The Navigation Economic Technologies Program

November 2005

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Determining System Capacity to Accommodate Grain Flows By Rail to the Mississippi River at St. Louis

US Army Corps of Engineers®

IWR Report 05-NETS-R-14

Navigation Economic Technologies

The purpose of the Navigation Economic Technologies (NETS) research program is to develop a standardized and defensible suite of economic tools for navigation improvement evaluation. NETS addresses specific navigation economic evaluation and modeling issues that have been raised inside and outside the Corps and is responsive to our commitment to develop and use peer-reviewed tools, techniques and procedures as expressed in the Civil Works strategic plan. The new tools and techniques developed by the NETS research program are to be based on 1) reviews of economic theory, 2) current practices across the Corps (and elsewhere), 3) data needs and availability, and 4) peer recommendations.

The NETS research program has two focus points: expansion of the body of knowledge about the economics underlying uses of the waterways; and creation of a toolbox of practical planning models, methods and techniques that can be applied to a variety of situations.

Expanding the Body of Knowledge

NETS will strive to expand the available body of knowledge about core concepts underlying navigation economic models through the development of scientific papers and reports. For example, NETS will explore how the economic benefits of building new navigation projects are affected by market conditions and/or changes in shipper behaviors, particularly decisions to switch to non-water modes of transportation. The results of such studies will help Corps planners determine whether their economic models are based on realistic premises.

Creating a Planning Toolbox

The NETS research program will develop a series of practical tools and techniques that can be used by Corps navigation planners. The centerpiece of these efforts will be a suite of simulation models. The suite will include models for forecasting international and domestic traffic flows and how they may change with project improvements. It will also include a regional traffic routing model that identifies the annual quantities from each origin and the routes used to satisfy the forecasted demand at each destination. Finally, the suite will include a microscopic event model that generates and routes individual shipments through a system from commodity origin to destination to evaluate non-structural and reliability based measures.

This suite of economic models will enable Corps planners across the country to develop consistent, accurate, useful and comparable analyses regarding the likely impact of changes to navigation infrastructure or systems.

NETS research has been accomplished by a team of academicians, contractors and Corps employees in consultation with other Federal agencies, including the US DOT and USDA; and the Corps Planning Centers of Expertise for Inland and Deep Draft Navigation.

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Determining System Capacity to Accommodate Grain Flows By Rail to the Mississippi River at St. Louis

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Washington, DC

For the:

Institute for Water Resources
U.S. Army Corps of Engineers
Alexandria, Virginia

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Summary of Interview Findings

Prepared by
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November 2005

SUMMARY

This report documents findings obtained from interviews of major grain terminal operators operating in the St. Louis area, conducted from 11 November to 28 November, 2005. It is an element of a U.S. Army Corps of Engineers' (Corps) Institute for Water Resources (IWR) study to determine rail and rail-barge transfer facility system capacity to accommodate grain flows by rail to the Mississippi River at St. Louis.

Summary of Most Significant Findings from the Interviews:

1. The majority (80 to 90 percent) of all grain coming into St. Louis is transported by truck, not rail, for a variety of reasons, none having to do with rail capacity or transfer facility capacity in St. Louis.

2. The majority (95 percent) of grain loaded on barges in St. Louis is destined for New Orleans export markets.

3. Grain moving through St. Louis may be down approximately 25% to 40% from its peak in 1997. Many transshipment facilities, both independent and part of vertically-integrated firms, benefited from major investments in capacity prior to 1997. There is some disagreement among the interviewees as to the current excess capacity in the St. Louis area. Peak capacity is an issue, with most grain moving from late September to January.

4. Much of the grain being shipped by rail in the upper West and Midwest is not being exported, but is being used domestically. Major domestic uses include ethanol (corn) and methyl esters (soy beans) fuel production in inland plants, production of corn gluten meal with the germ and starch extracted and separately marketed, and/or shipment to domestic feed lots (both raw corn and corn gluten are used for feed).

5. The major reason barge is preferred to rail for transport between St. Louis and New Orleans is due to New Orleans' setups to facilitate direct mid-stream transfers from barges to ships, with "forgiving" and more flexible barge schedules and contract terms, compared with price and time barriers and limited capacity for offloading rail cars to ships.

