Decatur Supply Chain Network Planning and Optimization Study

Final Report

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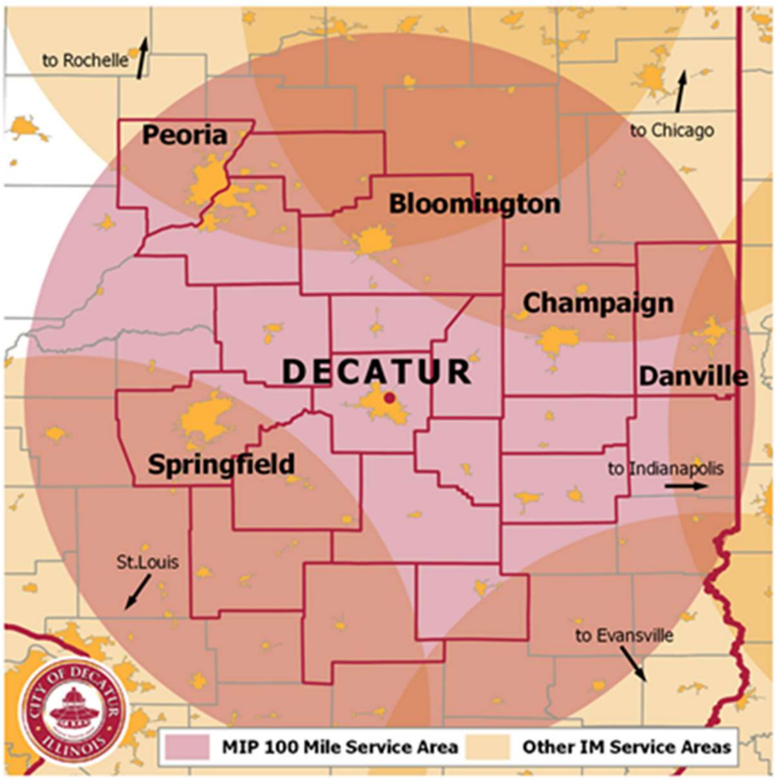
Introduction

The Decatur Supply Chain Network Planning and Optimization Study was commissioned to focus on opportunities to reduce freight transportation costs in the City of Decatur, Macon County and eighteen surrounding counties as illustrated in Exhibit 1. The Supply Chain Network Planning and Optimization Study used *big data* analytics to help the City, County and area businesses identify improvements in the regional supply chain network that result in lower shipping costs. The plan also provides quantitative metrics that can be used to strengthen competitive grant applications to state and federal funding sources.

Exhibit 1 Decatur Supply Chain Network Planning and Optimization Study Area



In scope counties included:

1. Champaign
2. Christian
3. Coles
4. De Witt
5. Douglas
6. Effingham
7. Fayette
8. Logan
9. Macon
10. McLean
11. Montgomery
12. Moultrie
13. Peoria
14. Piatt
15. Sangamon
16. Shelby
17. Tazewell
18. Vermilion
19. Woodford

This planning study uses a demand-based, supply chain network design and optimization approach to evaluate the efficiency of Decatur's regional freight transportation network. This same approach is used by railroads and trucking companies to optimize operating networks, and by agriculture producers, retailers and manufacturers to optimize complex global supply chains.

Leveraging supply chain data and business analytics to identify transportation cost reduction opportunities for companies is vitally important to support economic development and spur economic growth. In 2015 the estimated total freight transportation volume between the Decatur

Region and other domestic or foreign regions exceeded 490 million tons.[1] Billions of dollars are expended transporting the freight for regional businesses. An optimized supply chain network can greatly improve regional competitiveness, as well as, individual company profitability.

A supply chain consists of suppliers, production and manufacturing facilities, warehouses, and the flows of finished products from origin to customers. Typically 80% of a product's landed costs are locked in by the location of a company's facilities and the determination of product flows between them. With supply chain network design and optimization, companies can typically expect to reduce long-term transportation, warehousing, and other supply chain costs by *five to fifteen percent*, while improving levels of service and operational agility

Decatur Region Logistics Background

Decatur, in Central Illinois, is approximately equidistant from the major population centers of Chicago, St. Louis, Indianapolis and Des Moines. The Decatur Metropolitan Area is a major hub for manufacturing, biotechnology, agri-business, and logistics. In 2013, Archer Daniels Midland (ADM) opened the ADM Intermodal Ramp spurring the creation of the Midwest Inland Port (MIP) in Decatur.

The MIP has access to five major highways: Interstates 72, 55, 74, 70 and US Highway 51. The ADM Intermodal Ramp is directly served by the Class 1 railroads Norfolk Southern and Canadian National, and currently offers international intermodal container service on flatcar, stack car, and manifest rail cargo services. The MIP is also serviced by the Decatur Airport, the U.S. Customs office, and has Foreign Trade Zone status.

The City of Decatur understands that goods movement and freight-related activities are significant drivers of the regional economy. In response, the city undertook an innovative freight activity modeling effort based upon a proven private sector practice for improving efficiency and cutting costs in complex global supply chains. The primary tool for conducting the supply chain analysis was the Decatur Regional Optimization Model (DROM).

The DROM was used to analyze data about how freight currently moves into, out of and within the study region, across a network representing all surface transportation modes. Optimization algorithms were applied to freight demands on the existing network to identify constraints in the existing road, rail and intermodal networks. A second round of model runs tested logistics solutions, identified through data analysis and validated by local stakeholders, for addressing the highest value network constraints. Roadway congestion, outdated freight facilities, poor utilization of operating

[1] *USDOT, Federal Highway Administration (FHWA) Freight Analysis Framework version 4.3*

assets, as well as, limited access to rail and waterway networks can potentially impact the cost and efficiency of moving goods for regional shippers.

Three "what-if" scenarios suggested by the data analysis and validated by local stakeholders were analyzed further to estimate potential cost savings to the region's shippers, businesses and consumers. These include: 1. Freight consolidation; 2. Rail transload; and, 3. Domestic intermodal. In addition, the Decatur-area project team asked to include two additional "what-if" scenarios to estimate the supply chain benefits of 4a. the East Beltway; and, 4b. additional improvements identified in the Decatur Area Urbanized Area Transportation Study (DUATS) Long-Range Transportation Plan. DUATS is the federally designated Metropolitan Planning Organization (MPO) for the Decatur urbanized area and is required to prepare an LRTP to outline critical transportation projects. For a project to be eligible for federal funding, it has to be included in the LRTP.

The output from "what-if" scenario runs of DROM identified several freight transportation network enhancements that can reduce overall transportation costs for businesses in the Decatur Region. Exhibit 2a and Exhibit 2b show the impacts on freight flows from a theoretical optimization utilizing intermodal in the place of long-haul truck traffic. The red triangles represent the counties within the Decatur Region, the blue circles the origin/destination counties, and the green and blue lines the respective outbound and inbound freight flows. The green squares in Exhibit 2b show rail intermodal hubs where trucks pick up intermodal containers to be drayed to their final destination.

Exhibit 2a: Non-Optimized Decatur Region Freight Flows, Current State using Long-Haul Truck

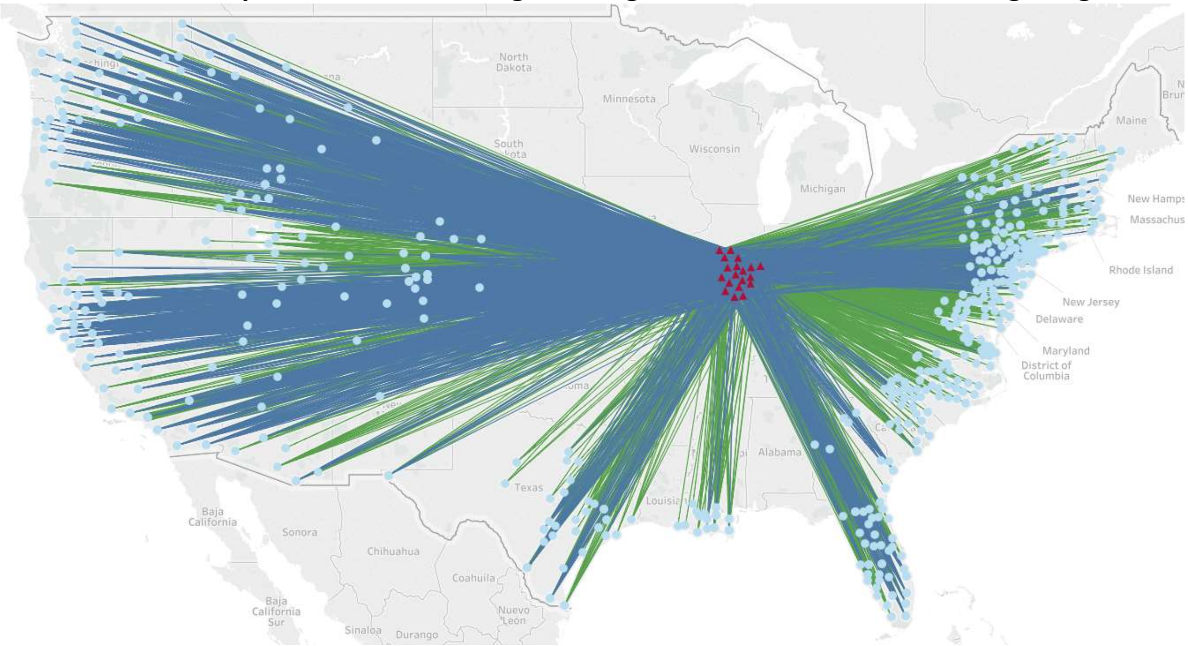
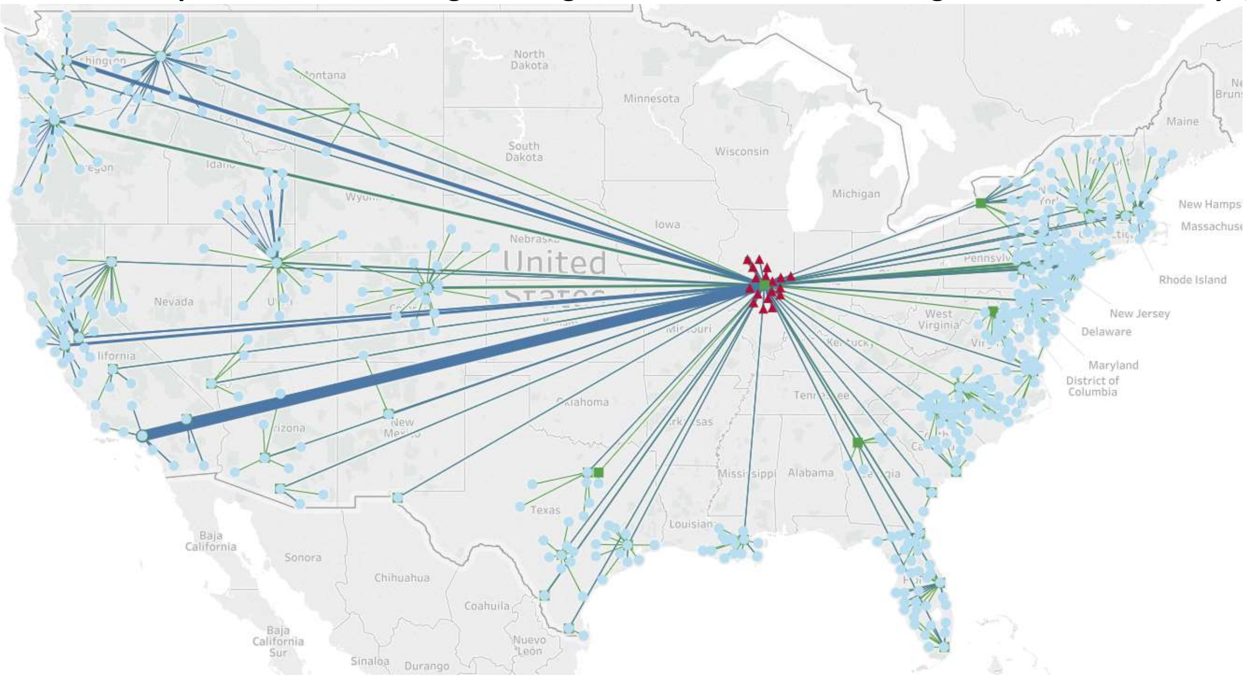


Exhibit 2b: Optimized Decatur Region Freight Flows, Future State using Intermodal and Drayage

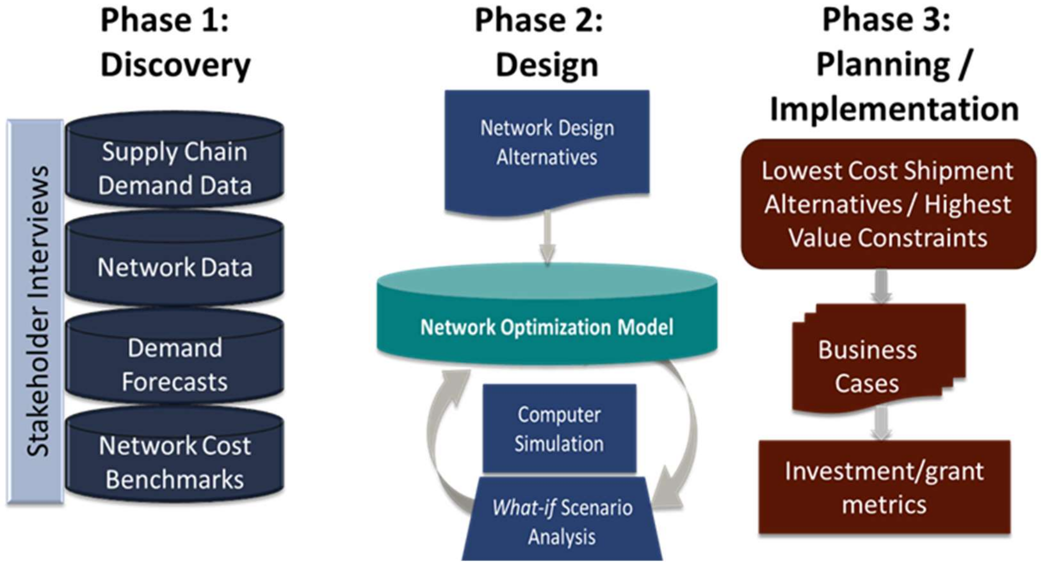


The Decatur Supply Chain Network Planning and Optimization Study's deliverables include a network optmization model, data visualization tool, and benefit-cost analysis (BCA) for three specific freight projects designed to support Decatur's efforts towards building a more efficient transportation system, supporting economic development, and providing better services for its citizens.

