargo are measured in different units than are used in the rest of the simulation: RORO is in square feet, and breakbulk is in short tons.

Table 8 Ship Attributes

Attribute	Unit
Type	NA
LIN	NA
Lloyds	NA
NISC	NA
Length	ft
Beam	ft
Draft	ft
Number of cranes (on ship)	No.
Maximum working cranes	No.
Capacity	
Container	Container
RORO	ft^2
Breakbulk	st
Tanker	cbbl
Load	
Minimum	%
Adequate	%
Rate of march	mph
Availability	%
Strategic	[true, false]
RORO, on-/offload rate	Vehicle/day
Apron width required	ft

NA = not applicable. NISC = Naval Intelligence Service Code.

6.4 CRANE DATA

6.4.1 Three types of cranes are modeled at berths: container, gantry, and TACS cranes. (Mobile cranes are modeled at ports.)

6.4.2 The capability rates for each type of crane are scenario parameters. (See "Scenario Parameters" on page 51.) Each type has two offload rates — one measured in containers per day and one in short tons per day for breakbulk cargo. Likewise, each crane type has two onload rates. The rate used for a crane in the simulation depends on the type of cargo being lifted and whether the activity is onload or offload.

6.4.3 Each berth (or set of contiguous berths) is assigned a number of container, gantry, and/or TACS cranes, which can be used at any location along the berth. (Even different TACS cranes, which may be physically on the same ship, are simplified in the model and allowed to work any ship at the berth.) Mobile cranes, which are assigned to the port as a whole, can work at any berth.

6.4.4 Incoming unit MHEs (enablers) are assigned to a specific berth at a port in order to enhance the port's capability. The MHEs modeled by ELIST are mobile cranes and TACS. (*Not Implemented*)

6.4.5 Breakbulk and container onload and offload capabilities for a ship at a berth depend on the number of available cranes, the ship value for *maximum working cranes* (the number of cranes that can operate on the ship at one time), and the capabilities of the crane types.

6.4.6 RORO cargo can be treated as breakbulk for ship loading and offloading. That is, RORO cargo can be loaded using cranes (measured in tons.)

6.4.7 When a ship is berthed, cranes are assigned to it for the duration of its stay at the berth.

6.5 BERTH SELECTION

6.5.1 When a ship arrives at a seaport to either offload or onload cargo, the available berth spaces are rated on the basis of the ship's characteristics and its cargo. The ship is assigned the best space available based on those parameters. If no appropriate berths are available, the ship waits in a queue.

6.5.2 A ship can only be assigned an available (as specified in the scenario) and unused section of berth that meets its specifications for length, depth, width, and apron width (if RORO). All of the following rules must be true to place a ship at a berth space:

6.5.2.1 Unused berth(s) length ≥ ship length + berth's *ship spacing* (if another ship is berthed adjacent to the space);

6.5.2.2 Berth *depth* ≥ ship *draft* + 2 ft;

6.5.2.3 Berth *width* ≥ ship *beam* + 2 ft; and

6.5.2.4 Berth apron width ≥ ship apron width required (ft).

6.5.3 Berth rating and selection include crane assignment if cranes are needed. Ratings are integer values of 1 and higher, where 1 is the best rating. The following rules are used for rating a berth space for offload based on the ship type and cargo. (Onload rates would be used for rating a berth for onload.) Berth rating assumes that the berth space has been dimensionally matched with the ship.

6.5.3.1 If the ship is a RORO ship and the cargo is 100% RORO, the following rules apply:

6.5.3.1.1 If the ship's *RORO offload rate per ship*, *infrastructure* is greater than the GOOD_RATE (200 vehicle/day), the rating is 1.

6.5.3.1.2 If the ship's *RORO offload rate per ship, infrastructure* is less than BAD_RATE (20 vehicle/day), the rating is 5.

6.5.3.1.3 If the ship's *RORO offload rate per ship*, *infrastructure* is none of the above, the rating is 2, 3, or 4 depending on where the berth's *RORO offload rate per ship, infrastructure* falls between GOOD_RATE and BAD_RATE.

6.5.3.2 If the ship is a tanker (with only POL cargo), the following rules apply:

6.5.3.2.1 If the berth's *tanker on-/offload rate per ship, infrastructure* is 0, the rating is 99.

6.5.3.2.2 If the berth's *tanker on-/offload rate per ship*, *infrastructure* is greater than GOOD_RATE (100,000 cbbl/day), the rating is 1.

6.5.3.2.3 If the berth's *tanker on-/offload rate per ship*, *infrastructure* is less than BAD_RATE (100 cbbl/day), the rating is 5.

6.5.3.2.4 If the berth's *tanker on-/offload rate per ship, infrastructure* is none of the above, the rating is 2, 3, or 4 depending on where the berth's *tanker on-/offload rate per ship*, *infrastructure* falls between GOOD_RATE and BAD_RATE.

6.5.3.3 Otherwise, for berth selection, when possible the maximum number of cranes should be assigned to the ship (ship's *max working cranes*) in order of preference: container crane, gantry crane, mobile crane, and finally TACS crane.

6.5.3.3.1 For each crane (of the number of desired cranes) that is not available, increase the rating by 2.

6.5.3.3.2 For each TACS crane assigned, increase the rating by 1.

6.5.3.3.3 If no cranes are available, and the ship has no shipboard cranes, the rating is 99.

6.5.3.4 If a ship has any container cargo, at least one crane with container capability must be assigned. If a ship has any breakbulk cargo, at least one crane with breakbulk capability must be assigned.

6.6 SEAPORT OPERATIONS: GENERAL

6.6.1 ELIST 8 models ship on- and offloading at the berth level only and does not provide a port-level option as did ELIST 7; i.e., ELIST 8 always matches ships to specific berths at the port and uses only the capability available at that berth to offload that ship. This means that all strategic arrivals at a seaport in an ELIST 8 scenario must be loaded ships (which was not the case with ELIST 7).

6.6.2 Ships and boats within the theater (inland waterway movement) use the same ports and the same on- and offload capabilities as used for strategic movements. The use of ports and on- and offload capabilities by strategic and intratheater transports during the simulation is recorded separately for reporting purposes. (separate recording *Not Implemented*)

6.7 SEAPORT OPERATIONS: STRATEGIC ARRIVALS

6.7.1 Strategic ship arrivals require berth space to be offloaded. If no appropriate berth space is available, the ship waits in a seaport queue until space becomes available.