6. A major concern for barge travel is maintaining an adequate water flow to permit full use of barge capacity; when the water level is low (as it is now), barges can only be filled part-way, greatly increasing the transport cost.

Cover Photo: View of Bulk Service Loading Facility, Granite City, IL

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INTRODUCTION

The Louis Berger Group Team met individually with representatives from the following firms:

- Bulk Service (11 Nov 2005),
- Slay Industries (11 Nov 2005),
- ADM Grain Company (11 Nov 2005),
- Tate & Lyle, the parent company of A.E. Staley (15 Nov 2005), and
- Cargill (28 Nov 2005).

The five interviews were complementary, and in most respects reinforced each other's messages and themes. Any instances of disagreement among the parties are identified in the following summary, but for ease of understanding the discussions are divided into major themes, rather than chronological topics.

MAJOR MARKET FORCES

Major market forces include the grain industry, and changes in sellers' choices of domestic or export markets, which in turn are greatly influenced by changes in transportation options and pricing. All forces have an impact on rail transport to St. Louis, and are discussed in turn. In brief, it appears that grain exports have been flat in recent years, and since crop yields have continually gone up, exports have lost overall market share. At the same time, the surface transportation system has simply evolved beyond what it was several years ago.

Economic Dynamic and Context: International and Domestic Grain Market Changes

It was reported and considered likely that grain passing through St. Louis to the export market has declined by about 25 to 40 percent from its peak in 1997. This is due to a number of causes. (Note that hard data are unavailable, because unlike along the Upper Mississippi, there are no locks and dams in St. Louis and south to collect volume information.)

1. First, the grain industry is viewed as a nearly perfect market mechanism, with many sellers and many buyers. On any given day, a farmer or grain broker can choose, based on readily available market information, whether to sell grain for export or to sell to domestic feed markets. Market choices for export result in grain shipments to the Pacific or the Gulf Coast. Domestic market choices could involve grain shipments to the south and southeast poultry and hog centers, or to the western cattle centers. Domestic choices also include sales to the biofuel markets located throughout the grain-producing region, or to hold on to the grain in expectation of better prices another day. One of the primary determinants of the net price to the seller is the cost of alternative modes and routes for transportation. Farmers and brokers in some regions have more choices and better access than others, giving them a cost advantage over more remote locations with fewer options.

2. A second dynamic entering into the export versus domestic market choice is the increasing role of genetically modified (GM) grain, and its lack of acceptance in European and other international markets. The farmer makes a decision on whether to grow GM grain early in the process, and for many, the appeal of a 30% to 40% increase in yield clearly offsets the premium of $0.12 per bushel offered for non-GM grain. The wisdom of this decision was proven this year in Illinois, where yields were much better than expected despite a prolonged drought. GM grain is hardier.

3. A third dynamic is increasing competition from grain producers in the rest of the world. Producers in the former Soviet states, as well as in Argentina and Brazil, have greatly increased their productivity and exports in recent years, in many cases building from US models and advances in technology and grain seed stock. Recently, Brazil and Argentina produced more soybeans than the United States, with yields increasing from 20 to 40 bushels per acre.

In general, the terminal operators believe that grain exports have been flat in recent years. Of course, crop yields have continually gone up, so exports have lost overall market share. As a result of these trends, and with some concern for foreign market viability in the face of foreign political pressures, dislike of the US, and increasing competition, some major players in the industry are focusing more of their efforts on the domestic market and localized processing.

Corn gluten has become a major new corn product, used primarily as animal feed (wet or dry). As corn gluten is processed, the germ and starch are extracted; the germ is marketed for its oil and the starch is further processed into fructose syrup.

Ethanol made reasonable market sense with corn at $2 a bushel and gasoline at $2 a gallon. It makes even more sense with corn at $1.50 a bushel and gasoline at $3 a gallon. Ethanol plants have been established at minor hub locations throughout the grain-growing region, often on the short-line railroads, and set up on a smaller scale with smaller elevators to accommodate smaller train loads (e.g., 50 cars rather than 100 or more cars). Over 80 such plants are now being constructed. One operator reported seeing four new plants just between Rock Island and Ames, Iowa, on a recent trip.