Developing the Decatur Regional Supply Chain Optimization Model

The Decatur Supply Chain Network Planning and Optimization Study included three phases as shown in Exhibit 3.

Exhibit 3: Decatur Supply Chain Network and Optimization Study Process Flow



A key feature of Phase 1 included stakeholder interviews with senior executives from 24 companies and organizations from the Decatur region (Exhibit 4). Supply chain interviews were conducted primarily to gather private sector transportation management data for use in the optimization modeling process. Following the interviews, nondisclosure agreements (NDA) were executed with eight companies that submitted nearly 1 million transportation records to the project.

Exhibit 4: Companies that Participated in Interviews for the Decatur Project

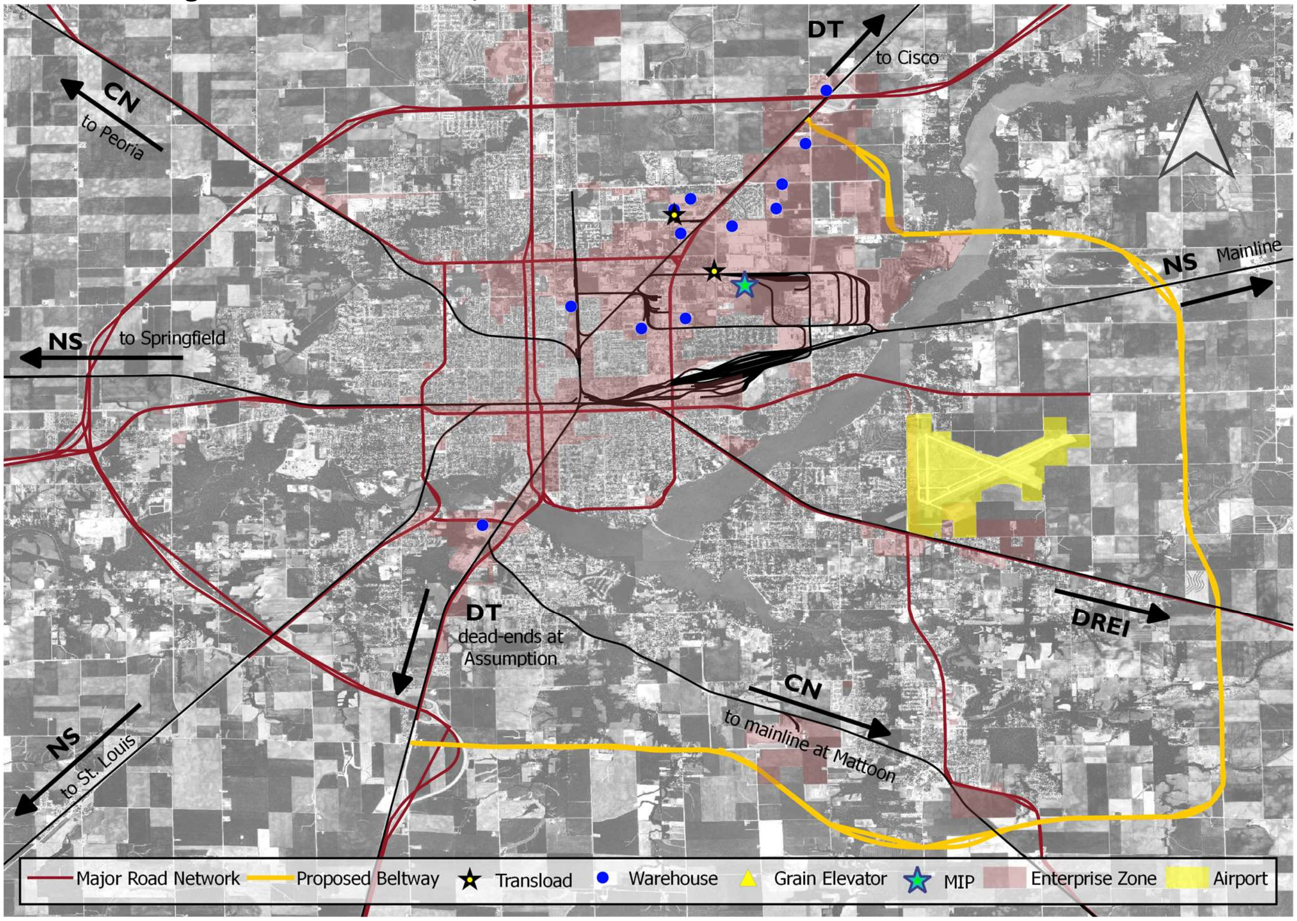
1. ADM	13. Marvin Keller
2. Akorn Pharmaceuticals	14.Mason Manufacturing
3. Ameren	15. McLeod Express
4. Canadian National Railroad	16. Norfolk Southern
5. Cargill	17. OmniTRAX
6. Caterpillar	18.Parke Warehouses
7. Decatur Airport	19. Ring Container
8. Decatur Memorial Hospital	20. T/CCI Manufacturing
9. EDC/Midwest Inland Port	21. Tate & Lyle
10. Hydro-Gear/Agri-Fab	22. The Kelly Group
11. Illinois Trucking Association	23. Topflight Grain
12. Macon County Farm Bureau	24. UPS

Another task from Phase 1 that carried over into Phase 2, was the assembly and cleansing of the data required by the model to develop and run optimization scenarios. The data elements fell into three primary modules: 1. The Network Module, 2. The Demand Module and 3. The Benchmark Module.

The Decatur Network Module

The network module is designed to represent the multimodal freight transportation network, and includes road, rail, intermodal and ocean networks. The network module includes the road, rail, and intermodal network in the Decatur Region as shown in Exhibit 5, as well as, corresponding modal network data defined for all counties in the U.S.

Exhibit 5: High-level View of Road, Rail and Intermodal Network in Decatur



Source: ArcGIS Rest Services, ESRI Imagery World 2D

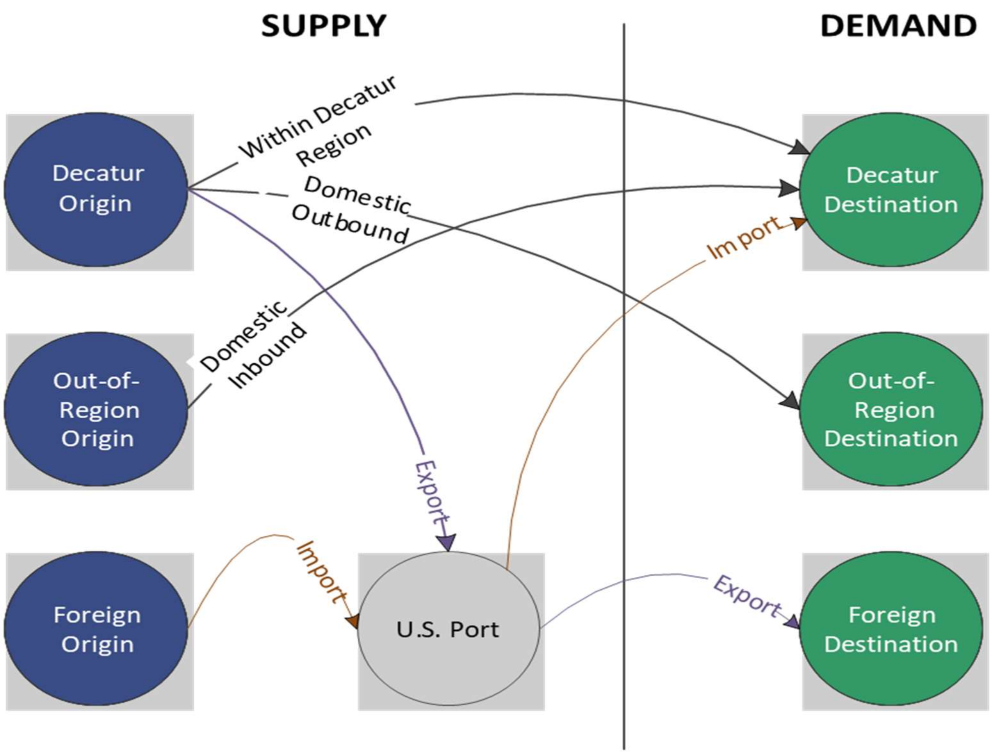
Intermodal nodes in the network refer to places were containerized cargo is transferred between modes, typically between truck and rail for domestic freight movements and between ship and truck/rail in international trade. There are approximately 193 intermodal facilities in the U.S. The ocean network is based on 41 foreign ports.

The movement of goods between an origin and a destination can be accomplished using a single mode or a combination of two or more modes (multimodal). The network module treats a multimodal movement in multiple legs with each leg completed using a single mode. For example, a multimodal shipment from Decatur, IL to New Orleans, LA might be accomplished by trucking the commodity to the nearest rail access point, then railing the commodity to New Orleans, and finally transferring the commodity to an ocean ship. In a multi-leg shipment, each leg will be constrained by the limitations of that mode. The diagram in Exhibit 6 shows how commodity flows are modeled to move between four types of nodes on the network:

1. **Decatur Region Origin/Destination**. In-region origins/destination flows were modeled at the county level. The Decatur Region consisted of the 19 Illinois counties discussed earlier. Each county can have inbound and outbound commodify flows.

2. **Out-of-Region Origin/Destination**. Domestic out-of-region origin/destination flows are also modeled at the county level with a 3-digit ZIP code (ZIP3) assigned. There are 3,143 counties in the U.S. If a county has more than one ZIP3 code, the ZIP3 with the highest population is used to represent the county.
3. **U.S. Port**. Decatur Region import/export commodity flows are modeled to include two legs: a domestic leg between a regional site and a U.S. port and international leg between a U.S. port and a foreign site.
4. **Foreign Origin/Destination**. There are 41 foreign countries or country groups in the model for import/export analysis.

Exhibit 6: Overview of Network Nodes and the Modeled Flow of Commodities



Source: Quetica

The Decatur Demand Module

The Demand Module includes both a domestic element, and an import/export element. The total tonnage and total value of domestic commodity flows originating or terminating in the Decatur Region comes primarily from commodity flow data in the Freight Analysis Framework (FAF) version 4.3. FAF is produced by the Federal Highway Administration (FHWA) and is derived from the Commodity Flow Survey (CFS) conducted every five years by the Census Bureau and Bureau of Transportation Statistics. FAF, now in its fourth generation (FAF4), is available online free of charge. The commodities represented in FAF are categorized using the Standard Classification of Transported Goods (SCTG) at the two-digit level. There are 43 commodity groups at the two-digit STCG level.

Base Year Domestic Commodity Flows

A weakness of FAF data is its lack of geographic detail. To address this weakness a linear regression approach was used to assign 43 commodity groups to a county-level.[2] Most approaches to FAF disaggregation use county employment as the primary independent variable. Quetica supplements employment with other public data exhibiting strong correlations to either production or attraction functions for specific commodity groups.

This multi-step disaggregation process of FAF 4.3 domestic commodity flows to the county level, has achieved a “goodness of fit” or R^2 coefficient exceeding 0.70 across all commodity groups. For example, in addition to employment, county level crop production statistics from the US Department of Agriculture were used to disaggregate Cereal Grain flows, which achieved R^2 values of 0.9196 for attraction, and 0.9209 for production values.

Using this county commodity data for the 19-county region, we can examine the 2015 baseline make-up of the regional freight transport system by observing the current use of modes, top product movements, and existing markets. Exhibit 7 shows the current use of modes in the region by tonnage and value.

By volume, approximately 68 percent of the region’s freight moves by truck as a single mode, which is similar to the national mode share for domestic freight moving by truck of 66 percent.[3] The second highest mode share in the region by weight is rail at 26 percent which is significantly higher than the national average of just 9 percent. Two percent of the region’s freight volume moves by barge, likely reflecting bulk materials moving on the Illinois River. The remaining volume (4 percent) moves by various combinations of modes. In terms of value, 80 percent of the region’s goods move by truck, versus 73 percent share nationally.

[2] *FAF commodities are classified using the Standard Classification of Transported Goods (SCTG). At a two-digit level there are 43 SCTG commodity groups.*

[3] *2017 Freight Facts and Figures – domestic freight movements in 2015. https://www.bts.gov/bts-publications/freight-facts-and-figures/freight-facts-figures-2017-chapter-2-freight-moved*