6.7.2 The activity of moving a ship to a berth and securing it takes the amount of time specified in the scenario parameter, *ship berth time*.

6.7.3 After a ship berths, all cargo is offloaded. The time required for offloading depends on the rates and availability of the assigned and required resources.

6.7.4 All cargo is stored at the port after it is taken off a ship unless, in setting up the scenario, the seaport was designated as the cargo's final destination. See "Storage" on page 37. If the scenario parameter, *storage constrains flow,* is true, cargo (except PAX) cannot be offloaded if storage space does not exist.

6.7.5 All breakbulk, RORO, and container cargo must be documented as it is taken off a ship. See "Documentation" on page 39. If the scenario parameter, *documentation constrains movement*, is set to true, documentation capability must be available for these types of cargo to be offloaded.

6.7.6 Offloading uses the scenario parameter, *intervals per day*. If all of a ship's cargo can be offloaded in one interval, as soon as the offload is complete, all the offloaded cargo continues with its deployment. Otherwise, all the cargo that can be offloaded in an interval continues its deployment, while the remaining ship cargo continues to be offloaded.

6.7.7 As soon as offload of the strategic ship is complete, the ship departs and the berth space becomes available. The time required to move a ship from a berth is specified in the scenario parameter, *time to deberth*.

6.7.8 Strategic and intratheater ships (load/unload) use the same seaport resources.

6.8 SEAPORT OPERATIONS: ON- AND OFFLOAD

6.8.1 On- and offload of a ship at a port require both personnel on- and offload capability and infrastructure on- and offload capability (except in the case of POL). Personnel capability values are entered for the port as a whole (personnel can work at any of the berths), and the infrastructure capability is based on data for each berth.

6.8.2 Different rates are stored for on- and offload capability; however, these rates represent the same resources, and consumption of offload capability reduces the onload capability available by an equivalent percentage (e.g., if one-third of the personnel offload capability for breakbulk is used during a time period, one-third of the onload capability is also used or unavailable).

6.8.3 For infrastructure offload capabilities, which are specific to a port's berths, summary values are shown when a port is being examined to provide an approximation of its total capability. These values cannot be entered or edited directly. (*Not Implemented*)

$$\text{No. of Ships}_{\mathit{Berth,\ Ship\ Type}} = \mathit{Floor}\,(\text{Length}_{\mathit{Berth}} / \text{Average Length}_{\mathit{Ship\ Type}})$$

$$\text{Tanker On-/Offload Rate, Infrastructure} = \sum_{B}^{\mathit{All\ Berths}} \text{No. of Ships}_{\mathit{B,\ Tanker}} \times \text{Tanker On-/Offload Rate per Ship, Infrastructure}_{B}$$

$$\text{RORO Offload Rate, Infrastructure} = \sum_{B}^{\mathit{All\ Berths}} \text{No. of Ships}_{\mathit{B,\ RORO}} \times \text{RORO Offload Rate per Ship,}_{\mathit{RORO\ B}}$$

$$\text{No. Container Cranes}_{\mathit{Berth}} = \mathit{minimum}\,([\text{No. Ships}_{\mathit{Berth,\ Container}} \times \text{No. of Cranes per Ship}], \text{No. Cranes}_{\mathit{Berth}})$$

$$\text{Max. Container Offload Rate, Infrastructure} = \sum_{B}^{\mathit{All\ Berths}} \sum_{C}^{\text{Num}\ \mathit{Container\ Cranes}_B} \text{Container Offload Rate}_{C}$$

$$\text{No. Breakbulk Cranes}_{\mathit{Berth}} = \mathit{minimum}\,([\text{No. Ships}_{\mathit{Berth,}\ \text{Breakbulk}} \times \text{No. Cranes per Ship}], \text{No. Cranes}_{\mathit{Berth}})$$

$$\text{Max. Breakbulk Offload Rate, Infrastructure} = \sum_{B}^{\mathit{All\ Berths}} \sum_{C}^{\text{Num}\ \mathit{Breakbulk\ Cranes}_B} \text{Breakbulk Offload Rate}_{C}$$

6.8.4 The port infrastructure onload rates (not displayed) will be calculated in the same way as for offload rates, but using onload numbers. (*Not Implemented*)

6.8.5 The expected offload rates for breakbulk, container, and RORO cargo depend on both the infrastructure capability (which is based on the berth's capabilities) and the personnel capability, both of which must be available for offloading to occur. Tanker offload capability depends only on infrastructure.

These rates are called "expected" because they are based on an average ship size; actual usable offload capability depends on actual ships arriving.

$$\text{Expected Rate}_{\mathit{Type}} = \mathit{minimum}\ ([\mathit{Max}]\ \text{Infrastructure Rate}_{\mathit{Type}}\ \text{Personnel Rate}_{\mathit{Type}})$$

6.8.6 Multicargo-type ships such as fast sealift ships (FSSs) are handled in the same way as single-cargo ships. The required offload capability depends on the amount of each cargo type.

6.8.7 Self-sustaining ships require MHE capability from the port like other ships. (Eventually, this requirement may be relaxed, for example, when no MHE is at a port.)

6.9 SHIP LOADING

6.9.1 In the initial version of ELIST 8, ship loading has been simplified. Later, targetlike vehicle loading will be implemented.

6.9.2 Cargo is only loaded onto ships that can carry cargo based on the asset/commodity rules.

6.9.3 No PAX are transported by ship within a theater.

6.9.4 The barrels of POL loaded cannot exceed the ship's *capacity, tanker*.

6.9.5 The number of containers loaded cannot exceed the ship's *capacity, container*.

6.9.6 The total short tons of breakbulk cargo cannot exceed the ship's *capacity, breakbulk.*

6.9.7 When loading RORO or breakbulk cargo, the commodity *stow factor* (a percent) is used to reduce the area that can actually be used to hold cargo (i.e., usable ship load area = *Capacity, RORO* × *Stow Factor*/100). The total square footage of RORO cargo cannot exceed the usable ship load area.

6.10 INTRATHEATER SHIP MOVEMENT METHODOLOGY

6.10.1 Intratheater movement by water requires network route capability, which means that all water routes require links in the network database. Links are naturally used to represent rivers, but they are also required from port to port through bays and oceans where travel by barge or ship is planned.

6.10.2 The travel time for a water movement is calculated by using the route distance and the travel speed, which is the minimum of the ship speed and the route speed.

6.10.3 A ship only takes up berth space while it is being loaded or unloaded. If it is not in use, it is "at the port" but does not require any constrained space (a berth space).