Barge Rates and Market Forces

Like the grain industry, the barge industry is viewed as a nearly perfect market mechanism, with many buyers and many sellers, enhanced by the relatively low cost of entry and exit to and from the market. This can lead to short-term shortages of equipment and capacity. For example, even before Hurricane Katrina, there was a shortage of barges caused by several factors. Many barges were scrapped before the end of their useful life because the scrap market was up, while many other barges were sold to foreign countries such as Argentina and Brazil in South America, where productivity is being increased through greater use of their inland waterways, largely employing US technology. Taken together with the effects of Katrina, some 2,500 barges have "left the market," and are no longer available to shippers in St. Louis.

Barge rates are now at a premium due to a shortage of bottoms, as observed in several interviews. Right now, there is a premium of 315% on top of the $3.99/ton rate to move grain to New Orleans. That premium never exceeded 400% in 2004, but this year in St. Louis, it has been as high as 900% (making it $1.12 to ship a bushel of grain), in the aftermath of the hurricanes. One operator expects the premium to go back to that level as they enter the busy January-March shipping season. Barge rates were too low for several years, leading operators to leave the market, scrapping or selling barges. Other barges were damaged in the hurricanes. With rates now up, new operators may be encouraged to enter the market.

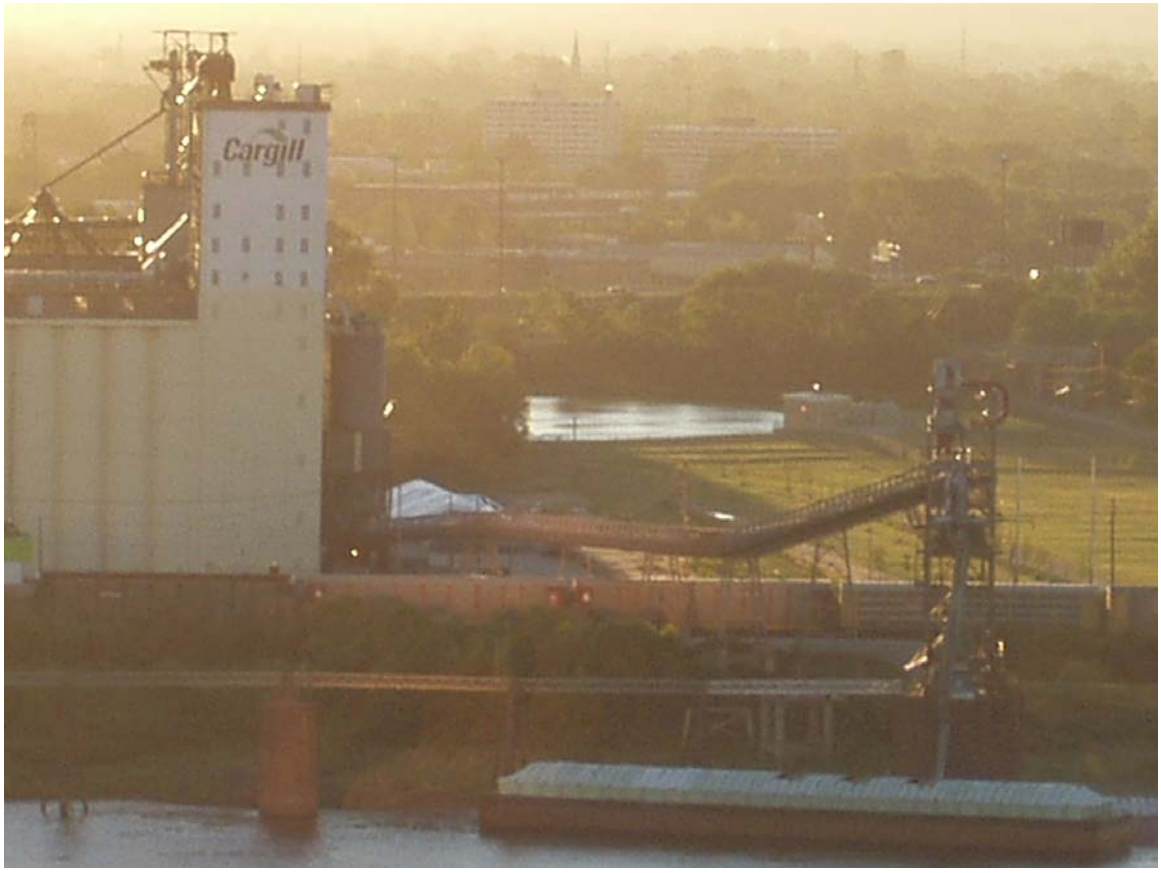
Rail Logistics, Economies of Scale and Pricing