Exhibit 7: 2015 Mode Share by Tonnage and Value

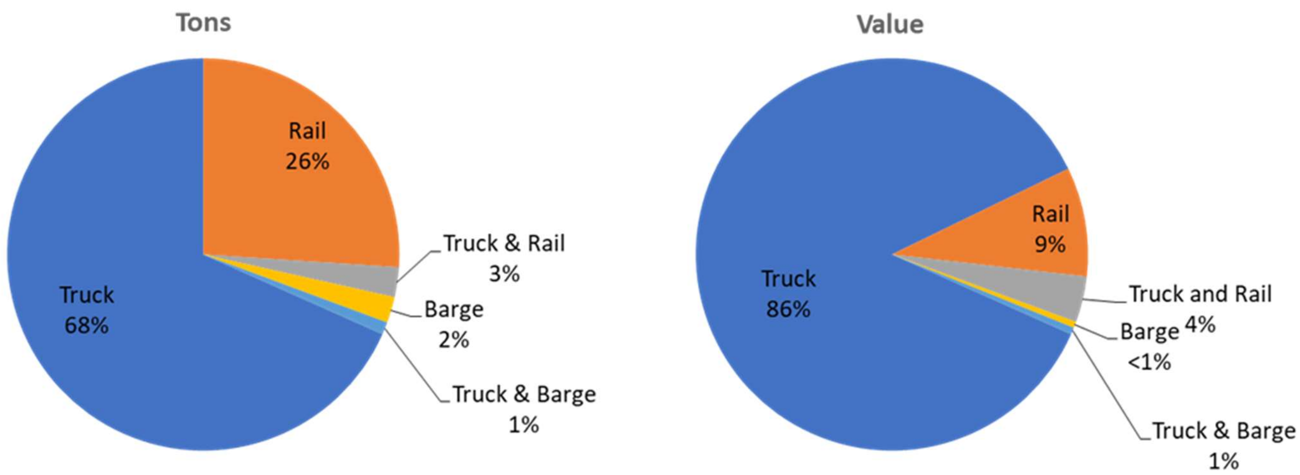
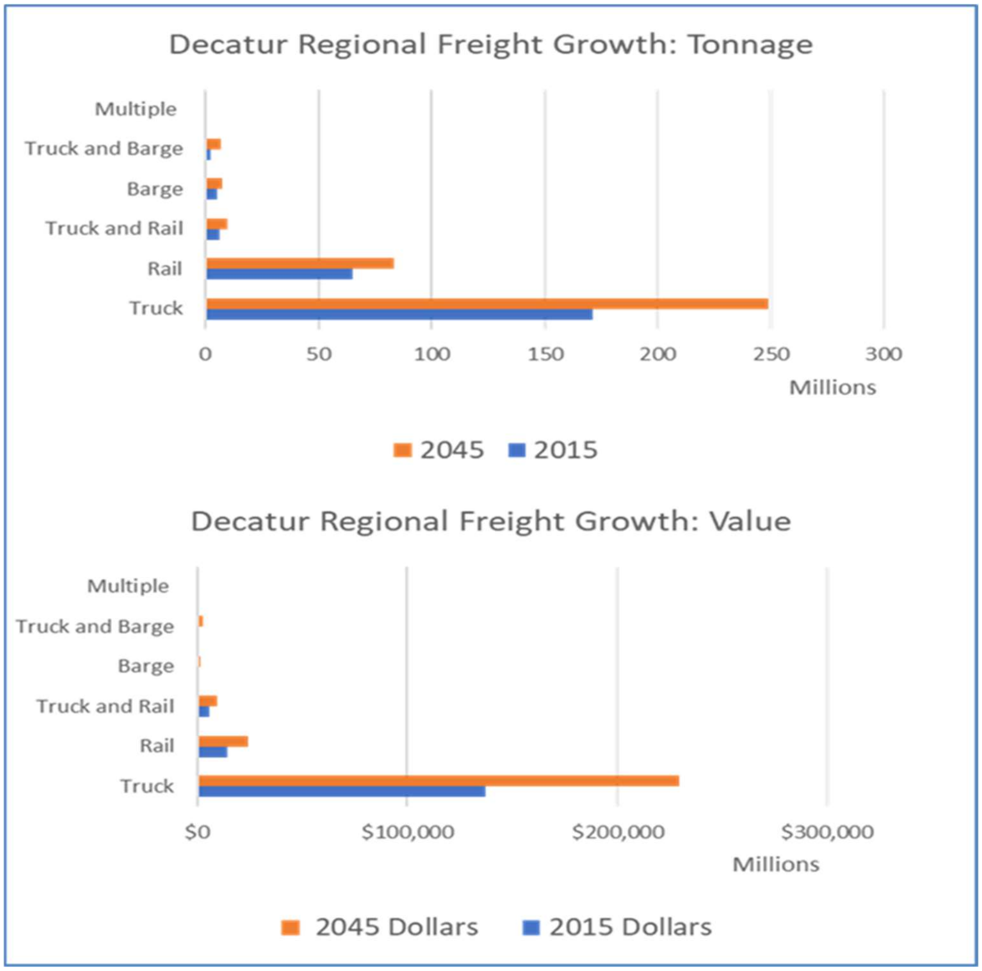


Exhibit 8: 2045 Commodity Flow Forecasts

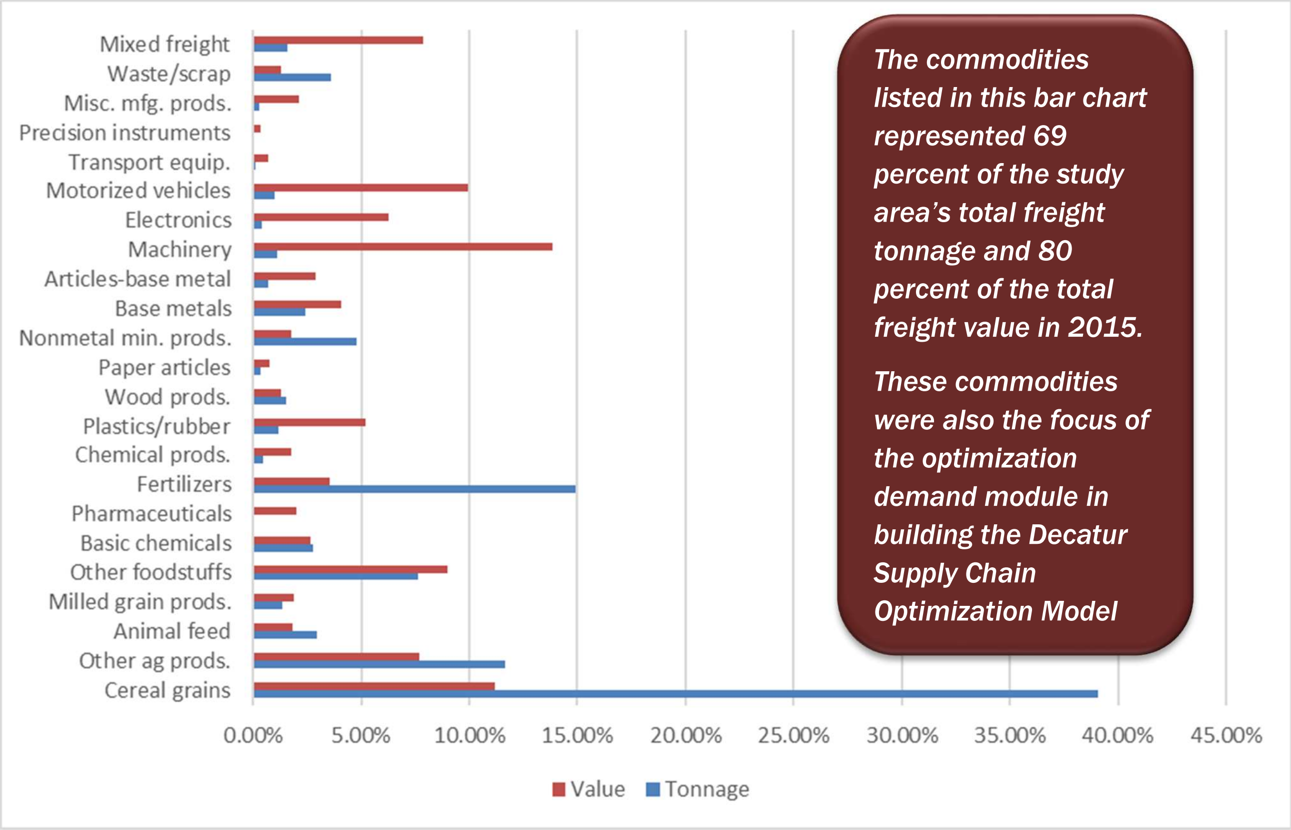


FAF data also provides forecasts in five year increments up to 2045. The bar graphs in Exhibit 8:8 shows that by tonnage, freight volume in the 19-county region is expected to increase over 42 percent from 2015 to 2045. By value, freight flows are expected to increase 67.5 percent. FAF forecast data suggests that the region's reliance on truck will continue to grow, with the percentage of freight moving by truck increasing to a 70 percent share by weight/volume.

Source for Exhibits 6 and 7: FHWA – Freight Analysis Framework, Graphed by Quetica, LLC.

To minimize noise and reduce computing time, the commodity data included in the analysis was restricted to the industries and supply chains most relevant to the local economy. Quetica identified 23 commodity groups with the most relevance to the regional economy. These priority commodities shown in Exhibit 9 represent 69 percent of Decatur's total freight tonnage and 80 percent of the total freight value in 2015.

Exhibit 9: Decatur's Target Commodity Groups by Tonnage and Value



Source: USDOT/FHWA Freight Analysis Framework. Graphed by Quetica.

Among the key commodity groups, agriculture crops and related products (Cereal grains, Other Agriculture Products, and Fertilizer) account for 65 percent of all commodity tonnage, but less than 25% of total commodity value. Cereal grains represent the single largest volume while Machinery is the highest value commodity. The 23 priority commodities were the focus of further analysis using the network optimization model.

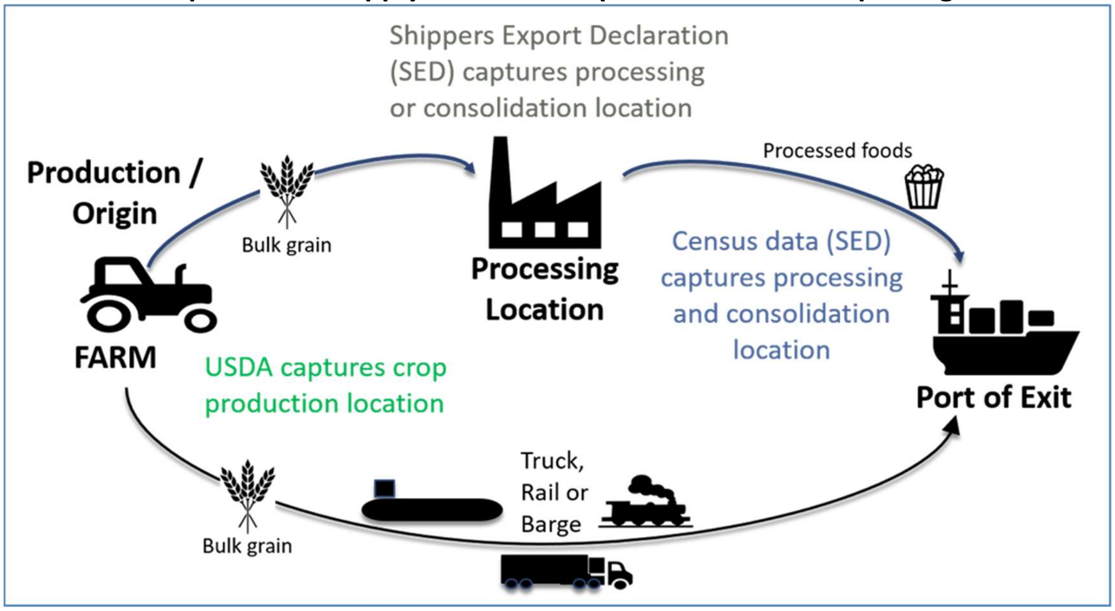
Import/Export Commodity Flows

The shortfall in geographic granularity that afflicts FAF domestic flows, carries over to import/export data as well. In its raw format FAF import/exports are distributed among only eight international regions or multi-country groups. To understand specific import/export markets, disaggregated FAF import/export data was assembled by the World Institute for Strategic Economic Research (WISER) to provide import/export tonnage and value for 41 foreign countries or country groups.

A second shortfall that was addressed in the raw FAF import/export data concerns the true origin of some export products. FAF import/export data is based on a "*Shippers Export Declaration*", or its recent replacement, the *Electronic Export Information (EEI) form*. These forms are filed with the U.S. Census Bureau whenever a commodity export exceeds $2,500 in value. While this export documentation is a reliable source for the origin of manufactured products, it is misleading for many agricultural exports and other products.

Exhibit 10 provides a high-level view of the supply chain for many agriculture commodity exports. Bulk grain exports often move from Midwest (e.g. Illinois and Decatur area) farms by truck, rail or barge to export gateways where they are consolidated and transloaded to ocean going ships. It is not uncommon for the shipper's export declaration (SED) to be filed at the export port, listing the gateway state as the state of origin, as opposed to the production state understating agriculture exports from the Midwest. Another common route takes raw grains from the farm to a processing plant, where food products and animal feeds are processed and sent on for export. In this scenario, the processing location is often listed as the origin location on SED documents.

Exhibit 10: Export Grain Supply Chain and Export Declaration Reporting



Source: Quetica

Exhibit 11 shows a comparison of several agricultural export commodity groups for the state of Illinois. The columns under the blue heads on the left were extracted from the unaltered FAF-4 database using EEI data as the source. The green headed columns on the right show data developed by the U.S. Department of Agriculture (USDA) from a variety of sources including farm cash receipts. The comparison of the two data sources shows that in 2014, the value of agriculture exports from the State of Illinois were at least 64 percent higher than what is reported in FAF-4 data. This difference in the origin of export flows can be critical when evaluating opportunities to lower transportation costs for agricultural exports.

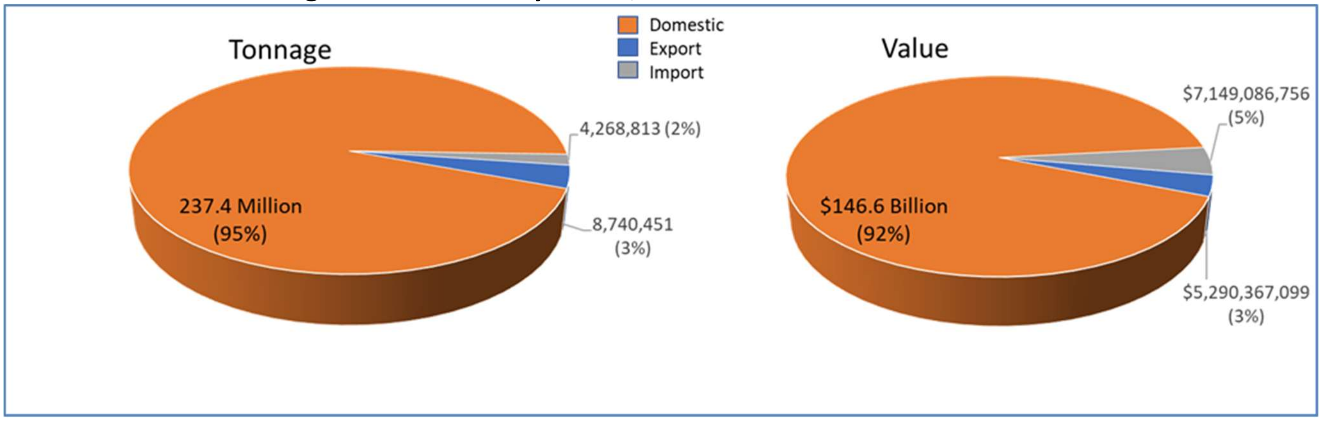
Exhibit 11: Comparison of Agriculture Illinois Export Data from USDOT and USDA

SCTG Code	Illinois Exports: FAF-4	2014 - Million $	SCTG Code	Illinois Exports: USDA	2014 - Million $
02	Cereal Grains	$ 1,883	034	Soybeans	$ 3,549
03	Other Ag-Products	$ 1,953	022	Corn	$ 1,820
04	Animal Feed	$ 1,439	0429	Feeds & Other Grains	$ 1,471
		$ 5,275	0412	Soybean Meal	$ 818
			029	Grain Products	$ 562
			032	Other plant products	$ 304
			021	Wheat	$ 135
Source: USDOT			Source USDA		**$ 8,659**

In total, import and export flows make up a small percentage of the Decatur regional economy. Even though exports represent a small share of all goods movement in the region, 8.7 million tons and $5.3 billion represent significant trade volumes in the regional economy.