6.10.4 When ship transport is planned, cargo accumulates in storage at the port until the minimum load of cargo that is appropriate for ship type's is waiting. At that time, if a ship is waiting at the port, it is berthed. If a ship is waiting elsewhere, however, it is sent to the seaport and berthed upon arrival. If no ship is free, the cargo continues to accumulate and wait. If no berth is free, the ship waits in one or more berth queues.

6.10.5 A minimum load for a ship is calculated as the scenario's *minimum watercraft load* ([%] × the applicable ship capacity attribute/100). If a ship can carry more than one type of cargo (e.g., FSS), a minimum load for the ship is considered to be a minimum load of either cargo type. Adequate loads are calculated in the same way by using the scenario's *adequate watercraft load* attribute.

6.10.6 Once a minimum load has accumulated and a ship has been requested, that cargo is committed to travel by the requested ship type. Waiting cargo that has not been committed can still be moved by other modes as assets become available.

6.10.7 The activity of moving a ship to a berth and securing it takes the time that has been specified in the scenario parameter, *time to berth.*

6.10.8 Once a ship has berthed, onloading to the ship continues until either no cargo is waiting at the port or the ship is full. If the ship is full, it will depart. If no cargo remains and the ship is not full, but it has at least an adequate load, it will also depart. Otherwise, it will wait a maximum amount of time for additional cargo and then depart. This duration, *maximum watercraft wait*, is a scenario parameter.

6.10.9 As cargo is loaded onto a ship, it is removed from storage (see "Storage" on page 37), and if it is breakbulk, RORO, or containers, it must be documented (see "Documentation" on page 39).

6.10.10 After a ship arrives at its destination, it is berthed and offloaded as described in "Seaport Operations: Strategic Arrivals" on page 19.

7.0 TRANSFER NODES

7.1 NODE DATA

Table 9 lists the general node attributes.

Table 9 General Node Attributes

Attribute	Unit
Name	NA
Class (for default attribute values)	NA
Country/state code	NA
Coordinates	[MGR, deg, deci-deg]
Icon Name Color	 NA NA
Elevation	ft
Height limit	in.
Weight limit	st
Width limit	in.
Military load class (MLC)	NA
Road intersection rate	Vehicle/day
Rail intersection rate	Railcar/day
Intersection type	[At grade, none, interchange]

NA = not applicable; MGR = military grid reference.

7.2 POINT OF INTEREST DATA

Table 10 lists the point of interest attributes.

Table 10 Point of Interest Attributes

Attribute	Unit
Road convoy clearance rate	Vehicle/day
Rail clearance rate	Railcar/day
Documentation rate	Vehicle/day
Staging area (not used)	[Node name]
Theater staging base (not used)	[Node name]
Equipment storage area	ft^2
PAX storage	pax
POL storage	cbbl
Container stacking height	Container
Road maximum loaded	Vehicle
Rail maximum loaded	Railcar
Maximum railcars at node	Railcar

7.3 TRAILER TRANSFER POINT (TTP) DATA

Table 11 lists the TTP attributes.

7.3.1 The cargo processing rates for a TTP are based on a full 24-hr day. If the node's hours of operation are less than 24 hr/day, the processing rates given will not be fully attainable. Effective rates will be:

Actual Processing Rate = Given Rate × (hours in operation/24 hr).

Table 11 TTP Attributes

Attribute	Unit
Hours of operation, start (*Not Implemented*)	NA
Hours of operation, end (*Not Implemented*)	NA

NA = not applicable.

7.4 GROUND TRANSPORT ONLOAD AND OFFLOAD DATA

Table 12 lists the on-/offload node attributes.

Table 12 On-/Offload Node Attributes

Type	Infrastructure Rate	Personnel Rate	MHE Rate	Effective Rate	Unit
Rail container on-/offload rate					Railcar/day
Container lifts on/off rail	1 or 2				NA
Rail breakbulk on-/offload rate					Railcar/day
Rail RORO on-/offload rate					Railcar/day
Rail POL on-/offload rate					Railcar/day
Rail total on-/offload rate					Railcar/day
Road breakbulk on-/offload rate					Truck/day
Road RORO on-/offload rate					Truck/day
Road POL on-/offload rate					Truck/day
Container on-/offload rate					Container/day

Note: No shading indicates used rates that users should enter; dark shading indicates the rates are not used; and light shading indicates the rates are the effective rates, which are calculated as the minimum of the used infrastructure, personnel, and MHE rates. NA = not applicable.

8.0 GROUND TRANSPORT VEHICLES

8.1 TRUCK DATA

Table 13 lists the truck attributes.

Table 13 Truck Attributes

Attribute	Unit
Type	NA
Weight capacity	st
POL capacity	gal
Container capacity	Container
PAX capacity	pax
Default availability	%
Cargo area width	in.
Cargo area length	in.
Bed height	in.
Curb weight	st
Rate of march	mph
On- or offload time	hr
Military (vs. commercial)	[true, false]

NA = not applicable.

8.1.1 A truck carries only one of the following at one time: containers, PAX, POL, or other cargo.

8.2 TRACTOR AND TRAILER DATA (FOR LINE-HAUL OPERATIONS)

Table 14 lists the tractor attributes.

Table 14 Tractor Attributes

Attribute	Unit
Type	NA
Default availability	%
Rate of march	mph

NA = not applicable.

Table 15 lists the trailer attributes.

Table 15 Trailer Attributes

Attribute	Unit
Type	NA
Weight capacity	st
POL capacity	gal
Container capacity	Container
Cargo area width	in.
Cargo area length	in.
Bed height	in.
Curb weight	st
Onload time	hr
Default availability	%
Offload time	hr

NA = not applicable.

Table 16 lists the tractor-trailer matching attributes.

Table 16 Tractor-Trailer Matching Attributes

Attribute	Unit
Tractor type	NA
Trailer type	NA

NA = not applicable.

8.2.1 Tractor-trailer match data are stored in a table that lists all possible matches between trailer types and the types of tractors that they can move.

8.2.2 ELIST 8 assumes that a trailer always travels at the same rate of march as the tractor that pulls it.

8.2.3 A trailer carries only the following at one time: containers, POL, or other cargo.

8.3 RAILCAR DATA

Table 17 lists the railcar attributes.