Rail lines charge much lower rates for 100-car trains versus 50-car trains. One of the major costs (in time) for rail lines is the loading and unloading; therefore, long-distance rail lines prefer longer hauls, and set their rates accordingly. They also offer discounts to facilities that can, for example, handle 100 cars with a 15 hour turnaround. As an example, Union Pacific (UP) offered a discount of $.05 per bushel to an Illinois facility that made the investment to increase its productivity to 100 cars in 15 hours (nearly doubling the farmers' profit margin). Rail lines also operate shuttles. For example, Burlington Northern Santa Fe (BNSF) operates 110- to 115-car shuttle trains from Illinois to West Texas feedlots. BNSF has aggressively established and marketed these shuttle train locations; there are at least six so far in Central and Northern Illinois. The railroads cannot match barge prices from the Upper Mississippi to Gulf ports, so they seek market share by diverting grain to other markets that barges cannot reach.

Shipping Illinois grain to West Texas and Oklahoma frees up Kansas and Nebraska grain to go to Texas Gulf ports for export, or to be shipped to California. At just one of the new facilities (at Waverly, IL, close to Springfield), BNSF handled 50 million bushels of grain last year. With dedicated trainsets on regular routes and time limits for both loading and unloading the trains (typically 15 hours), BNSF and the Union Pacific Railroad maximize velocity, improving both labor and equipment utilization, justifying a much lower rate structure for long hauls, all while costs to/through St. Louis have increased. This is a paradigm shift, with super-efficient handling and dedicated equipment sets making multiple "turns" to move the grain to new domestic market opportunities.

Vertically Integrated Operations

Many operations are vertically integrated and provide advantageous rates to those who use their integrated storage, shipping, and processing facilities. One operation provides a good example, owning an enormous grain processing facility in Decatur, owning its own ethanol plants, and with both truck and rail access directly to the Port of St. Louis. It owns most of its rail cars and is considering purchasing a truck fleet, due to shortages in trucking firms (and drivers) driving up costs.



View of Cargill Loading Facility – Vertically Integrated Operations

Rail versus Truck Characteristics and Decision Factors

Rail provides an advantageous rate for longer haul operations (300 to 400 miles or more), with the exception of the short line ethanol niche, discussed above. Rail also provides pricing incentives for 100 to 110 car lots. Trucks hold the pricing advantage for smaller lots of less than 175 miles. There is a national shortage of truck drivers, and many firms have reportedly left the market due to small margins on grain shipments.

Rail versus Rail Choices: Switching Costs

Rail lines will charge from $200 to $300 per car to switch loads from one rail line to another. $200 per car would be the rate for an entire train load, with higher charges for smaller increments. Thus, port facilities that lack direct elevator-to-loading facility access are at a major disadvantage.

Rail versus Barge Choices: Dynamics in the New Orleans Area

Very little rail traffic in grain should be expected between St. Louis and New Orleans because of the facilities and capacity in New Orleans, and the competitive advantage of barge over rail.

Grain traveling by barge can be off-loaded mid-stream onto ocean-going vessels, whereas rail shipments would require special handling. Loading a ship takes approximately 16 hours. Barge rates include a built-in window of five days wait with no penalty, which is fairly easy to mesh with ship schedules. On the other hand, rail shuttles impose penalties for each day of delay over 16 hours, which brings in the element of risk either for incurring penalties, or for off-loading the grain into storage then reloading, at additional cost.

ST. LOUIS CHARACTERISTICS

Seasonality, Advantages and Disadvantages

The upper Missouri, Illinois, and Mississippi Rivers typically freeze in winter, while St. Louis remains clear year-round. St. Louis is also the first major port south of the network of locks on the Upper Mississippi. As a result of the weather, approximately 60 percent of annual grain traffic through St. Louis takes place from December through March of each year, peaking in January, when some operations work around the clock to unload the trucks and trains and load the barges.

St. Louis is at an excellent nexus for grain deliveries, with millions of bushels per year growing in nearby states (see Table 1), easily accessible by truck through the interstate highway system, and with an additional millions of bushels per year in northern states such as Minnesota, North Dakota and South Dakota, with good rail access for winter movements.