Exhibit 12 shows the share of domestic, import and export flows for all commodities in 2015. Even though exports represent a small share of all goods movement in the region, 8.7 million tons and $5.3 billion represent significant trade volumes in the regional economy.

Exhibit 12: Decatur Regional Commodity Flows, Domestic and International 2015



Source: FHWA – Freight Analysis Framework, Graphed by Quetica, LLC.

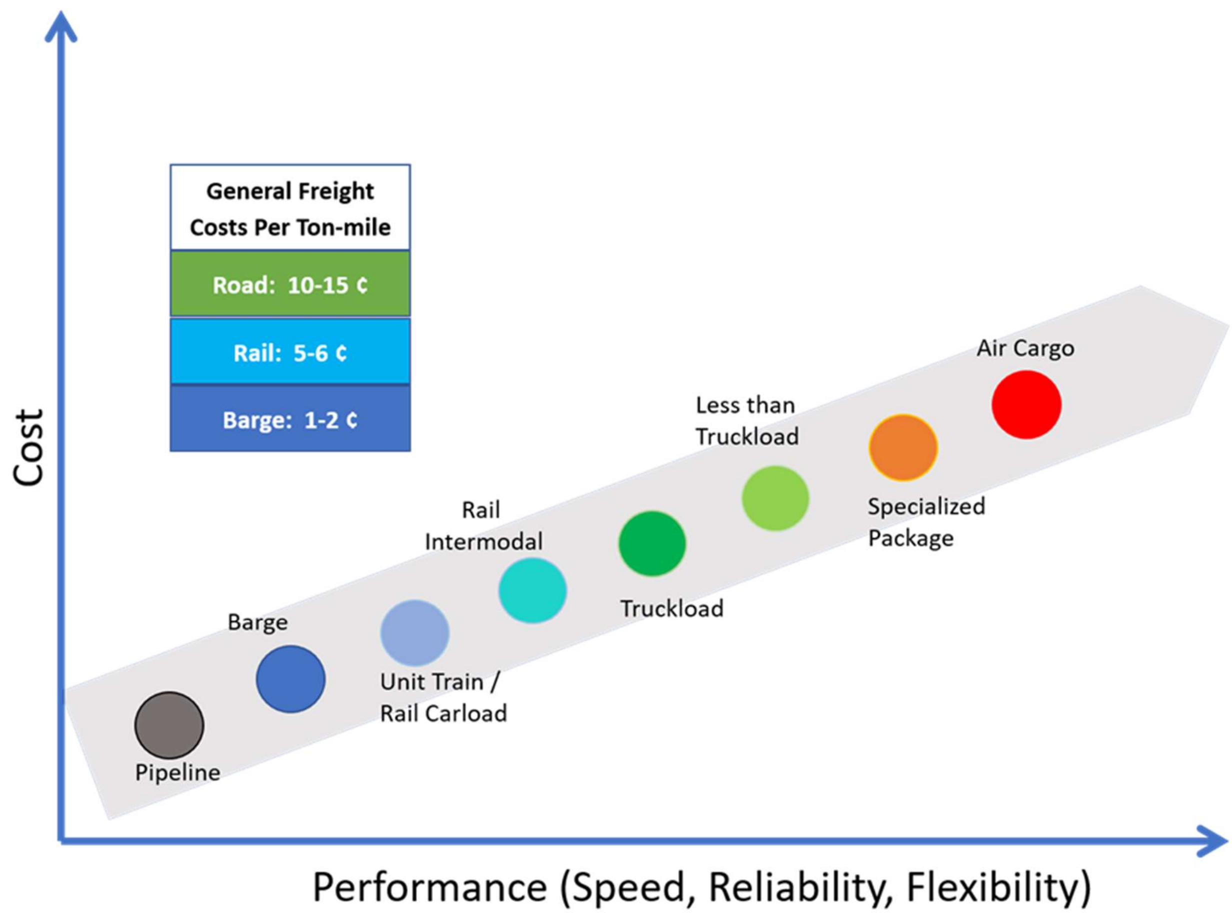
Decatur Benchmark Module

The Benchmark Module includes industry benchmark costs for moving different commodities within all trade lanes (origin to destination) by mode and equipment type. The benchmark data also includes some of the common service charges such as fuel surcharges, transloading costs, intermodal lift costs, consolidation costs, stop-off fees, etc. Data for the benchmark module comes from both the shipping records obtained during the Decatur Supply Chain Network Planning and Optimization Study, as well as industrywide benchmarks provided by 3rd party data collectors.

Finding Opportunities to Lower Business Transportation Costs

In general terms, each mode of freight transportation provides a mix of cost, speed, accessibility, and flexibility that shapes its service attributes and offerings. Service needs also play a major role in determining the mode(s) used by specific industries for the commodities they consume and produce. For example, air cargo services are most often used to transport products with a high value to weight ratio (e.g. computer chips), or products that are extremely time sensitive (e.g. fresh flowers), and/or require a high-level of flexibility (e.g. on-site replacement parts). At the opposite end of the modal spectrum, pipelines are very inflexible and usually handle only a single product. Barges usually transport products with low time sensitivity (e.g. sand, gravel, road salt). Exhibit 13 shows a common array of modes for moving goods along with the general service attributes that define modal options.

Exhibit 13: Modal Service Attributes and Cost



Competition between service and price tends to be greatest the closer the modal options are on the spectrum. However, access to one service may alter the ability to substitute for a similar service, especially when initial capital costs for accessing a competitive mode are high. The global nature of trade and the long distances many products move often results in the use of multiple modes to achieve the best price and service mix. In addition, the flexibility and door-to-door attributes of trucking services make trucking the undisputed choice for “first and last-mile” freight transport.

Products depend on different transport services based on factors such as inventory holding costs, weight, perishability or shelf-life, fragility, and sensitivity to market conditions. For example, medical devices (e.g. pacemakers) have a high cost to weight ratio, high inventory holding costs, and time definite delivery windows measured in minutes and hours. These conditions are best met by the services specialized package and air cargo carriers routinely provide. Conversely, grain has a low cost to weight ratio, low inventory holding costs and delivery windows measured in days as opposed to hours. These factors make low cost barge or rail services more suitable for grain transport. Air cargo and expedited truck delivery services may cost thousands of dollars on a weight basis versus barge and rail services which are more likely to have cost measured in cents.

Defining “What-if” Scenarios to Test with the Optimization Tool

After assembling the supply and demand data modules and constructing the initial network optimization model, the freight movement data was analyzed to identify opportunities for reducing freight shipping costs without significant changes to the existing network.

Results from the initial commodity analysis were reviewed with the Decatur-area project team and opportunities to reduce area business costs were discussed in the context of “what-if” scenarios. What-if scenarios test network strategies for reducing supply chain costs. Three of the most common network strategies are discussed briefly in the remainder of this section. In the next section we explore the model results specifically for Decatur from implementing these and other strategies.

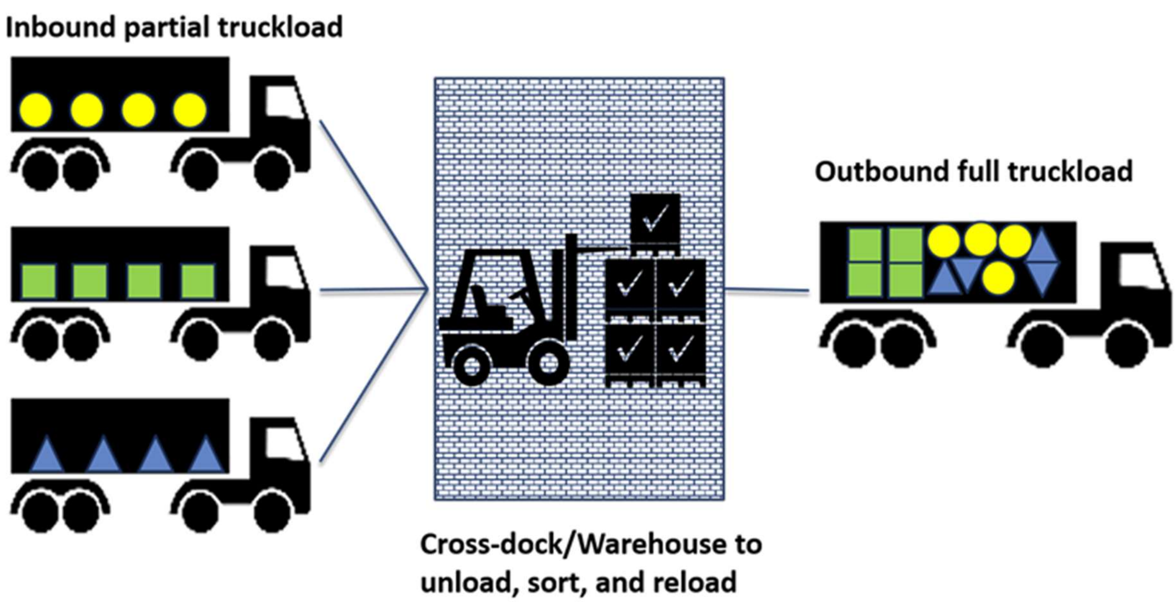
1. **Freight Consolidation / Deconsolidation**: Freight consolidation is usually accomplished using cross dock or warehousing facilities where trucks bring in many small loads originating from surrounding geographic areas. Shipments destined to a common external region are reloaded for a truckload (TL) linehaul move to a distribution center in the destination area. The goal under the freight consolidation scenario is for shippers in the Decatur Region to use shipment aggregation to reduce their transportation costs while maintaining proper levels of service to account for slight increases in delivery times from the aggregation process.

   Cross-docking is a common strategy for implementing shipment consolidation to lower supply chain costs. Cross-docking is a procedure where freight from an incoming truck or railcar is unloaded, sorted, consolidated and loaded directly into outbound trucks, trailers, or railcars with little or no storage in between. Cross-docking can be leveraged to consolidate freight across one shipper or multiple shippers (see Exhibit 14).

In this scenario the commodity data is analyzed to identify shipments moving by truck in partial truckload, partial container load or less-than-truckload (LTL). Partial load or partial container rates can be 3-4 times higher than that of full truckload or full-container rates. Cross-docking can be used in several logistics situations, including:

- *Transportation cross-dock*. Cross-docking is used to consolidate shipments from several suppliers (often in LTL batches) to TL shipments, achieving economies of scale. Transportation companies sort and consolidate parcels and pallet loads based on geographic destination in the process. The cross-docking services can be provided by a pure cross-docking service provider or owned and operated by a trucking company to offer more competitive rates to shippers.
- *Manufacturing cross-dock*. Cross-docking is used for the receipt, consolidation, and shipment of raw materials or component parts from many suppliers for TL shipments to a manufacturing plant.
- *Distributor cross-docking*. Multiple manufacturers ship merchandise to a common distributor's cross dock facility. The distributor assembles or partially assembles products on a multi-SKU (stock keeping unit) pallet before delivery to the next receiver in the supply chain.
- *Retail cross-docking*. Products from multiple suppliers are received at a retailer's distribution center, moved across the dock, and consolidated with other products bound for the same store. Wal-Mart delivers about 85% of its merchandises using a cross-docking system.

Exhibit 14: Representation of Freight Consolidation Scenario

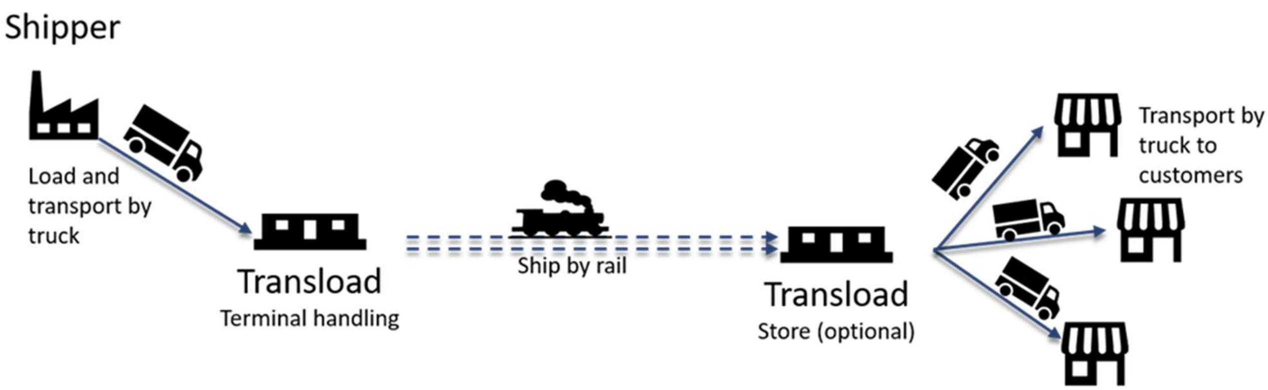


Source Quetica, LLC.

2. **Transload Analysis - Rail:** Transload facilities involve transferring non-containerized commodities from one mode to another (Exhibit 15). Transloading can be used to effectively leverage railroad

services where shippers/receivers do not have direct rail access at their production or warehousing facilities. Transloading works for many commodities, including finished and unfinished goods, fresh food and beverage products, lumber, paper, metals, building materials, a variety of packaged bulk commodities, as well as special shipments that cannot travel their entire route by road. The focus of this scenario and analysis is on truck-to-rail and rail-to-truck transloading for dry and liquid bulk commodities. The scenario targets bulk commodities such as building materials, chemicals, metals, scrap and miscellaneous manufactured products moving by truck over 500 miles.

Exhibit 15: Summary of End to End Truck to Rail Transload Process



Inbound	Process	Outbound	Description
	Load		The commodity is loaded on a short-haul truck for delivery to a transload facility
	Transport by truck		The truck delivers the commodity to a transload facility, usually within 50 miles of origin.
	Transload		The commodity is loaded onto rail cars. This can be accomplished in many ways depending on the commodity. Transload facilities for bulk liquid commodities will have specialized bays where liquids are pumped through a pipeline to a rail tank car. Dry bulk commodities may use gravity, pneumatics, or a mechanical means to transfer from one mode to another. Forklifts, cranes, and other lifting equipment may be used for other commodities.
	Terminal handling		The loaded rail car will be spotted for pick up by a railroad carrier. Transload facilities may be served by a single railroad or multiple railroads. Multiple railroad carriers serving a transload facility offer the advantage of price competitiveness and routing options.
	Ship by rail		The loaded rail cars are routed to the transload facility near the destination, or may be delivered directly to the customer if they are rail served.
	Store (optional)		Sometimes, at the option of the customer (and when available) the transload will store the commodity on-site until the customer requests the material. Options may exist for either long- or short-term storage.
	Transport by truck		The commodity is transloaded to short-haul trucks for the final leg of the journey and the cycle is complete.