Table 17 Railcar Attributes

Attribute	Unit
Type	NA
Weight capacity	st
POL capacity	cbbl
Container capacity	Container
PAX capacity	pax
Cargo area width	in.
Cargo area length	in.
Levels	No.
Gauge	NA
Onload time	hr
Offload time	hr
Default availability	%

NA = not applicable.

8.3.1 A railcar carries only the following at one time: containers, POL, or other cargo.

8.3.2 Rail prime movers (engines) will not be modeled in ELIST 8.

8.4 TRUCK, TRAILER, AND RAILCAR LOADING

8.4.1 A simplified vehicle loading occurs. (Eventually, targetlike vehicle loading will be implemented.)

8.4.2 Cargo is only loaded onto vehicles that can carry it based on the asset/commodity rules.

8.4.3 The number of personnel loaded cannot exceed the vehicle's *PAX capacity*.

8.4.4 The amount of POL loaded cannot exceed the vehicle's *POL capacity*.

8.4.5 The number of containers loaded cannot exceed the vehicle's *container capacity*, and the weight of the loaded containers cannot exceed the *weight capacity* of the vehicle.

8.4.6 When loading a single (level 4 or level 6) cargo item on a vehicle, the commodity *stow factor* has no effect. For all other breakbulk and RORO cargo, the stow factor (a percentage) is used to reduce the area that can actually be used to hold cargo. That is, usable vehicle load area = actual area × stow factor/100.

8.4.7 The sum of the area (in square feet) of all breakbulk and RORO cargo items cannot exceed the area of the vehicle bed (*cargo area width* × *cargo area length*) reduced by the commodity *stow factor*. Also, the total weight of these cargo items cannot exceed the *weight capacity* of the vehicle. An exception to this rule is listed in Item 8.4.8 below.

8.4.8 If a single item of known dimensions does not fit the vehicle area (but the weight is not exceeded), the commodity's *width overhang* and *length overhang* will be considered as follows. If the item's *width* – the commodity's *width overhang* ≤ *cargo area width* of the vehicle, and the item's *length* – *length overhang* ≤ *cargo area length*, the item can be loaded. (*Not Implemented*)

8.4.9 An item of known dimensions can be packed into a vehicle if the size of the cargo fits within the size of the vehicle. No stow factor is required for the first item, but this factor is taken into account if additional items need to be stored. If additional items can fit into the vehicle, two conditions must be met: (1) the item's dimensions must be less than those of the cargo area, and (2) sufficient unused space must be available for packing.

Unused space is calculated as follows:

Unused Area = Total_Area – sum (area_of_each_item × stow_factor_of_item).

8.4.10 A vehicle is considered fully loaded and ready to depart if it holds at least an adequate load. If the vehicle is carrying less than an adequate load, it will wait up to a maximum amount of time for additional cargo. If, after waiting, no new cargo has arrived, the vehicle will depart.

8.4.11 The scenario parameters, *adequate truck load* (in percent), *maximum truck wait*, *adequate railcar load*, and *maximum railcar wait*, are used to determine loads and wait times for partially loaded vehicles.

9.0 LINKS AND ROUTES

9.1 LINK DATA

Table 18 lists the general link attributes.

Table 18 General Link Attributes	
Attribute	
Name	Line width
Class	Line color
Line style	Connecting nodes 1 & 2

9.2 ROAD LINK DATA

Table 19 lists the road attributes.

9.2.1 Roads are modeled as two distinct directional links: forward travel is from *connecting node 1* to *connecting node 2*, and return travel is from *connecting node 2* to *connecting node 1*.

9.2.2 *Entry rate* is the number of vehicles that can start onto the link (in each direction) during a certain time period.

9.2.3 The actual entry rate available to the simulation will be decreased by the percentage of *civilian traffic*. (*Not Implemented*)

9.2.4 The *rate of march* is the expected rate of travel on the link, including short periodic stops and delays.

9.2.5 Road links can be one way; however, they default to two-way road links.

9.2.6 The following ELIST 7 attributes were not included in ELIST 8 because they were rarely used: *number of lanes*, "*trafficability*," *surface width, surface type*, *surface condition, alignment, min grade*, and *min turn radius.*

Table 19 Road Attributes	
Attribute	**Unit**
Length	mi or km
Entry rate (in each direction)	Vehicle/day
Weight limit	st
Height limit	in.
Width limit	in.
Military load class	NA
Rate of march	mph or km/hr
One way	[true, false]
Node travel to (for one way)	NA
Civilian traffic	%
MSR (name) (*Not Implemented*)	NA
MSR = main supply route; NA = not applicable.	

9.3 RAIL LINK DATA

Table 20 lists the rail link attributes.

Table 20 Rail Link Attributes	
Attribute	**Unit**
Length	mi or km
Entry rate	Railcar/day
Rate of march	mph
Weight limit	st
Height limit	in.
Width limit	in.
Gauge	NA
Civilian traffic (*Not Implemented*)	%
NA = not applicable.	

9.3.1 Rail links are modeled as one link. Travel can occur in both directions on that link. The numbers of vehicles using the link are recorded separately for forward travel (from *connecting node 1* to *connecting node 2)* and return travel (from *connecting node 2* to *connecting node 1*).

9.3.2 *Entry rate* is assumed to be total capability for railcars entering the link, including travel in both directions.

9.3.3 Actual entry rate available to the simulation will be decreased by the percentage of *civilian traffic.* (*Not Implemented*)

9.3.4 *Gauge* of rail links will be used to ensure consistent and appropriate gauge rail routes. (*Not Implemented*)

9.4 WATERWAY LINK DATA

Table 21 lists the waterway link attributes.

Table 21 Waterway Link Attributes

Attribute	Unit
Length	mi or km
Entry rate	Ship/day
Rate of march	mph
Depth limit (*Not Implemented*)	ft
Civilian traffic (*Not Implemented*)	%

9.4.1 Waterway links are modeled as one link. Travel can occur in both directions on waterway links. The numbers of vehicles using the link are recorded separately for forward travel (from *connecting node 1* to *connecting node 2)* and return travel (from *connecting node 2* to *connecting node 1*).

9.4.2 The actual entry rate available for the simulation will be decreased by the percentage of *civilian traffic*. (*Not Implemented*)

9.5 PIPELINE LINK DATA

Table 22 lists the pipeline attributes.

9.5.1 The direction of flow is not recorded for pipeline links. Flow in either direction can occur up to the pipe's *rate of flow*.