Table 1: Upper Midwest Grain Production

	Crop Production		
State	**Corn for Grain (1,000 bushels)**	**Sorghum for Grain (1,000 bushels)**	**Soybeans for Beans (1,000 bushels)**
Missouri	309,750	9,230	173,250
Illinois	1,732,750	7,480	425,250
Indiana	856,750		247,020
Iowa	2,153,850		512,550
Kansas	429,000	180,000	100,800
Minnesota	1,088,000		285,600
North Dakota	135,600		106,200
South Dakota	466,100		138,600
Subtotal	7,171,800	196,710	1,989,270
Total US Production	10,857,440	375,105	2,967,075
Regional Production as % of Total US Production	66%	52%	67%

Source: usda.mannlib.cornell.edu/reports/nassr/field/pcp-bb/2005/crop1005.txt 11/17/2005

However, despite the location advantages, grain movement through St. Louis has changed significantly in recent years. One operator believes this is because the grain market environment itself has markedly changed. Further, in 25 years of experience, he states that he has never seen such a rapid pace of changes as within the past few years. One operator used to draw grain from Iowa, Illinois, Missouri, Indiana, and even Ohio and Michigan. The Upper Mississippi market is basically gone (at least for one operator; another operator reported continued shipments from the Upper Mississippi); indeed one operator's market draw area has shrunk to just Illinois and south, perhaps only within a 100-mile circle of St. Louis: their draw area extends about 100 miles west and northwest into Missouri – primarily with shuttle trains, and about 50 miles east and 40 miles south – primarily by truck. They received very limited shipments from North Dakota. There are now intervening opportunities for marketing grain to livestock feedlots, and to ethanol plants (both discussed previously). For example, little Iowa grain leaves that state anymore. One operator believes this is because there are so many ethanol plants scattered across the state, each drawing from a 50-mile circle.

Both the long-haul feedlot shuttle trains with low rate structures and the short-haul ethanol markets have drawn grain away from St. Louis, all while costs to/through St. Louis have increased.

Because of its location and excellent intermodal freight network, St. Louis is also a hub for many other goods such as automobiles and coal. For example, St. Louis is a major location for repackaging autos – bringing together different shipments of vehicles and mixing and matching new train loads and truck loads for distribution throughout the country. It is also a major hub for coal, and some former shippers of grain, such as Slay Industries, have left the grain shipment industry altogether in favor of the year-round stability and more constant demand of other commodities. However, there was no indication that these other commodities are "squeezing" capacity for grain, despite questions to the topic, or that there is not sufficient rail capacity for all commodities. (It was noted, however, that UP does have capacity constraints across all commodities.)

MAJOR CARRIERS AND PEAK CAPACITY ESTIMATES

Most of the interviewees see no major surface transportation capacity issues. Some rail capacity issues have forced rail rates up, and crewing shortages have led to the shuttle train concept, and made short local moves more expensive. Truck rates have not increased so much.

One representative stated that there is excess capacity for movement of grain in St. Louis. He stated that no more capacity is needed and the system is operating at 60% of capacity. This was contradicted by another representative, who stated that the system is operating near capacity during the 3-month high season.

The major "players" in St. Louis today are:

- ADM – St. Louis, MO
- ADM – Sauget, IL
- Bulk Services – Granite City, IL

- Cargill – East St. Louis, IL
- Continental Grain & Barge – Cahokia, IL, and
- Tyler Street – St. Louis, MO, operated by Bulk Services

Altogether they are handling from 250 to 300 million bushels per year; in 1997 they handled about 500 million bushels, with capacity for perhaps 600 million bushels. Rough estimates of current volumes by terminal operator are shown in Table 2.

Table 2: 2005 Volume Estimates by Terminal Operator

Carrier	Est. 2005 Bushels (millions)	Est. 2005 Tons* (millions)
Operator 1	60	1.71
Operator 2	30	. 86
Operator 3	15	.43
Operator 4	70-80	2.0 – 2.29
Operator 5	70	2.0
Operator 6	40	1.14
Total	**285-295**	**6.14-6.43**

* Corn at 35.6 bushels per ton, wheat at 33.3 bushels per ton – rough estimate "blended"

The total is 285-295 million bushels per year – rounded up the estimate of shipment is 300 million bushels per year. The practical maximum is 500 million bushels (based on 1997 throughput, with facilities enhancements since that time); if the season were spread over the year the maximum would be 600 million bushels.