Source: Quetica and Iowa DOT (Iowa DOT, 2014b).

3. **Intermodal Service Scenario:** In private industry, "intermodal" refers to cargo that is containerized in steel boxes. Most international containerized trade is done using 20 or 40-foot ISO containers.[4] So called "domestic containers" are typically 48 or 53-feet in length and are used to maximize the cubic capacity of over-the-road tractor semitrailers. Intermodal service is designed to capture the best of each mode by combining the economies of rail linehaul (with a much lower average cost per mile) with the flexibility of trucking for local drayage. There are several variations to rail intermodal service that range from "piggy-back" service where semitrailers are loaded onto flatcars to premium service involving double-stacking containers in well cars.

Long-haul double-stack service is less expensive than truckload service because one train can move 200 containers whereas 200 trucks and drivers would be needed to move 200 highway truckloads. However, due to terminal in-gating, loading and off-loading containers onto the trains, interchanging trains, and drayage delivery, intermodal transit usually takes longer to complete than door-to-door truck delivery.

Every year, nearly 25 million containers and trailers are moved using intermodal transportation in the U.S. (IANA, 2015). Electronics, mail, food, paper products, clothes, appliances, textiles and auto parts all take a ride on the country's intermodal network. Intermodal freight has been the fastest growing segment of the freight rail industry since 1980 (FRA, 2015). Domestic intermodal traffic will continue to increase as more long-haul truck loads are converted from highway to intermodal rail (Inbound Logistics, 2012). Domestic and international intermodal freight can involve multiple shipment modes, such as truck, rail, barge, and ocean.

Decatur Specific Scenario Results and Implementation Recommendations

The scope of work for the Decatur Supply Chain Network Planning and Optimization Study called for the analysis of five what-if scenarios. For the first three scenarios described in the previous section, the DROM was used to estimate the market demand from additional freight service offerings resulting from network enhancements. Members of the project Steering Committee also requested a freight-focused analysis of several proposed highway network enhancements, including the completion of a regional beltway project, and a bundle of highway improvements identified in Decatur's Long-Range Transportation Plan (LRTP). These last two scenarios were analyzed using a combination of the freight database assembled and the Decatur Regional Travel Demand Model. The following section presents the results of each scenario analyzed along with recommendations for implementing the strategy.

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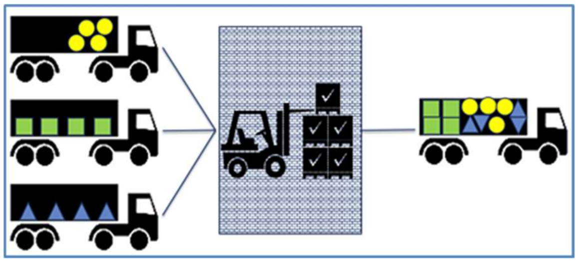
[4] *ISO stands for International Standards Organization, an international body that establishes the dimensions for shipping containers used in international commerce.*



1. Freight Consolidation / Deconsolidation

The DROM was used to test the impact of a cross-docking facility in Decatur to reduce shipping costs for regional businesses. In the following analysis the Total Market Opportunity (TMO) measures the potential market for cross-docking in terms of total market volume as measured in tons.

The consolidation strategy analysis is based on the following assumptions and in-scope commodities:

- The analysis focuses on converting truck shipments traveling over 750 miles. Only domestic shipments originating from or terminating in the Decatur study area are in scope: Shipments with both an origin and destination in the region are not included. Shipments internal to the region are omitted because shipment consolidation is typically used for long haul shipments in order to offset the cross-docking consolidation and operational costs.
- Where a cross-dock is used, outbound shipments from the region would be trucked to the cross-dock, consolidated, and then shipped to out-of-region destinations. Baseline shipments in the model are assumed to be consolidated when: 1) Transported to a cross-dock from the same origin site; or, 2) Transported from the cross-dock to the same destination site.
- This optimization is focused on dry commodity shipments, the most common type of shipments using cross-docking operations. Refrigerated and liquid commodities are excluded in this analysis. Although refrigerated shipments can also be consolidated using refrigerated facilities, the TMO would be much smaller due to lower freight volumes. Liquid commodity shipment consolidation involves other supply chain management techniques and is not the focus of cross-docking operations. Exhibit 16 lists the commodities included in the scope of the freight consolidation analysis. The table shows all the commodity categories provided at the two-digit Standard Classification of Transported Goods (SCTG) format found in the FAF.

Exhibit 16: Commodities Included in the Freight Consolidation Scenario (highlighted)

SCTG	Commodity	SCTG	Commodity	SCTG	Commodity	SCTG	Commodity
01	Live animals/fish	12	Gravel	23	Chemical prods.	34	Machinery
02	Cereal grains	13	Nonmetallic minerals	24	Plastics/rubber	35	Electronics
03	Other ag prods.	14	Metallic ores	25	Logs	36	Motorized vehicles
04	Animal feed	15	Coal	26	Wood prods.	37	Transport equip.
05	Meat/seafood	16	Crude petroleum	27	Newsprint/paper	38	Precision instruments
06	Milled grain prods.	17	Gasoline	28	Paper articles	39	Furniture
07	Other foodstuffs	18	Fuel oils	29	Printed prods.	40	Misc. mfg. prods.
08	Alcoholic beverages	19	Coal-n.e.c.	30	Textiles/leather	41	Waste/scrap
09	Tobacco prods.	20	Basic chemicals	31	Nonmetal min. prods.	43	Mixed freight
10	Building stone	21	Pharmaceuticals	32	Base metals		
11	Natural sands	22	Fertilizers	33	Articles-base metal		

Transportation costs in the baseline model are used to benchmark costs currently paid by companies to transport the commodities in the scope. The net total cost savings (TCS) is the difference between the baseline transportation costs and the optimized transportation costs. The optimized transportation costs are those that companies would pay if the cross-docking operations were established and leveraged to transport the same shipments as the ones in the baseline.

The optimized transportation costs are defined as:

$$COST_{Optimized} = COST_{TruckShortHaul} + COST_{TruckLongHaul} + COST_{Cross\text{-}Docking} + COST_{StopOff}$$

Where:

$COST_{Optimized}$ = the optimized transportation costs leveraging cross-docking operations.
$COST_{TruckShortHaul}$ = the short haul truck costs to transport the commodities from the origin to a cross-dock for outbound shipments, or from a cross-dock to a final destination for inbound shipments.
$COST_{TruckLongHaul}$ = the long-haul truck costs to transport the commodities from a cross-dock to out-of-state destinations for outbound shipments, or from out-of-state origins to a cross-dock for inbound shipments.
$COST_{Cross\text{-}Docking}$ = the costs a cross-docking operator would charge to receive, sort and ship commodities.
$COST_{StopOff}$ = the cost, or stop-off charge, assessed by trucking companies for shipments requiring additional stops in transit, excluding the origin and final destination. The stop-off charges vary, depending on the negotiated contracts.

Using Decatur as a hub for potential outbound freight consolidation in the optimization model run, the results suggest that the TMO is approximately 604,335 tons annually. The potential savings if the entire market opportunity was converted would exceed $33.5 million in savings annually. Other Agriculture Products and Animal Feed Products both offer potential volumes in excess of 100,000 tons per year as well as savings greater than $5 million (Exhibit 17). Five other product types offer savings opportunities exceeding $2 million.

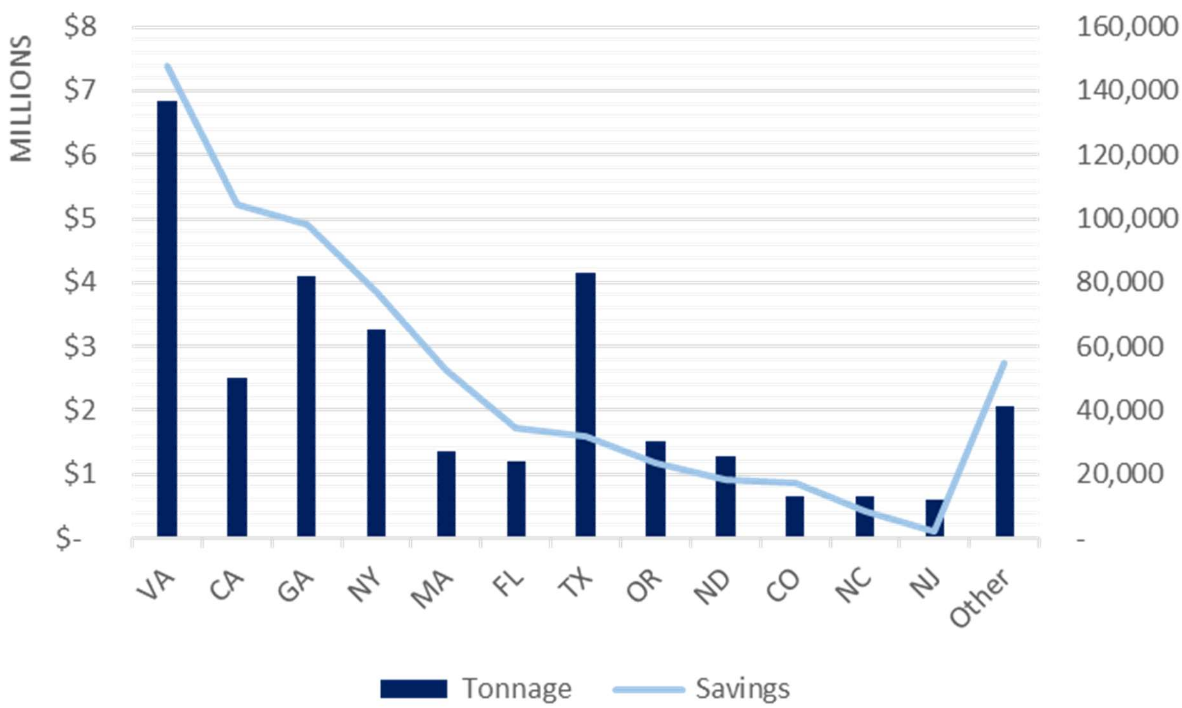
Exhibit 17: TMO for Consolidation, by Commodity

Product	Tonnage	Savings
Other ag prods.	118,008	$5,926,163
Animal feed	100,581	$5,733,541
Mixed freight	63,733	$3,992,610
Wood prods.	53,418	$3,876,370
Electronics	49,943	$3,677,674
Milled grain prods.	41,547	$2,627,025
Other foodstuffs	44,343	$2,172,933
Printed prods.	20,903	$998,108
Furniture	15,577	$934,608
Articles-base metal	25,052	$726,733
Other	71,230	$2,875,471
TOTAL	**604,335**	**$33,541,236**

The optimization model run testing the market for a regional cross-dock suggests that the Total Market Opportunity (TMO) exceeds 600,000 tons annually and would result in 25 percent cost reduction to regional shippers.

The trade lane between Decatur and the State of Virginia represents the largest annual opportunity by volume and savings with almost 140,000 tons and over $7 million (Exhibit). California and Georgia are also trade lanes that offer Decatur area shippers significant cost savings from shipment consolidation. The bar-line chart in Exhibit 18 shows the market potential for the top state trade lanes.

Exhibit 18: TMO for Consolidation, by Outbound State



Source: Quetica

Decatur UPS Cross Dock Facility: The Decatur Park District oversees the Decatur Airport and the airport's business park. The business park is a foreign trade zone (#245) and features 42 acres of land adjacent to the airport runway available for commercial development. The business park also features a vacant cross dock facility that that was originally built for UPS air cargo operations through the Decatur airport.

During the first decade of the 21st Century, Decatur served as a UPS hub for Southern Illinois, employing about 300 people in Decatur at four facilities, including a cross dock operation at the Decatur Airport serviced twice daily by a UPS Boeing 757.[5] In 2008, the economic recession and consolidation in the air cargo industry resulted in a decision by UPS to consolidate its Decatur air cargo operations in Peoria, IL. While UPS discontinued direct air service to Decatur, it continued serving customers in the region by truck. When UPS discontinued its twice daily air service in Decatur, it also abandoned a cross-dock facility located in the airport business park. The former UPS cross-dock facility has remained vacant since UPS discontinued air-service to Decatur in February 2009. The vacant facility (see Exhibit 19) remains available for purchase or lease. The cross-dock building has nine bays for pickup and delivery trucks, and several bays for large line-haul trucks. The facility also contains office space. Discussions with staff at the Decatur Park District during this study suggested that access to the facility from major highways in the region has been a barrier to finding an operator for the facility.

Exhibit 19: Vacant Cross Dock Facility at the Decatur Airport Business Park

Recommended Steps for Implementing Freight Consolidation Solutions

[5] Chris Lusvardi, *UPS to drop Decatur Airport stop for Boeing 757.* Herald&Review, Nov. 27th, 2008. Accessed online at: https://herald-review.com/news/local/ups-to-drop-decatur-airport-stop-for-its-boeing/article_92d9d081-6699-5089-a000-f373eccb7e5f.html

Based upon the results of the freight consolidation model run the following steps are recommended to pursue cost saving initiatives through freight consolidation strategies:

- Discuss data and findings with existing warehouse/cross-dock operators on opportunities to expand services, focusing on the top commodities and top Decatur-state trade lane pairs.
- Explore opportunities to use the former UPS cross-dock facility at the Decatur Regional Airport, especially among product groups that may be able to use either truck or air modes or both, such as electronics and plastics/rubber.
- Work with interested businesses to develop a high-level business case that would include sketch-level engineering cost estimates, and initial return on investment (ROI) metrics. If results are promising the next step would involve developing an investment grade business plan, with benefit cost analyses and other metrics to support state and federal financing opportunities.

2. Transload Analysis - Rail

Transloading involves moving non-containerized cargo between two transportation modes. Typical transload operations involve truck-to-rail, truck to barge, or rail-to-barge. For the Decatur region transload analysis, the scenario examines transloads between truck and rail. Supply chains utilizing a transloading process leverage the access capabilities of trucking for the short haul pickup/delivery and lower cost modes like rail for the long-haul shipment to provide cost efficient transportation.