Table 22 Pipeline Attributes	
Attribute	**Unit**
Length	mi or km
Rate of flow	cbbl/day

9.6 ROUTES

9.6.1 In ELIST, the term *route* refers to a specific path between an origin and a destination. Every route has a mode, road, rail, helicopter, waterway, or pipeline.

9.6.2 Road, rail, waterway, and pipeline paths consist of a set of connecting links and various characteristics based on the attributes of the links. Air and helicopter routes have an origin and a destination, but no links. Route attributes are based only on attributes of the end nodes and the distance between them.

9.6.3 Main supply routes (MSRs) will be stored with the network. Specifically, if an MSR exists in a network, each link on the MSR will store the name of the MSR. Multiple MSRs can be defined in one network. (*Not Implemented*)

9.6.4 Routes can be found by ELIST 8, and entered or edited by a user.

9.6.5 If an MSR exists, when ELIST 8 finds routes, it will give preference to MSR links based on a factor yet to be determined. Thus, when a road route is required, the path found may not be the most direct path if the cost of traveling to and from the MSR is determined to be worth the benefit of traveling on the MSR. (*Not Implemented*)

9.6.6 A road route can be designated HET, convoy, military direct delivery, or commercial direct delivery. If a route between two nodes is so designated, any movement of that type *must* use that route. Only one route of each type can exist between two nodes.

9.6.7 A future version of ELIST 8 will store a more detailed representation of the physical dimensions (height/width) for links and make use of these data in routing. (*Not Implemented*)

9.6.8 Multiple routes of the same mode can exist between two nodes. Each route is assigned a priority. The route with the lowest priority is designated as the primary route. A scenario parameter, *use alternate routes*, [true/false], indicates whether an alternate route can be used if the primary route is busy.

9.6.9 When any number of vehicles travel a route, they require and use the following resources:

- *Entry rate* (vehicle/day) for each link being traveled,
- *Road intersection rate* (vehicle/day) for each node through which road movement travels, and
- *Rail intersection rate* (railcar/day) for each node through which rail movement travels.

9.6.10 To use a road route or a rail route, all vehicles must meet the size and weight limits of each link and node through which they travel (*weight limit*, *height limit*, *width limit*, and *MLC*).

10.0 STORAGE

10.0.1 Cargo awaiting further movement or undergoing a delay must be stored. Storage can be monitored by the category of cargo: equipment (breakbulk, RORO, and containers), personnel (PAX), and POL. Breakbulk, RORO, and container cargo all use the point of interest *equipment storage area*. Personnel use the *PAX storage area*, and POL cargo uses *POL storage area*.

10.0.2 Cargo at its final destination in the scenario does not require or consume storage.

10.0.3 The scenario parameter, *storage constrains movement*, determines whether the limited amounts of equipment storage and POL storage can actually constrain movement to and at a node or whether only the amounts will be recorded. PAX "storage" never constrains movement, but the amount of en route people at a location over time is recorded, including the overflow.

10.0.4 For storage to constrain movement in the scenario, the following are considered:

10.0.4.1 When all of the storage area at a node is in use, nothing else can be unloaded in that area (from any asset type, including ship, truck, etc.).

10.0.4.2 If a line-haul tractor arrives with a loaded trailer and a trailer is in storage awaiting pickup, the trailers will be swapped without requiring storage area for both trailers. (Currently trailers do not require storage; *Not Implemented.*)

10.0.4.3 Loaded tractor trailers participating in a line haul will not move to a node where storage is full but will wait at the origin (of the required movement) until storage space is available. (unless a trailer is waiting to return; see Item 10.0.4.2 above). (*Not Implemented*)

10.0.4.4 If vehicles are backed up to some level outside a node (because of the lack of available storage, *or* documentation, *or* offload resources), no transport assets are assigned to trips going to that destination. Cargo waits at origins, and assets are used for other destinations.

10.0.5 Equipment storage is measured by area (in square feet). Containers can be stacked up to the *container stacking height* of the node. The effective storage area is calculated by the node's *equipment_storage area* (in square feet) × s*torage utilization factor/100*. The *storage utilization factor* is a scenario parameter with a default of 60%.

10.0.6 When cargo is loaded on a vehicle, it is removed from its storage area.

10.0.7 When cargo is offloaded from a vehicle, it is put in the appropriate storage area, unless the location is the cargo's final destination in the scenario in which case storage is not used.

10.0.8 Loaded vehicles waiting to depart a storage area do not require storage. Otherwise, a bottleneck could occur (e.g., unable to load cargo because the loaded vehicle cannot be stored).

10.0.9 Empty truck and trailer assets do not require storage. (This rule ensures that empty truck and trailer assets can arrive at the location and pick up equipment in storage.)

11.0 DOCUMENTATION

11.0.1 The documentation rate at a node is the amount of equipment and supplies at that location that can be officially documented as having been "transferred." Documentation is expressed in terms of "vehicles."

11.0.2 Each time one of the following activities is performed, it must be documented:

- Onload to or offload from a strategic platform, and
- Arrival or departure of an RLN item on an intratheater movement.

11.0.3 The scenario parameter, *documentation constrains movement*, determines whether the limited amount of documentation "resources" will actually constrain movement to and at a node or whether only the number of transfers will be recorded.

11.0.4 A typical cargo documentation team can work 750 vehicles per day.

11.0.5 The documentation for each type of movement is tracked as follows:

11.0.5.1 Loading to or from a strategic asset is recorded in vehicles or vehicle equivalents based on the commodity load category for breakbulk, RORO, and container cargo. Personnel and POL are not documented.

11.0.5.2 For road and rail intratheater movements of RLN items, documentation is recorded in vehicles or vehicle equivalents if no assets are being used. Personnel and POL are not documented.

11.0.5.3 For water or air intratheater movements of RLN items, documentation is recorded in vehicle equivalents of the cargo (not the asset.)

11.0.5.4 Assets moving without cargo are not documented.

12.0 GROUND TRANSPORTATION

12.1 TRIP SCHEDULES

12.1.1 A trip schedule is a rotating sequence of pairs of travel hours (travel and rest combinations), for example, 6 hr of travel with 2 hr of rest; 4 hr of travel with 10 hr of rest, or 6 hr of travel with 2 hr of rest; and so on.

12.1.2 ELIST 8 stores trip schedules for convoy, military direct delivery, commercial direct delivery, and rail trips. Any movement of these types must follow the appropriate trip schedule, whether they move in a serial or individually.

12.1.3 Any movement that has a trip schedule starts that schedule as it leaves the point of origin. The schedule must only affect trips longer than the first travel time. No carryover between separate or return trips is allowed.