Several terminal operators indicated that 1997 was their banner year. One operator handled 3.5 million tons in grain and grain by-products. Another roperator is geared to handle 4 million tons per year at one location (mostly grain by-products), and 2 million tons per year at a second location within the St. louis area (whole grain). Their capacity is 15,000 tons per day at the first location and 10,000 at the second. This year they will ship 2.1 million tons. A third operator believes total volumes through the Port of Metropolitan St. Louis are down perhaps 25% from their 1997 peak (compared to others who suggest a decline of 40%). In 1997, the operator handled 100 million bushels through this facility and expects to handle 70-80 million this year (30% by rail). This operator believes that 1997 was somewhat of a fluke, in that all factors converged to favor the St. Louis port (STL) that year, including the fact that crop yields far exceeded elevator storage capacity, forcing grain to STL. Since then, there has been major expansion to grain storage facilities here and elsewhere. In STL, all operators have made improvements to their truck handling facilities, as well.

BASIC UNDERLYING TRANSPORT FACTORS & MEASUREMENTS

1. It requires approximately 5 days to travel from St. Louis to New Orleans by barge. A barge can travel approximately 200 miles per day southbound without locks, and about 125 miles per day northbound without locks. The rate slows to about 100 miles per day northbound or southbound with locks. This is important when factoring the cost of time into transport decisions.

2. Approximately 95% of the grain shipped by barge from St. Louis goes to New Orleans. About 5% goes to the Ohio River.

3. Barge draft size and loading capacity depends upon location and water level. There is currently not a cohesive water management policy. Politics have been determining water use along the Missouri River, which supplies 60% of the water flow at St. Louis and south. Recreational uses have won out over industrial uses.

4. New "super-barges" with 14-foot drafts will increase the capacity and make St. Louis more competitive if there is sufficient water flow.

5. Corn averages 56 pounds per bushel. Wheat averages 60 pounds per bushel.

6. There are approximately 35.7 bushels of corn per ton (raw grain) and 33 bushels of wheat per ton.

7. A standard high-capacity facility, with a belt rated at 4,500 tons per hour, can effectively average 3,000 tons per hour, and can fill two barges at a time. A unit train with 120 to 125 cars can be unloaded in one day, filling 8 barges. 120 cars carry 100 tons each @ 2000 pounds/ton, divided by 56 pounds/bushel means over 400,000 bushels per train, divided by 60,000 bushels/barge gives 7+ barges. A 9-foot draft barge can move 1,700 tons.

8. One St. Louis facility has four pits -- a pit for rail; two pits for trucks; and a pit for either trucks or rail depending on demand.

9. It takes 16 hours to unload a 110 rail car train onto barges. It takes two minutes to unload a truck. The facility with four pits could unload on a typical day 600 trucks with a maximum of 900 trucks plus a shuttle train. The daily capacity of loading barges is 800,000-900,000 bushels per day. On good days the facility can load 12 barges in 24 hours. Each barge can hold 60,000 bushels (9-foot draft.).

10. A 100-car train is the typical length capacity at elevators.

INITIAL CONCLUSIONS ABOUT CAPACITY MODELING

1. Capacity should be based on having a high shipping grain season – December/January/February.

2. Limiting factors on capacity are:

    - Car train length – 110 to 115 cars
    - Fleet barge size – dependent on water level (draft) and location
    - Number of pits and belt size

3. A daily capacity of existing facilities and a yearly capacity with a high shipping season should be calculated.

4. The capacities will be based on existing facilities.

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The centerpiece of these efforts will be a suite of simulation models. This suite will include:

- A model for forecasting **international and domestic traffic flows** and how they may be affected by project improvements.
- A **regional traffic routing model** that will identify the annual quantities of commodities coming from various origin points and the routes used to satisfy forecasted demand at each destination.
- A **microscopic event model** that will generate routes for individual shipments from commodity origin to destination in order to evaluate non-structural and reliability measures.

As these models and other tools are finalized they will be available on the NETS web site:

http://www.corpsnets.us/toolbox.cfm

The NETS bookshelf contains the NETS body of knowledge in the form of final reports, models, and policy guidance. Documents are posted as they become available and can be accessed here:

http://www.corpsnets.us/bookshelf.cfm

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