The Decatur baseline optimization suggests opportunities exist in the region to further leverage the railroad network and lower transportation costs for regional businesses. Transloading is often required to effectively access the rail network when shippers do not have direct access through spurs into their facilities. Transloading works for many commodities, including finished and unfinished goods, fresh food and beverage products, lumber, paper, metals, building materials and a variety of packaged bulk commodities, as well as special shipments that cannot travel their entire route by truck. The transload optimization strategy discussed here is focused on truck-to-rail and rail-to-truck transloading for dry and liquid commodities since this scenario provides the largest potential cost savings opportunities identified in the baseline optimization. The optimization strategy analysis is based on the following scope and assumptions:

- All domestic shipments between the region and out-of-region locations, as well as the domestic legs of import/export shipments in the regional optimization model are in-scope. All import/export shipments include two legs of the shipments: the domestic leg is the shipment between a location and a U.S. port site; and the international leg is the shipment between a U.S. port and a foreign port or foreign origin/destination site. In this analysis, the international legs of import/export shipments are not included in the scope. The analysis focuses on converting truck shipments currently traveling over 500 miles, and those opportunities where transloading would present savings of at least $5 per ton.

- In domestic shipments, only inbound shipments to and outbound shipments from the Decatur Region are included in the analysis. Shipments within the region are not in scope, because they are too short to be cost effective.
- It is assumed that baseline shipments are not consolidated. In the transloading process, freight is hauled from its origin to a nearby rail terminal by truck, transloaded to railcars, shipped by rail to a destination terminal and transloaded back on to a truck for delivery to the final destination.
- The commodity groups highlighted in Exhibit 20 are in scope for the transload scenario. (Note: At the two-digit level, some of the highlighted SCTG commodity groups include both dry and liquid commodities such as animal feed, fertilizer, and waste/scrap).

Exhibit 20: Commodities Included in the Rail Transload Scenario (highlighted)

SCTG	Commodity	SCTG	Commodity	SCTG	Commodity	SCTG	Commodity
01	Live animals/fish	12	Gravel	23	Chemical prods.	34	Machinery
02	Cereal grains	13	Nonmetallic minerals	24	Plastics/rubber	35	Electronics
03	Other ag prods.	14	Metallic ores	25	Logs	36	Motorized vehicles
04	Animal feed	15	Coal	26	Wood prods.	37	Transport equip.
05	Meat/seafood	16	Crude petroleum	27	Newsprint/paper	38	Precision instruments
06	Milled grain prods.	17	Gasoline	28	Paper articles	39	Furniture
07	Other foodstuffs	18	Fuel oils	29	Printed prods.	40	Misc. mfg. prods.
08	Alcoholic beverages	19	Coal-n.e.c.	30	Textiles/leather	41	Waste/scrap
09	Tobacco prods.	20	Basic chemicals	31	Nonmetal min. prods.	43	Mixed freight
10	Building stone	21	Pharmaceuticals	32	Base metals		
11	Natural sands	22	Fertilizers	33	Articles-base metal		

Transportation costs in the Decatur baseline model are used to estimate the costs companies currently pay to transport the in-scope commodities. The optimized transportation cost is what companies would pay if transloading operations were used to transport the same shipments included in the baseline. The optimized transportation cost is defined as:

$$COST_{Optimized} = COST_{Trucking} + COST_{Rail} + COST_{Transloading}$$

Where:

$COST_{Optimized}$ = optimized transport costs leveraging recommended transloading operations.
$COST_{Trucking}$ = trucking costs between origin/destination and a railroad transloading site.
$COST_{Rail}$ = the rail freight costs between origin and destination railroad transloading sites.
$COST_{Transloading}$ = the total transloading costs.

The scenario assumes two transloads for each shipment (one at rail origination and one at rail destination) although some shipments may require only one transload if one end of the rail leg has direct access to rail. Using the two transloads per shipment assumption, results in a more conservative market opportunity estimate. The TMO for rail transload is roughly 1.5 million tons resulting in over $64 million in savings. The table in Exhibit 21 is sorted on total savings. While Animal feed offers the largest volume by tonnage, Basic chemical products offer the greatest savings opportunity worth over $21 million. Fertilizer products offer the second largest potential savings of $16.7 million. The top two commodity groups are liquid products, and four of the top ten are liquids. Dry bulk Animal feed could provide an additional $13 million in savings. Overall, commodities moving in dry van equipment account for roughly 60 percent of the optimized rail transload tonnage with liquid commodities accounting for the other 40 percent. But, in terms of potential cost savings dry commodities represent 40 percent and liquid 60 percent.

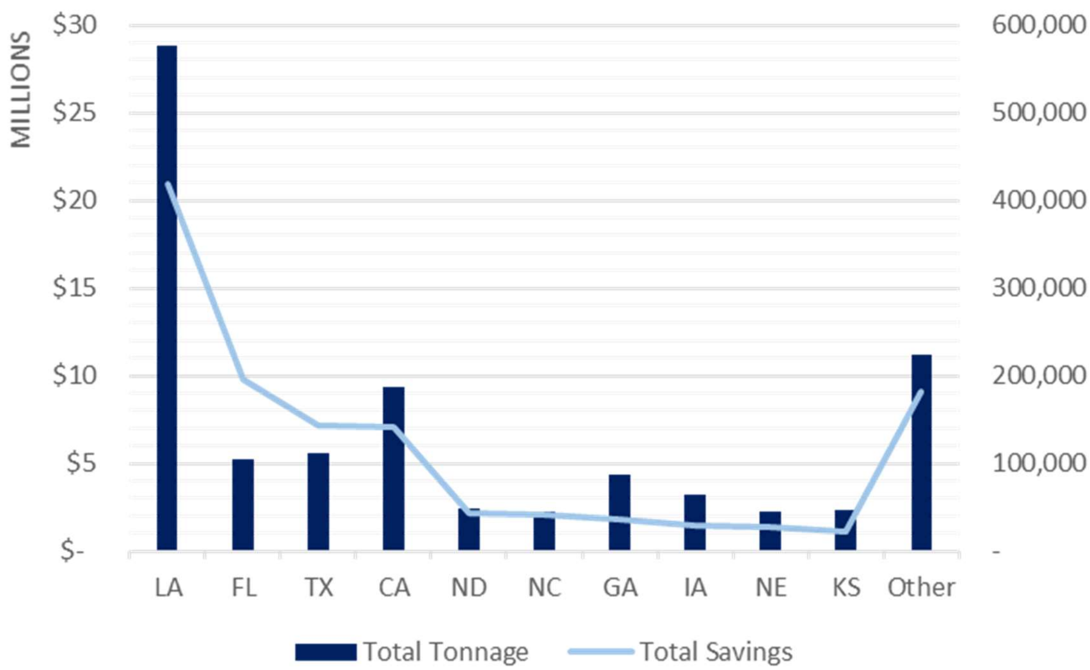
The bar chart in Exhibit 22 shows that for Decatur, the trade lane with Louisiana represents by far the largest opportunity in terms of tonnage and cost savings for regional shippers: Over 575,000 tons per year worth $20.9 million. Decatur shipments between the states of Florida, Texas, and California also provide significant cost savings opportunities ranging from $7.1 million to $9.8 million annually with volumes in each lane exceeding 100,000 tons.

Exhibit 21: TMO for Rail Transload, by Commodity/Equipment Type

Product	Equipment	Tonnage	Optimized Cost	Savings
Basic chemicals	Tank	352,894	$33,998,589	$21,064,810
Fertilizers	Tank	227,950	$20,765,559	$16,596,976
Animal feed	Dry	501,015	$35,403,909	$12,839,466
Base metals	Dry	118,155	$10,257,529	$2,656,536
Waste/scrap	Dry	80,402	$10,001,331	$2,426,675
Basic chemicals	Dry	54,973	$4,055,537	$2,189,638
Articles-base metal	Dry	51,974	$5,771,390	$1,693,625
Milled grain prods.	Dry	60,182	$4,921,815	$1,653,941
Animal feed	Tank	22,236	$1,674,374	$944,887
Chemical Products	Tank	12,945	$1,128,949	$660,801
Other	-	57,646	$4,909,653	$1,291,611
Total		**1,540,371**	**$132,888,634**	**$64,018,967**

The optimization analysis for regional transload suggests a market exceeding 1.5 million tons annually, with annual cost reduction to shippers of 39 percent.

Exhibit 22: TMO for Rail Transload, by State



Existing Transload Services in Decatur: Currently a few transloading operations are located in Decatur. Parke Inc. offers warehousing, custom processing and blending, third-party logistics and transloading services focused primarily on food and food ingredients. Keen Transport Inc. also offers transloading services in Decatur. Keen Transport is a national heavy-haul logistics and transportation service provider based in Carlisle, PA. Keen focuses on the construction, mining, and agriculture equipment markets. It is important to note that while transload services exist in one form or another in the Decatur area, those transload operations may not be designed or situated to handle certain commodities or markets due to equipment needs, special warehousing or handling needs, and/or access to national railroad networks serving specific areas of the country.

The optimization analysis for the transload scenario in Decatur identified dry bulk animal feeds, base metals, as well as, liquid chemicals and fertilizers as top unserved transload opportunities. States in the Gulf Coast and Southeastern U.S. were among the top potential markets. A recent change in Decatur's regional railroad network discussed below, may provide an opportunity for potentially developing transload services around these identified market opportunities.

In January of 2018, CSX announced that it was putting 650 miles of rail lines up for sale, including the Decatur and Danville subdivisions in Illinois and Indiana. The winning bidder for the line sale was the Decatur and Eastern Railroad (DREI), a short line railroad owned by WATCO Companies, a short line holding company. The DREI began operations of the 126 miles of track between Decatur and Terre Haute, IN in September of 2018. On its website WATCO Companies states that its Terminal and Port Services "*is a leader in bulk, break-bulk, and liquids rail/truck transloading.*" While on its own the DREI does not reach to the Atlantic Southeast or Gulf Coast, the short-line interchanges with the Canadian National (CN), Norfolk Southern (NS), Union Pacific (UP) and CSX. The DREI line runs parallel to US-36 and passes by the Decatur Airport and the Airport Business Park.

Members of the consulting team for the supply chain optimization study met with Dave Riggs, a Commercial Manager for the WATCO Companies in December of 2018. During the meeting, summary information about the rail transload market analysis for the Decatur region was shared. Mr. Riggs noted the information seemed very valuable, but with operations just initiated, it was a very busy time for the railroad.

Recommended Steps for Implementing Rail Transload Solutions

Based upon the results of the Decatur model runs, the following steps are recommended to pursue cost saving initiatives through freight consolidation strategies:

- The commodity analysis and Decatur model runs indicate large volumes of outbound animal feed, followed by lesser amounts of liquid chemicals. Between the base year and 2045, the projected volume of Waste/scrap that could be transloaded to rail is estimated to more than quadruple. It is recommended that a follow-up meeting be conducted with existing transload and rail operators in the region to discuss data and findings and explore opportunities to expand facilities or create new facilities that could accommodate different/additional commodities.

3. Railroad Intermodal Analysis

Chicago is the nation's busiest rail hub, as it is the central meeting location of east and west Class 1 railroads. The Greater Chicago Area is host to more than 20 rail intermodal ramps. However, that level of activity also brings congestion and delays, especially when through shipments require draying a container from an eastern railroad to a western railroad or vice-versa. For example, a February 2018 headline in the Journal of Commerce read: *"Chicago intermodal rail delays 'unprecedented' since January."* The article went on to describe severe "gridlock" and delays that were prompting detention penalties of \$75 - \$150.[6]

The ADM Intermodal Ramp is located to the east of downtown Decatur and is served primarily by the Canadian National (CN) and Norfolk Southern (NS) with connectivity to Decatur & Eastern Railroad (DREI). The ADM Intermodal Ramp has the capacity for 150,000 lifts per year and currently serves only international freight moving from the West, East, and Gulf Coasts. Examining opportunities to expand the MIP market offering, with an explicit examination of domestic market opportunities was a key motivation for undertaking the network planning and optimization study. Lane balance is a critical factor in successful railroad service market expansion. The market expansion opportunities examined under the intermodal scenarios include: increased volumes through connections to domestic west coast markets via hand-offs between NS and BNSF or UP in St. Louis or between DREI and UP in Pana; increased North American intermodal volumes via CN and NS through Kansas City Southern Railroad's (KCS) access to Mexico; and other opportunities with the WATCO purchase of the CSX/Decatur subdivision line.

Exhibit 23: Aerial View of MIP

Exhibit 23 shows an aerial view of the Midwest Inland Port (MIP) in Decatur. The MIP ADM Intermodal Ramp has access to four rail carriers: Canadian National (CN), Norfolk Southern (NS), Decatur Central

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[6] *Ari Ashe, Journal of Commerce, online edition. Chicago intermodal rail delays 'unprecedented' since January, February 22, 2018. https://www.joc.com/rail-intermodal/class-i-railroads/chicago-intermodal-rail-delays-unprecedented-january_20180222.html*

(DCC) and Decatur and Eastern Illinois (DREI). The MIP can provide access to ocean gateways on the East Coast, West Coast and Gulf Coast.

While ADM provides public access to the MIP facility, it is sometimes perceived as a private facility. A prime motivation for examining the MIP through optimization analysis, was to help identify potential market opportunities to expand services and volumes at the MIP facility.

The optimization analysis is based on the following scope and assumptions:

- All domestic shipments between the Decatur region and out-of-state locations, as well as the domestic legs of import/export shipments in the Decatur model, are included in the scope. Import/export shipments include two shipment legs: 1) The domestic leg is between a Decatur region location and a U.S. port site; and, 2) The international leg is the shipment between a U.S. port and a foreign port or foreign origin/destination site. In this analysis, the international legs of import/export shipments are not included in the scope.
- For domestic shipments, only the movements between the Decatur region and out-of-state locations are the focus of the analysis. Shipments within the region are not included in scope because intermodal shipments are typically used for long haul shipments. The analysis focuses on converting truck shipments currently traveling over 750 miles and savings opportunities of greater than $100 per container.
- It is assumed that baseline shipments are not consolidated. In trucking-to-intermodal conversions, freight originated and terminated in the same locations can be consolidated to lower transportation costs. However, the consolidation strategy requires additional supply chain management capabilities. The optimization strategy in this section does not include cost savings from this type of consolidation process.
- Rates between the Decatur region and CN or NS served sites are estimated to be on par with rates between Chicago and CN or NS served sites.
- It is assumed that less-than-container shipments are not used. If a shipment is less than a container, the full container shipment costs are used in cost benchmarks. Less-than-container shipment allows companies to consolidate multiple small shipments into one full container. Successful use of less-than-container shipment can further reduce intermodal transportation costs and decrease the lift numbers in an intermodal yard. However, it also requires additional transportation management capabilities.
- Liquid commodities are excluded in the analysis because they require ISO tank containers with a much smaller market size than dry commodity container shipments. Commodities included in the analysis were primarily manufactured and/or processed products, seen in Exhibit 24.