12.1.4 During the rest periods, the vehicles are considered to be off the road or main rail line (not blocking or affecting link capability.)

12.1.5 Asset vehicles without cargo do not follow any trip schedule.

12.2 GROUND TRANSPORTATION ON- AND OFFLOADING

12.2.1 The on/offload capabilities at a node for a certain mode (i.e., road or rail) depend on up to three values for each cargo type: infrastructure capability, MHE capability, and personnel capability. This representation assumes that personnel and MHE can be assigned to on- and offload of one cargo type and mode (e.g., *road breakbulk*, *rail general*).

12.2.2 The use of three values will allow arriving unit MHE or personnel (enablers) to increase the available offload capability up to the fixed infrastructure limit. (*Not Implemented*)

12.2.3 The *effective rate* is the usable capability and is calculated as the minimum of *infrastructure rate*, *personnel rate*, and *MHE rate*.

12.2.4 This representation assumes no interaction between rail loading and road loading, except for containers. Container loading to and from railcars and trucks uses the same personnel and MHE resources. Loading to and from railcars, however, may use the loading resources two times (i.e., requires two times the capability). This function is controlled by the node attribute *container lifts on/off rail*.

The infrastructure container on-/offload capability for road assets is considered to be unconstrained. The loading of containers to and from rail is limited by the number of railcars that can be processed each day because a sufficient loading area must be adjacent to the track for the MHE to work.

12.2.5 The rail infrastructure is assumed to be limited to the total number of railcars that can be loaded regardless of type; thus, rail has the attribute, *rail total on/offload*, railcars per day limit. (This assumes that different types of railcars could be loaded on the same lengths of track. This attribute limits the total number of railcars that can be loaded).

12.2.6 The *rail max loaded* and *road max loaded* attributes reflect space available for these items, and once these numbers are reached, no more loading is done. The maximum loaded railcars are usually constrained by the amount of track available for staging loaded railcars. An additional benefit of this constraint is that it keeps the model from tying up resources if they cannot be used.

12.3 ROAD MOVEMENT METHODOLOGY

12.3.1 All road or rail vehicles arrive in an “outside vehicle queue,” which is considered to be outside the node and is unconstrained. Vehicles are not released until they enter the node and their cargo is unloaded.

12.3.2 Assets are not be assigned to a trip or loaded with cargo if the destination’s outside vehicle queue reaches a predetermined level.

12.3.3 Trailers are counted as one vehicle (as in the *road max loaded* queue).

12.3.4 ELIST has four configurations for road travel: convoy, military direct delivery, commercial direct delivery, and line laul.

12.4 CONVOY

12.4.1 All unit equipment travels in convoy formation. Unit equipment is identified as ULN components required to move by “self” (without a transportation asset).

12.4.2 If the scenario parameter, *convoy requires serials*, is true, convoy moves follow the rules provided in “Serial Moves” on page 44.

12.4.3 A convoy follows the scenario’s *convoy trip schedule*, if it is defined, according to the rules provided in “Trip Schedules” on page 40.

12.4.4 A convoy requires *convoy clearance* capability at the origin to start the trip.

12.4.5 Vehicles arriving at their destination enter that node’s “outside vehicle queue.”

12.4.6 To enter the node, the vehicles require the following:

- *Road convoy clearance,*
- *Documentation* (if documentation is required), and
- *Storage* (if storage constrains movement and this is not the final destination).

12.5 MILITARY DIRECT DELIVERY

12.5.1 A military direct delivery is the transport of cargo using a military asset truck or tractor-trailer.

12.5.2 Node clearance is not a factor for direct deliveries.

12.5.3 Military direct deliveries must travel in serials if required by the scenario parameter, *military direct delivery requires serials*. (See “Serial Moves” on page 44.).

12.5.4 The serial follows the scenario’s *military direct delivery trip schedule* if it is defined. See “Trip Schedules” on page 40.

12.5.5 Vehicles arriving at their destination enter that node’s “outside vehicle queue.”

12.5.6 To enter the node, the vehicles require the following:

- *Documentation* (if documentation is required) and
- Some offload capability.

12.6 COMMERCIAL DIRECT DELIVERY

12.6.1 A commercial direct delivery is the transport of cargo using a commercial truck or tractor-trailer.

12.6.2 Node clearance is not a factor for direct deliveries.

12.6.3 Commercial direct deliveries must travel in serials if the scenario parameter, *commercial direct delivery requires serials,* is true. See “Serial Moves” on page 44.

12.6.4 The serial follows the scenario parameter, *commercial direct delivery trip schedule*.

12.6.5 Arriving vehicles enter the “outside vehicle queue” of the destination. See “Trip Schedules” on page 40.

12.6.6 To enter the node, vehicles require the following:

- *Documentation* (if documentation is required) and
- Some offload capability.

12.7 LINE HAUL

12.7.1 If available, line haul is generally preferred over direct delivery for commodities that require vehicles for transport. However, the scenario commodity asset rules define the preferences.

12.7.2 Line-haul movement requires that TTPs with asset pools that include tractors and trailers are established for the scenario. These asset pools have the TTP as the home node and an area of operation just like a standard asset pool.

12.7.3 Line-haul tractor-trailers can only travel between two nodes in the tractor pool's area of operation. If the destination is not a TTP, the tractor waits for offload to occur and returns with the empty trailer.

12.7.4 A trailer asset is loaded at the origin node and is not unloaded until it reaches its destination.

12.7.5 A tractor is assigned only for the route segment to the next TTP, where it leaves the loaded trailer, collects an empty trailer if one is available, and returns home immediately with or without a trailer.

12.7.6 After being delivered to a TTP that is not the final destination, a trailer has a delay before it can continue. This time is specified in the scenario parameter, *line-haul transition time* (2–3 hr). A new tractor can be acquired for the next leg of the line haul at any time during or after this delay.

12.7.7 A tractor-trailer only leaves a TTP during its hours of operation, that is, between the TTP's *hours of operation, start* and the *hours of operation, end*.

12.7.8 Line-haul tractor-trailers travel in serials if required by the scenario parameter, *linehaul requires serials*. See "Serial Moves" on page 44.

12.7.9 Arriving vehicles enter the "outside vehicle queue" of the destination.

12.7.10 To enter the node, the tractor-trailers require the following:

- *Documentation* (if documentation is required), and
- Storage (if storage constrains movement and there is no waiting tractor for the leg of line haul).

12.7.11 There is no constraint on the total number of vehicles that can enter or exit a node (gate clearance). It is assumed that this would not constrain the node more than the access roads.

12.8 SERIAL MOVES

12.8.1 ELIST 8 models serial moves, not convoys explicitly.

12.8.2 A serial size is limited by the scenario parameters, *minimum serial size* and *maximum serial size*.

12.8.3 No extra time is modeled for the assembly of a serial or a convoy.

12.8.4 A spacing distance between serials leaving the same node is enforced. The distance (in feet) is specified in the scenario parameter, *convoy spacing*.

12.8.5 Serials or convoys consume an equivalent amount of link capability as the same number of individual trucks.

12.8.6 When some vehicles have been waiting at a node for a serial to form and a length of time has passed with no new vehicles showing up, the waiting vehicles move, even though they are less than the *minimum serial size*. This time is defined in the scenario parameter, *max serial wait time*.

12.8.7 A serial travels at the slower speed: the scenario's *convoy rate of march*, the slowest vehicle's *rate of march*, or the link's *rate of march*.

12.9 RAIL MOVEMENT METHODOLOGY

12.9.1 There are scenario-specific minimum and maximum numbers of railcars that make a train, *minimum railcars/train* and *maximum railcars/train*. These values should consider terrain and other conditions. The maximum number of cars is preferred. (ELIST 8 builds trains as large as possible.)

12.9.2 Unit integrity will be maintained where possible within a train. (*Not Implemented*)

12.9.3 The assembly of a train does not take up time.

12.9.4 Trains follow the scenario parameter, *rail trip schedule*, for travel and rest times. See "Trip Schedules" on page 40.

12.9.5 If an item is tagged for rail movement and rail is available from the POD, it does not travel to the staging area (SA) and delay there. If rail is not available from the POD but is from the SA, it will road march to the SA, delay, and then travel via rail to the theater staging base (TSB). (*Not Implemented*)

12.9.6 A railhead has a limiting *rail clearance* rate — a maximum number of vehicles (train cars) that can exit (or enter) the node on one day.

12.9.7 Travel speed of rail movements is based on the scenario parameter, *rail rate of march*.

12.9.8 Trains arriving at a node enter the rail outside vehicle queue.

12.9.9 Railcars can enter the node when:

- The number of railcars at the node is less than the parameter, *max railcars at node*,
- *Storage* is available (if required), and
- Some offload capability is available.

13.0 PIPELINE

13.0.1 Pipelines are modeled with a network of pipeline links. Each pipeline link of the network has a *rate of flow* in barrels per day (or comparable units).

13.0.2 No assets are needed to move bulk POL via pipeline; only route capability is required.

13.0.3 POL requires storage at the destination if it is not the RLN’s final destination in the scenario. If storage is required, but not available, the POL waits at the destination. (The trip will not be postponed for lack of storage.)

13.0.4 ELIST 8 assumes that the pipeline is loaded with fuel. POL delivered via pipeline arrives instantaneously, and distance is not a factor

14.0 ROTARY WING

14.1 ROTARY-WING DATA

Table 23 lists the rotary-wing aircraft attributes.

Table 23 Rotary-Wing Aircraft Attributes

Attribute	Unit
Type	NA
LIN	NA
PAX capacity	pax
Weight capacity	st
Container capacity	Container
Onload time	hr
Offload time	hr
Rate of march	mph
Availability	%

NA = not applicable.

14.2 ROTARY-WING LOADING

14.2.1 Cargo is only loaded onto helicopters that can carry it based on the asset or commodity rules. No dimensional check is done on Level 6 cargo.

14.2.2 Only one category of cargo is loaded onto a single helicopter (i.e., POL, breakbulk, RORO, container, or PAX).

14.2.3 The amount of personnel loaded will not exceed the *PAX capacity*.

14.2.4 The amount of POL, breakbulk, or RORO cargo loaded will not exceed the helicopter's *weight capacity*.

14.2.5 The number of containers loaded will not exceed the helicopters's *container capacity*.

14.3 ROTARY-WING TRANSPORTATION

14.3.1 Rotary-wing movement requires only rotary-wing assets.

14.3.2 There are no infrastructure requirements at the origin, at the destination, or on the route.

14.3.3 A rotary-wing vehicle is considered fully loaded and ready to depart if it holds at least an adequate load. If the vehicle has less than an adequate load, it waits up to a maximum amount of time for additional cargo. At that time, if no new cargo has arrived, the vehicle departs. *Maximum rotary-wing wait* and *adequate rotary-wing load* are the scenario parameters.

15.0 ENABLERS AND ARRIVING ASSETS

15.0.1 An "enabler," which is in the ETPFDD theater arrivals, enhances the capability of some stationary resource and can be used after its arrival to assist in the movement of other items. Thus, an arriving RLN component is assigned a location and a resource such as airport processing rate or berth crane capability.

15.0.2 An arriving asset is some equipment in the theater arrivals that is used after its arrival to assist in the transport of other items. Thus, it is assigned a vehicle type, asset type, and asset pool.

15.0.3 After completing their last required movement, arriving assets become the number of vehicles assigned in the scenario. If the asset type is individually tracked, the vehicles become available at their current location.

15.0.3.1 Vehicles that become available outside the area of operation for the asset pool will immediately travel to the pool's home. (*Not Implemented*)

15.0.4 The enabler/asset can be active either at its destination for the remainder of the simulation or at its POD or APOD for a preset interval. After that interval, movement to the destination resumes.

15.0.5 Unit equipment and personnel arriving in the theater are marked as enablers or arriving assets as part of the scenario.

16.0 MARRY-UP AND ASSEMBLY REQUIREMENTS

16.1 MARRY UP

16.1.1 All components of the ULN (i.e., split ULNs) with movements to the given location are included in the marry-up activity. Zero or more locations may be specified for the ULN to be able to marry up.

16.1.2 The marry-up activity can be specified to occur either before or after the optional delay at the node.

16.1.3 During marry up, personnel and cargo wait at the location until the *percent for delivery/marry/assembly* of the total personnel and cargo arrives at the location. They then continue with the remaining movement requirements. The scenario parameter is *percent for delivery/marry/assembly*.

16.1.4 If personnel will be involved in a marry-up activity, following that activity, these personnel will not require external transportation assets. It is assumed that they will be carried by organic transport, that is, via their own equipment. (*Not Implemented*)

16.2 ASSEMBLY (*Not Implemented*)

16.2.1 A requirement to assemble will be specified (in ETEdit) for a group of RLNs. (The group must have a common parent in the unit hierarchy.) The assembly requirement will be for a specific location, and all components of the group with movements to the given location will be included in the activity.