Exhibit 24: Commodities Included in the Intermodal Scenario (highlighted)

SCTG	Commodity	SCTG	Commodity	SCTG	Commodity	SCTG	Commodity
01	Live animals/fish	12	Gravel	23	Chemical prods.	34	Machinery
02	Cereal grains	13	Nonmetallic minerals	24	Plastics/rubber	35	Electronics
03	Other ag prods.	14	Metallic ores	25	Logs	36	Motorized vehicles
04	Animal feed	15	Coal	26	Wood prods.	37	Transport equip.
05	Meat/seafood	16	Crude petroleum	27	Newsprint/paper	38	Precision instruments
06	Milled grain prods.	17	Gasoline	28	Paper articles	39	Furniture
07	Other foodstuffs	18	Fuel oils	29	Printed prods.	40	Misc. mfg. prods.
08	Alcoholic beverages	19	Coal-n.e.c.	30	Textiles/leather	41	Waste/scrap
09	Tobacco prods.	20	Basic chemicals	31	Nonmetal min. prods.	43	Mixed freight
10	Building stone	21	Pharmaceuticals	32	Base metals		
11	Natural sands	22	Fertilizers	33	Articles-base metal		

The optimized transportation costs are defined as:

$$COST_{Optimized} = COST_{TruckDryage} + COST_{IntermodalRail} + COST_{Lift} + COST_{RepositioningEmptyContainer}$$

Where:

$COST_{Optimized}$ = the optimized transportation costs using the suggested intermodal yard

$COST_{TruckDrayage}$ = the drayage costs to truck a container from origin to originating intermodal yard and from terminating intermodal yard to final destination.

$COST_{IntermodalRail}$ = the intermodal railroad costs between originating and terminating intermodal yards.

$COST_{Lift}$ = the lifting costs to move a container from truck to railcar at originating intermodal yard and from railcar to truck at terminating yard.

$COST_{RepositioningEmptyContainer}$ = the costs to reposition empty containers to Nebraska

The TMO for additional intermodal service in the Decatur Region equals over 2 million tons of freight and represents over $87 million in annual cost savings for shippers (Exhibit 25). The largest market opportunity by volume and by value is Other Foodstuff products with 430 thousand tons and almost $17.5 million in savings. Other agricultural products is the second largest opportunity with over 223 thousand tons worth $10.7 million. In total, 17 different product groups offer shippers annual transportation cost savings of at least $1 million. Domestic intermodal accounts for just about 60 percent of the total volume and savings opportunities with 1,258,822 tons versus international tonnage of 842,479 and $50,472,617 of the $87,373,283 total.

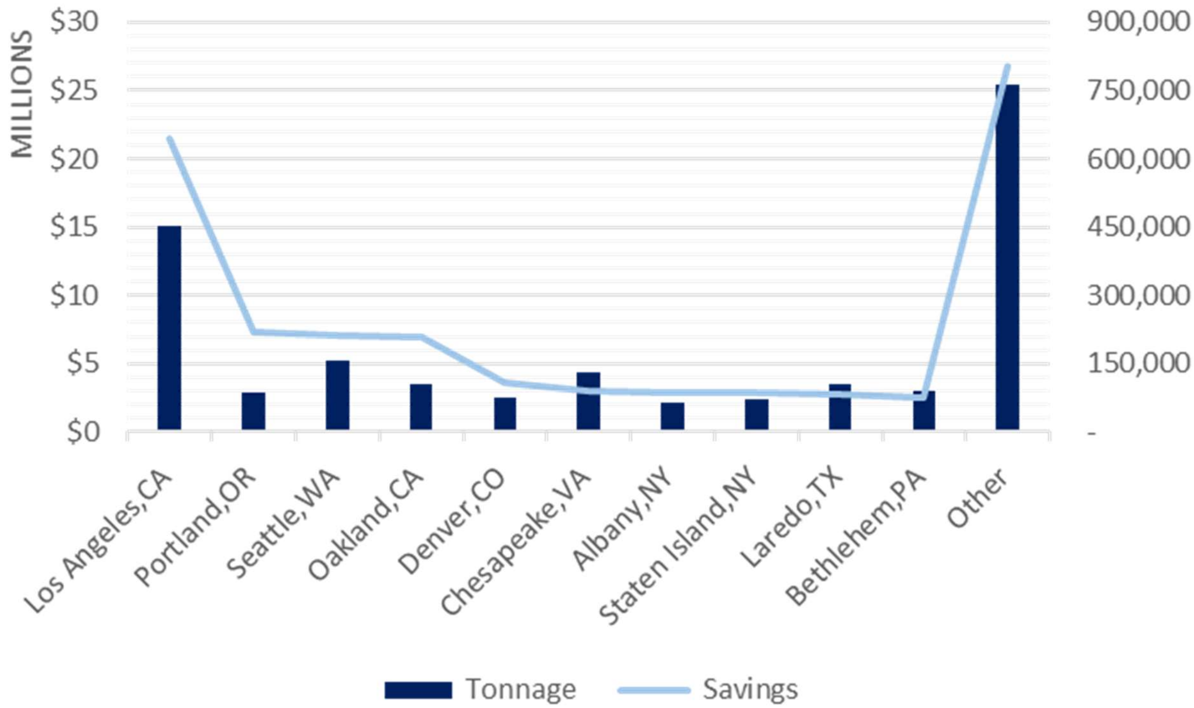
Exhibit 25: TMO for Intermodal Scenario, by Commodity

Product	Tonnage	Optimized Cost	Savings
Other foodstuffs	430,094	$ 41,937,065	$ 17,355,037
Other ag prods.	223,550	$ 19,766,574	$ 10,703,510
Electronics	189,334	$ 18,177,541	$ 8,310,481
Machinery	174,279	$ 18,072,572	$ 6,719,979
Milled grain prods.	135,000	$ 11,986,459	$ 5,362,352
Base metals	128,052	$ 12,572,985	$ 5,874,533
Mixed freight	124,507	$ 11,616,979	$ 5,160,330
Articles-base metal	121,927	$ 12,930,040	$ 4,920,783
Motorized vehicles	87,760	$ 9,308,247	$ 3,738,395
Wood prods.	74,944	$ 5,681,732	$ 3,067,882
Plastics/rubber	71,947	$ 7,585,561	$ 3,022,081
Other	339,907	$ 32,866,875	$ 13,137,919
Total	**2,101,301**	**$ 202,502,629**	**$ 87,373,283**

The optimization analysis for expanding intermodal rail service suggests a domestic market exceeding 1.2 million tons, with annual cost savings of 30 percent.

Los Angeles represents the largest trade lane accounting for over 450 thousand tons and $21.5 million in transportation costs savings (Exhibit 26). The five trade lanes between Decatur and California (Los Angeles, Oakland, French Camp, San Bernardino, and Fresno) produce market opportunities of over 670 thousand tons worth $33.8 million. West bound trade lanes make up the top five trade lanes by cost savings.

Exhibit 26: TMO for Intermodal Scenario, by Trade Lane



As noted earlier, examining opportunities to expand MIP intermodal service offerings for domestic movements to and from Decatur was an important motivation in understanding the analysis. Results from the intermodal market analysis were discussed in a meeting with officials from ADM and the project team when the results became available. The discussion about potentially expanding intermodal services quickly turned to the topic of improving truck access to the yard. Currently, the Norfolk Southern Railway provides the following directions to truck drivers on its website:

- From IL-48 turn south onto 27th Street.
- Turn east onto E Parkway Drive and follow back to the ADM location XZ1 addressed 3095 E Parkway Drive.

Members of the project team noted that the current access requires trucks to cross an at-grade rail line at North 27th Street and Breneman Road. Because of the crossing's proximity to the yard, this CN crossing can at times experience extended blockages from rail car switching activities. There is also a second at-grade crossing where 27th Street crosses the NS line at East Faries Parkway. Previous discussions of addressing the CN bottleneck have included a grade separation, or constructing a new access road across property owned by T/CCI and ADM that would connect N 27th St. and 22nd St. Because the crossing at 22nd Street is a half-mile further from the rail yard it is less likely to be blocked by trains.

Recommended Steps for Implementing Rail Intermodal Solutions

Based upon the results of the Decatur model runs, the following steps are recommended to pursue cost saving initiatives through intermodal strategies:

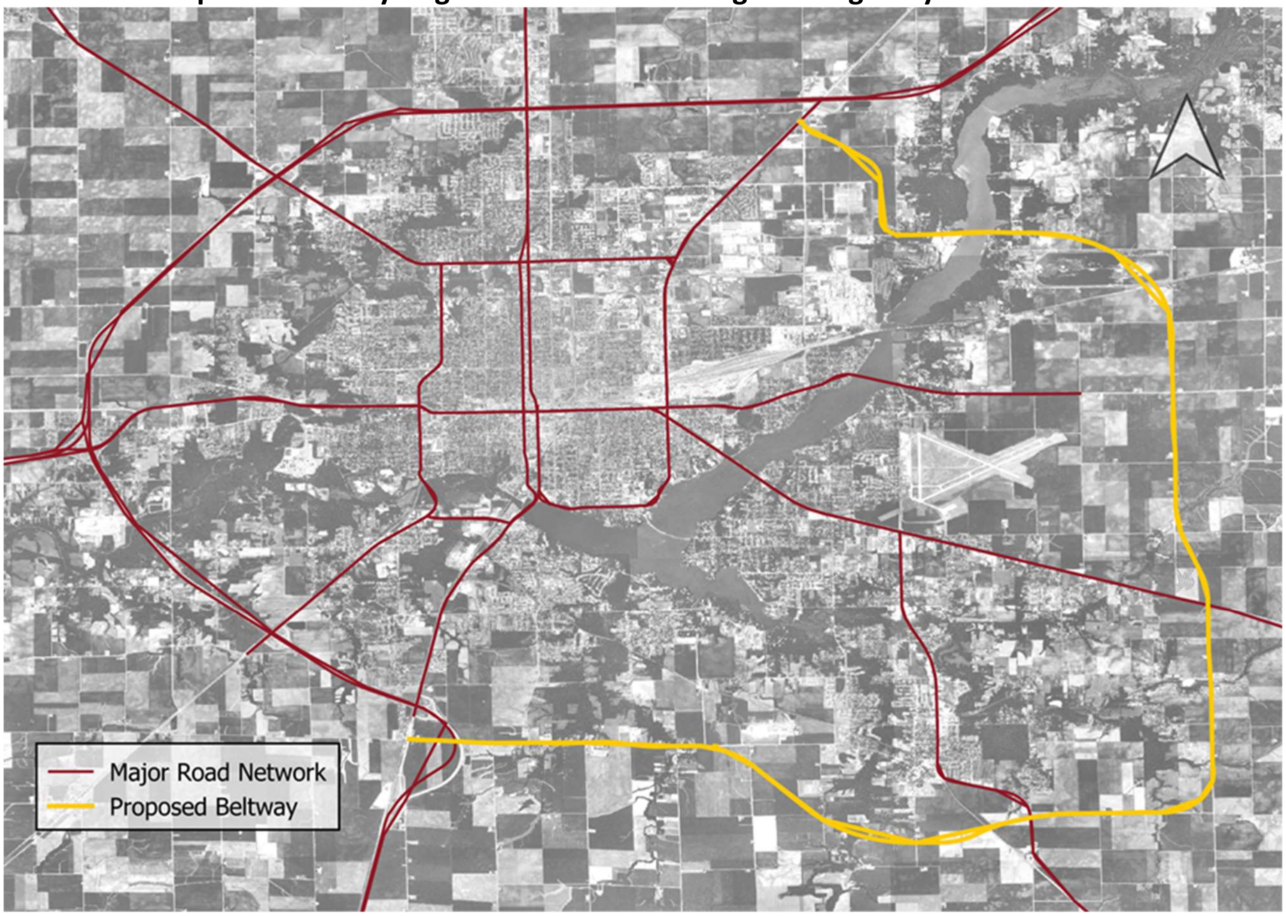
- For additional international volumes through the port, MIP officials should meet with local shippers and ADM to discuss barriers to the increased utilization of the ramp and how to overcome those barriers.
- Discussions with local stakeholders and the Illinois Soybean Association suggest a growing international market for identity preserved agricultural products. MIP officials should work with local farmers and transportation providers to identify operational procedures that would efficiently load identity preserved grains into containers that can then be shipped through the MIP and on to international markets thereby increasing and diversifying the markets for the region's premium agricultural products.
- Due to the 60/40 split of domestic versus international intermodal and the need for separate operations to service domestic and international intermodal freight, there will be a need to identify a location for a domestic intermodal ramp. Bringing local truck carriers into this conversation may also provide opportunities to improve asset utilization.

4. Ancillary Local Road Projects and their Bearing on Decatur Supply Chains

Throughout the course of the supply chain analysis, local business and civic leaders repeatedly raised truck access to the industrial areas of Decatur as a hurdle for the city to gain prominence as a logistics hub. During initial stakeholder interviews the issue of truck access was raised by regional trucking companies and the Illinois Trucking Association as a long-standing issue among the motor carrier community. At the mid-point of the study, the steering committee asked the consultant team if several proposed roadway projects could be included as scenarios to better understand their impact on regional logistics. To complete the road project evaluations, the consultants used the freight database developed for the optimization tool, in conjunction with the updated regional travel demand model. The results of that effort are presented as the final two scenarios.

The goal of the by-pass and regional road network improvement scenarios was to examine the impacts of network improvements on business transportation costs. The primary network enhancement in this group of improvements included the completion of a proposed "ring route" or by-pass on the east side of the city (Exhibit 27), as well as, proposed grade-separations within two heavy freight corridors.

Exhibit 27: Proposed Beltway Alignment on Decatur Regional Highway Network



Source: ArcGIS Rest Services, ESRI Imagery World 2D

4A. Beltway Scenario

To develop the Decatur highway network optimization scenarios, it was determined that local freight flows and truck traffic at a very high-level of detail would be required. The DUATS regional travel demand model contains 573 Travel Analysis Zones (TAZ) for Macon County. To conduct the road network scenario analysis, it was determined that an update to Decatur's regional travel demand model was required, as well as, commodity flow data at a TAZ level. Details regarding the model update are described in a separate document available through the Decatur Urbanized Transportation Study (DUATS).

The Northeast Connector (Beltway) is a part of Decatur Region's Long-Range Transportation Plan (LRTP). Completing an eastern Beltway would eliminate at-grade railroad crossings on the local road network, reduce congestion and travel times for residents, remove trucks from downtown Decatur, and improve transit reliability. The Beltway is a major roadway project that addresses several traffic safety and mobility concerns. As such, a traditional travel demand model (TDM) was deemed to be the more appropriate tool to quantify traffic and safety impacts on the local roadway network. An initial evaluation of Beltway impacts was done using an updated DUATS TDM. However, completing the Beltway will also provide the necessary access to enable successful freight consolidation, transload and expanded intermodal scenarios. These impacts are examined using a BCA approach later in this section.