16.2.2 The assembly activity will occur either before or after the optional delay at the node.

16.2.3 During assembly, the personnel and cargo will wait at the location until the *percent for delivery/marry/assembly* of total people and cargo has arrived at the location. They will then continue with the remaining movement requirements. The scenario parameter is *percent for delivery/marry/assembly*.

16.2.4 If personnel will be involved in an assembly activity, following the assembly, these personnel will not require any external transportation assets. It is assumed that they will be carried by organic transport, that is, via their own equipment

16.2.5 Each RLN (including parent RLNs) will have only one assembly requirement.

17.0 SCENARIO DATA

17.1 SCENARIO PARAMETERS

Table 24 lists the scenario parameter attributes.

Table 24 Scenario Parameter Attributes

Attribute	Unit
Mode selection	[specified, model, both]
Percentage for delivery/marry/assembly	%
Intervals per day	[1... 24]
Storage constrains flow	[true, false]
Storage utilization factor	%
Documentation constrains flow	[true, false]
Use alternate routes	[true, false]
Load ships at port destinations	[true, false]
Make RLNs with missing projection available	[true, false]
Flow unsourced RLNs	[true, false]
Requires serials for convoy	[true, false]
Requires serials for line haul	[true, false]
Requires serials for military direct delivery	[true, false]
Requires serials for commercial direct delivery	[true, false]
Minimum vehicles/serial	No. of vehicles ($\geq$1)
Maximum vehicles/serial	No. of vehicles ($\geq$ minimum serial size)
Maximum serial wait	day
Serial rate of march	mph
Serial spacing	ft
Line-haul transition time	hr
Convoy rate of march	mph
Adequate truck load	%
Maximum truck wait	day
Minimum railcars per train	Railcar

Table 24 Scenario Parameter Attributes (Cont.)

Attribute	Unit
Maximum railcars per train	Railcar
Rail rate of march	[mi/hr, km/hr]
Maximum train wait	day
Adequate railcar load	%
Maximum railcar wait	day
Adequate watercraft load	%
Minimum watercraft load	%
Maximum watercraft wait	day
Time to berth	hr
Time to deberth	hr
Adequate rotary-wing load	%
Maximum rotary-wing wait	day
Fixed-wing load Adequate Minimum Maximum	 % % day
Gantry crane container, onload or offload	Container/day
Container crane container, onload or offload	Container/day
Mobile crane container, onload or offload	Container/day
TACS crane container, onload or offload	Container/day
Gantry crane breakbulk, onload or offload	st/day
Container crane breakbulk, onload or offload	Container/day
Mobile crane breakbulk, onload or offload	st/day
TACS crane breakbulk, onload or offload	st/day

17.2 ADDITIONAL SCENARIO DATA

Each scenario is specified to move the requirements of a selected ETPFDD.

17.2.1 ETPFDDs are comprised of RLNs, which are the combination of unit (ULN), cargo resupply (CIN), and personnel (PIN) records. Each record has associated equipment and personnel that require movement through specified locations at specified times. ETPFDDs differ from TPFDDs by allowing users to add any or all of the following:

- Additional movement locations, consisting of three additional origin intermediate locations (ILOCs), a strategic ILOC, SAs, in-theater staging bases, and five additional follow-on locations;
- Optional delays at the given TPFDD locations;
- An additional level of cargo detail, Level 6, which specifies individual pieces of cargo;
- Marry up (at or before the TPFDD destination) and assembly (after the TPFDD destination) of RLNs; and
- Relationships between RLNs for subordination and support relationships.

17.2.1.1 ***Projection:*** Each ETPFDD can be assigned zero or more projections, which capture how each equipment, cargo, or personnel item was deployed in a simulation scenario. Various reports and graphs can be generated based on this information. Projections are used for incorporating results from other models, such as JFAST and MIDAS, which feed strategic arrivals into the theater.

17.2.1.2 ***Tools:*** Tools must exist to assist the user in setting up full reception staging onward movement and integration (RSOI). These include the following:

- Cargo expansion using either Type Unit Characteristics File (TUCHA) data or calling the TARGET model;
- Backward planning of the *origin departure date*;
- Applying SA and in-theater staging on the basis of movement requirements;
- Creating parent relationships of RLNs; and

- Generating marry-up relationships for records that have been split between the air and sea modes of transporation for the strategic leg.

17.2.2 ***Theater:*** ETPFDDs can require movement to and from many different countries. Users must specify which sets of countries (Joint Operation Planning and Execution System [JOPES] country/state codes) are of interest for the given analysis.

17.2.3 ***Berth availability:*** Every berth has an attribute, *available for military use*. All berths available for military use become the default berths assigned to the scenario. This set can be tailored as part of the scenario to add or remove berth availability over time.

17.2.4 ***Asset pools:*** Every scenario can have zero or more asset pools. Each pool consists of the following items:

17.2.4.1 Home node: The home node is the location at which all vehicles begin servicing the plan and to which they return to when not in use.

17.2.4.2 Nodes served: Nodes served include the set of nodes that this pool can service. If no nodes are listed, the pool can service all locations within the plan.

17.2.4.3 Vehicle availability over time: Vehicle availability over time consists of the set of vehicles and the times when they are available for service.

17.2.4.4 Routes, including line-haul TTPs.

17.2.5 ***Routes:*** The system automatically generates routes between nodes on the basis of the shortest travel time. Users can override these routes by directing the system to find routes based on other criteria (e.g., distance or capacity) or by specifying intermediate nodes the routes must pass through.

17.3 OPTIONAL SCENARIO PARAMETERS

The following optional scenario parameters are available:

17.3.1 Master Scenario of Events List definitions are user-specified actions that either increase or decrease the resource capabilities of theater infrastructure. These can be assigned before the simulation is executed or during the simulation, as long as the event is at or beyond the current simulation time.

17.3.2 Arriving asset specifications assign vehicles that are arriving in the ETPFDD to specific asset pools in the theater.

17.3.3 The arriving enabler specification translates units arriving in the ETPFDD to additional theater resources at specified locations.

17.3.4 Trip schedules define the timing of how vehicles travel in the theater. They can be modeled to drive continually or to take predetermined rest periods. Schedules can be defined for military convoys, military transporters, and commercial transporters.