The DUATS regional travel demand model[7] was used to examine traffic impacts from building the Beltway from IL-48 in the northeast portion of Decatur to US-51 south of Decatur near Elwin. The model output suggests daily vehicle hours traveled (VHT) on Macon County's roads would be reduced by 1,612 hours assuming a 55 mile per hour speed limit and 2,203 hours assuming 65 miles per hour[8] (Exhibit). Applying common BCA dollar figures for passenger and commercial traffic, as well as truck operational costs, the annual benefits to the public from reduced congestion in 2045 would range from $9.8 to $13.1 million.

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[7] *Documentation for an Update to the Decatur Regional Travel Demand Model, DUATS. October 2018.*

[8] *The Travel Demand Model assumed the Brush College Road improvements would be made in addition to the Beltway; however, the changes in VHT and VMT from the Brush College Road improvement projects have been accounted for and removed from these figures.*

Exhibit 28: Monetized Impacts of Beltway Construction at 55 and 65 miles per hour

	2015	2045 Base	2045 Beltway55	2045 Beltway65
Total VHT	70,347	79,913	77,888	77,296
Change in VHT	-	-	(1,612)	(2,203)
Daily Benefit	-	-	$37,764	$50,415
Annual Benefit	-	-	$9,818,615	$13,107,990
Discounted			$1,690,721	$2,257,137
Truck VHT	6,558	7,390	7,168	7,117
Change in VHT	-	-	(179)	(230)
Daily Benefit	-	-	$16,562	$21,210
Annual Benefit	-	-	$4,306,201	$5,514,500
Passenger VHT	63,789	72,524	70,720	70,179
Change in VHT	-	-	(1,433)	(1,973)
Daily Benefit	-	-	$21,202	$29,206
Annual Benefit	-	-	$5,512,414	$7,593,489

While the Beltway has positive benefits for the Macon County road network in terms of reducing congestion and the time residents will spend traveling, the number of vehicle miles traveled (VMT) will increase due to the physical length of the route compared to routes through the city of Decatur. The increase in VMT is a disbenefit ranging from $90,133 to $156,960 in 2045 (Exhibit). It is important to note here, that public benefits, as described below, far outweigh the limited disbenefit of vehicle miles traveled as illustrated in Exhibit 29.

Exhibit 29: Monetized VMT from Beltway Construction at 55 and 65 miles per hour

	2015	2045 Base	2045 Beltway55	2045 Beltway65
Total VMT	2,622,828	2,969,830	2,991,319	3,012,261
Change in VMT	-	-	21,489	42,431
Daily Benefit	-	-	($346.67)	($603.69)
Annual Benefit	-	-	($90,133)	($156,960)
Discounted	-	-	($15,520)	($27,028)
Truck VMT	278,791	310,807	312,888	314,399
Change in VMT	-	-	2,127	3,638
Change in NO_X	-	-	0.0192	0.0329
Change in $PM_{2.5}$	-	-	0.0005	0.0008
Daily Benefit	-	-	($300.15)	($513.43)
Annual Benefit	-	-	($78,038)	($133,493)
Passenger VMT	2,344,037	2,659,023	2,678,431	2,697,862
Change in VMT	-	-	20,665	40,095
Change in NO_X	-	-	0.0062	0.0120
Daily Benefit	-	-	($46.52)	($90.26)
Annual Benefit	-	-	($12,095)	($23,467)

Considering the nature of the freight focused projects discussed earlier (intermodal, rail transload, and truck consolidation terminals) and that of the beltway project, a full BCA for the Northeast Connector was out of scope for the Supply Chain Network Planning and Optimization Study. However, previous analyses prepared for Macon County related to the Northeast Connector project from October 2017 and July 2018 were reviewed.

In particular, the BCA for an Infrastructure for Rebuilding America (INFRA) Grant application for the combined Northeast Connector project produced a *2.72-to-1 Benefit to Cost ratio* with total benefits at a net present value of $247 million and included monetized benefits from improved road safety and emergency response; improved state of good repair from the elimination of at-grade crossing maintenance; an increase in economic competitiveness from travel time savings; improved environmental sustainability from a reduction in carbon and air emission; and an improvement in quality of life from reduced congestion and improved transit reliability. The Better Utilizing Investments to Leverage Development (BUILD) Grant application to replace Rea's Bridge yielded total benefits at a net present value of $74.7 million and a *Benefit Cost Ratio of 4.46 to 1*.

Stakeholder outreach during the Decatur Supply Chain Network Planning and Optimization Study highlighted an issue impeding commercial and industrial development opportunities for the Decatur Airport. The former UPS Facility on site is currently vacant, and Park District officials have been unsuccessful in finding a new tenant in part due to the lack of 'sufficient' highway access connecting the facility to the region's highway network. The construction of the Northeast Connector from IL-48 to US-36 would provide potential commercial and industrial businesses the needed highway access to locate at or near the Decatur Airport.

A BCA framework was developed for the inclusion of freight projects and related benefits into future Beltway related grant applications. The BCA contains benefit calculators for transportation cost savings, reductions in emissions, and reductions in crashes from three freight focused projects: a domestic intermodal ramp, a rail transload facility, and a truck consolidation facility. The BCA is designed to calculate the benefits should the three projects be built at the same time to create a 'Logistics Park', as well as if only a single project is built. As plans for one or more of these projects advance and specific commodity and trade lane commitments from regional shippers are secured, the inputs can be modified to focus on those commodities and trade lanes creating a more conservative and realistic BCA.

The BCA combines a number of outputs of the DROM with commonly used BCA figures to calculate the benefits. Outputs from the DROM used as inputs into the BCA include: 2015 optimized volume estimates; associated average transportation costs on a per ton basis such as the baseline unit costs, optimized unit costs, and any additional optimized costs such as container repositioning fees, transload costs, and consolidation costs; average transportation distances for the baseline and optimized scenarios; and any assumptions used in the optimization modeling such as the average tons per truck, container, and rail car, or minimum requirements used in the decision tree like length of haul and cost savings.

Combined, the three freight projects would conservatively produce over $1 billion worth of benefits over the typical life of a project (20 years). These annual benefits equal discounted benefits of over $491 million and a net present value of $461 million (Exhibit 30). *The results suggest the Northeast Connector could unlock substantial savings and benefits to regional shippers and residents* by providing necessary highway access to the Decatur Airport for commercial and industrial development. More information and full details regarding the freight projects' BCA can be found in the 'Benefit-Cost Analysis Freight Projects Narrative' Technical Memorandum.

Exhibit 30: Freight Projects Benefit Cost Analyses Results Summary

Project	Total Benefits	Total Costs	Net Present Value	B/C Ratio
Domestic Intermodal	$294,148,981	($19,841,034)	$274,307,947	14.83 : 1
Rail Transload	$136,986,755	($8,569,744)	$128,417,011	15.98 : 1
Truck Consolidation	$60,291,801	($1,249,017)	$59,042,784	48.27 : 1
TOTAL	**$491,427,537**	**($29,659,796)**	**$461,767,742**	**16.57 : 1**

Recommended Steps for Implementing Beltway Scenario

Based upon the results from the detailed freight data developed for Decatur and the DUATS TDM results, the following steps are recommended to pursue grant opportunities to help fund the construction of the Northeast Connector:

- Extend the proposed Beltway construction from IL-105 to US-36 to provide the Decatur Airport with sufficient highway access to enable commercial and industrial development.
- As further discussions are had with private sector shippers, update the BCA to align with specific commodity and trade lane commitments to create a more 'shovel-ready' BCA.
- Utilize the results from the freight projects' BCA to supplement and strengthen Beltway grant proposals.

4B. Brush College Road and North 27th Street Grade Separation Projects

DUATS' *Decatur Pathways 2040* is Decatur's latest long-range transportation plan. It focused on the interrelationships between the various modes in creating a transportation system that meets the mobility needs of the region's residents and businesses. The LRTP identified several freight related projects to modify at-grade rail crossings along the Brush College Road and North 27th Street corridors. The projects would improve travel time for rail

Benefits to the shipping community from this project would accrue from a reduction in travel time for shippers and the public, a reduction in miles traveled and associated emissions, and improved safety for shippers and the general public from the removal of the at-grade crossing.

The Brush College Road projects are forecasted to reduce the VHT by 413 hours daily and 107,570 in total for the year 2045 (Exhibit 31). The reduction in travel time is worth almost $1.5 million annually to passengers and over $1 million annually to businesses operating heavy duty trucks.[9]

Exhibit 31: TDM Results for Brush College Road, Change in VHT

Brush College Rd. 2045	Daily		Annual	
	Reduced VHT	*Monetized*	*Reduced VHT*	*Monetized*
Auto	371.4	$5,496	96,559	$1,429,070
Truck	42.3	$3,909	11,011	$1,016,315
TOTAL	413.7	$9,405	107,570	$2,445,386

The elimination of the at-grade crossings would have a much smaller impact on VMT as opposed to VHT as traffic can take a more direct route from origin to destination without having to worry about getting stuck in rail and road related congestion. The TDM estimates the Brush College Road project would reduce VMT by just under 340,000 miles annually, with annual benefits totaling just $2,380 in the year 2045 (Exhibit 32).

Exhibit 32: TDM Results for Brush College Road, Change in VMT

Brush College Rd. 2045	Daily		Annual	
	Reduced VMT	*Monetized*	*Reduced VMT*	*Monetized*
Auto	1,256.8	$2.82	326,781	$734
Truck	44.9	$6.33	11,684	$1,646
TOTAL	1,302	$9.15	338,465	$2,380

The TDM results suggest the proposed North 27th Street project would have a smaller impact on local VHT than the Brush College Road projects, but a larger impact on local VMT. The North 27th Street project would reduce VHT by 32,581 worth almost $1 million annually by 2045. By 2045, VMT falls by over 1.1 million worth $23,726 annually (See Exhibits 33 and 34).

Exhibit 33: TDM Results for North 27th Street, Change in VHT

N. 27th St. 2045	Daily		Annual	
	Reduced VHT	*Monetized*	*Reduced VHT*	*Monetized*
Auto	100.1	$1,482	26,029	$385,223
Truck	25.2	$2,326	6,552	$604,750
TOTAL	125	$3,808	32,581	$989,973

Exhibit 34: TDM Results for North 27th Street, Change in VMT

N. 27th St. 2045	Daily		Annual	
	Reduced VMT	*Monetized*	*Reduced VMT*	*Monetized*
Auto	3,771.7	$8.47	980,639	$2,203
Truck	587.7	$82.78	152,810	$21,523
TOTAL	4,359	$91.25	1,133,449	$23,726

[9] *Based on 260 workdays per year; ATRI*

Recommended Steps for Implementing LRTP Projects

Based upon the results of the DUATS travel demand model update the following steps are recommended to pursue the improvement of the Brush College Road and North 27th Street corridors:

- At this time, we were unable to determine if future capacity on North 27th Street will be constrained due to a lack of infrastructure investments (i.e. grade separation at the intersection near Kile Street). The TDM suggests that even with the additional truck traffic from the Intermodal Scenario's 2045 TMO volumes the level of service within the N 27th St. corridor would remain between 'A' and 'B'. However, the TDM update was based on train crossing and delay data that was dated prior to the opening of the MIP's intermodal ramp and other industrial development within the corridor: 33 train crossings per week and 3.4 hours of delay reported in 2013 and forecasted to grow to 53 train crossings and 7.5 hours of delay in 2035.[10] Traffic signal data related to at-grade crossing produced delay should be collected along with an updated field study conducted of the at-grade crossing back-ups along the corridor.
- Discussions with project partners and private sector business suggested an alternative solution to the grade separation in the North 27th Street corridor. This would involve a new road being built across property owned by T/CCI and connect N 27th St. and 22nd St. This alternative should be reviewed and evaluated as a possible more cost-effective solution.

Summary and Conclusions

This ground-breaking regional freight network optimization effort undertaken by the City of Decatur, in coordination with the Economic Development Corporation of Decatur and Macon County, the Midwest Inland Port, and DUATS, provides planners and economic development professionals in the Decatur Region with a powerful tool for strategic decision-making. The optimization tool and associated databases can be leveraged to provide insights about cost saving opportunities for area businesses, while also reducing heavy commercial vehicle traffic and associated road wear, improve roadway safety, and support economic growth.

The initial applications of the DROM explored three freight network scenarios for reducing business transportation costs in the Region. Two additional scenarios were analyzed using the DUATS travel demand model and the detailed freight data developed for the optimization analysis. The scenario results presented in this report show several solid investment potentials, with each strategy having the potential to save millions in annual freight transportation costs. It is also important to understand that for each freight logistics scenario the shipment data analyzed with DROM was

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[10] *Decatur Area Transportation Efficiency Study, Final Report. December 2013.*

largely exclusive to each solution. In other words, shipments assigned to one scenario, were not available to other scenarios.[11] So, a commodity shipment assigned to the cost savings under freight consolidation, was excluded from potential savings in the other scenarios that were analyzed. The implication is that if multiple solutions, (e.g. freight consolidation, transload and intermodal) were implemented in a single multimodal center in the Decatur Region the resulting TMO is nearly $175 million annually (see Exhibit 35).

Exhibit 35: Results of Combined Freight Logistics Scenario

Scenario	Total Tonnage	Total Savings	Baseline Cost	Optimized Cost	Cost Savings
Cross-dock	604,335	$ 3,541,236	$ 32,738,952	$ 99,197,716	25%
Intermodal	1,524,176	$60,300,147	$ 11,981,139	$ 151,680,992	28%
Transload	1,865,115	$79,730,553	$ 99,801,485	$ 120,070,932	40%
Total	**3,993,626**	**$ 173,571,936**	**$544,521,576**	**$ 370,949,640**	**32%**

Near the end of the Decatur Supply Chain Network Planning and Optimization Study, a series of stakeholder meetings were held with regional businesses to share and discuss results of the scenario analysis. During these meetings several businesses indicated a desire to take the additional steps required to develop detailed business cases that could result in the implementation of the supply chain network solutions identified. Based on the analysis conducted to date, it is recommended additional steps be undertaken to work with Decatur Area businesses toward the development of investment grade business plans.

[11] *Note: When the three freight logistics scenarios were run together, there is some "leakage" in the summary totals resulting in some minor differences in totals as compared to running each scenario individually.*