



# National Consortium for Remote Sensing in Transportation

## Streamlining Environmental and Planning Processes

### **Background Data Conversion to GIS format – ORNL Remote Sensing and GIS-Based Characterization of the Multimodal Freight Transportation Network for Transportation Planning and Environmental Assessment Synthesis Report**

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#### **Task Introduction**

Recent legislations, including the Inter-modal Surface Transportation Efficiency Act (ISTEA) of 1991, the Transportation Equity Act for the 21<sup>st</sup> Century (TEA21), and the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), highlight the needs for incorporating freight transportation in the transportation planning and development processes, in which the National Environmental Policy Act (NEPA) Environmental Impact Statements (EISs) is an important part. Nevertheless, freight transportation is multimodal and intermodal and involves highways, railways, waterways, and intermodal facilities. The large geographic scope, the interdependency, and the interconnectivity of the system pose special challenges on the development of data and tools to meet these needs. Many state Departments of Transportation (DOTs) and Metropolitan Planning Organizations (MPOs) have paid special attention to freight transportation in recent years and have included freight into their long-range transportation planning activities. Limited efforts have been made to incorporate freight with the traditional transportation planning framework, particularly when environmental issues are in consideration.

One of the major objectives of this proposed effort is to leverage remote sensing and geospatial information technologies (RS&GIT) to address the data needs during the early transportation planning process with combined considerations of freight transportation performance and potential environmental issues. The second objective of the project is to apply and implement tools and procedures to evaluate transportation planning options and to identify critical environmental issues associated with these options from a freight transportation perspective. To achieve the first objective, multiplatform images and multi-source databases will be utilized to characterize and attribute the multimodal freight transportation network for the selected project site, i.e., I-69 SIU 9. To facilitate freight analysis, the project will collect and integrate data with different geographic scales. At the local level, the project will focus on data with refined resolution: data such as local land use and land cover patterns, maps of environment-related variables, demographic characteristics, and high resolution images. At the regional and national levels, modal networks, facility databases, freight origin-destination matrices, flow distribution patterns, and business patterns will be collected and integrated. To achieve the second objective, the project will first construct an interconnected analytical network to represent the multimodal freight transportation infrastructure, which will include highways, railways, waterways, terminals, ports, and intermodal facilities. The project will then apply intermodal and multimodal freight flow routing tools to evaluate performance improvements of freight transportation on the multimodal network. Performances to be evaluated will include improved capacity and reduced transportation time or costs at regional and national levels. Critical environmental impacts will be then assessed through the overlay of the multimodal transportation network and maps of environment-related variables at the local and regional level for different planning options.

#### **Traditional Approaches**

The focus of the project is on the development of data and procedures to support the early planning on the multimodal freight transportation network with environment considerations. Obviously some of these data and procedures will come from the NEPA EIS process. Other data and procedures can be also used to feed into the NEPA EIS process. Traditionally, transportation planning and environmental assessment are separate processes. The problem with this separation is twofold. First, analysis results and decisions, including data and tools, generated during the transportation planning process are hardly utilized in the process of environment assessment under NEPA. Second, tremendous resources such as detailed environment data created for the project site during the environment assessment process are not directly fed into transportation planning activities until specific projects are selected, which in many cases will result in the revision and reassessment of transportation plans. With SAFETEA-LU, transportation plans are required to include “a discussion of the types of potential environmental mitigation activities and potential areas to carry out these activities ....” Developing

USDOT/RITA Streamlining EIS

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linkages between transportation planning and project development/NEPA processes is non-binding and vulnerable for SAFETEA-LU. Nevertheless, various efforts have been made to develop seamless transportation decision procedures to streamline transportation project development process. "Indiana's Streamlined Environmental Procedures"<sup>1</sup> is a good example. Under these new procedures, an Environmental Assessment (EA) is conducted in transportation planning; and various public agencies are involved in the planning stage "to develop purpose and need and in the screening of preliminary alternatives and mitigation strategies." FHWA also has a Planning and Environment Linkages (PEL) initiative<sup>2</sup>, which is intended to serve as "an approach to transportation decision-making that considers environmental, community, and economic goals early in the planning stage". FHWA has particularly looked into the possibility of the use of GIS to facilitate the PEL approach.

Incorporating freight into the transportation planning and project development process is another area that the proposed effort aims to contribute to. Freight transportation is different from passenger transportation. It is multimodal and intermodal. In particular, it involves interconnectivity of transportation infrastructure in large geographic areas and across jurisdictional boundaries. Although many of the project decisions are made at local or state levels, performance improvements of these projects for freight transportation may need to be evaluated at the regional and national levels. A recent study as documented in the NCHRP Report 594<sup>3</sup> found that many state DOTs and MPOs have included freight into their long-range planning activities; and many have also conducted freight-specific studies. Nevertheless, few freight-related studies are directly undertaken within the traditional transportation planning framework. As identified by the NCHRP report, lack of data and tools is among some of the key issues that "hinder the ability of states and MPOs to fully incorporate freight into the process."

Recent projects<sup>4,5</sup> at ONRL conducted for USDOT and Florida DOT have put specific emphasis on the development and integration of data and tools to facilitate freight analysis at the state level. These data and tools are potentially applicable for supporting transportation planning from a freight perspective. The project with USDOT developed methods to estimate commodity production, consumption, and origin-destination matrices at the disaggregated level, using Census county business pattern data and national Freight Analysis Framework data. The project with Florida DOT developed and implemented procedures to: (1) integrate data for multimodal networks, terminals, airports, water, ports, and intermodal facilities to construct an interconnected analytical multimodal network for Florida; and (2) route and assign freight flows to the Florida Multimodal Network. These existing efforts made progress in terms of integrating data from different sources and providing analytical tools to support freight analysis, but these studies are not directly undertaken in the context of transportation planning.

The availability of high-resolution images and detailed environment-related data, plus data and tools that have been developed and cumulated previously will make it possible for the current project to incorporate freight into the transportation planning process and to consider environmental issues at the same time.

## **Streamlining Approaches**

To develop linkages between the transportation planning and project development/NEPA processes and to incorporate freight into transportation planning activities, the project will first leverage images from different platforms and geospatial data from different sources to develop a database that will include data layers, such as, but not limited to, multimodal transportation networks, land use and land cover maps, freight origin and destination patterns, environment-related data, economic and demographic characteristics, to develop a database for the multimodal transportation network. Subsequently, the project will apply, implement, and validate a set of tools and procedures to construct an interconnected multimodal freight transportation network, evaluate freight performance improvements of transportation planning options, and assess corresponding critical environmental issues as associated with specific planning options. The ultimate goal of the project is to make effective use of

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<sup>1</sup> FHWA, Indiana's Seamless Transportation Decision-Making Process, Successes in Stewardship Newsletter, September 2001.

<sup>2</sup> FHWA, Streamlining Planning and Environment Linkages (PEL) through statewide GIS Applications, Successes in Stewardship Newsletter, December 2007.

<sup>3</sup> Cambridge Systematics, Inc., Prime Focus, LLC, and Kevin Heanue, NCHRP Report 594 – Guidebook for Integrating Freight into Transportation Planning and Project Selection Processes, TRB, Washington, 2007.

<sup>4</sup> Xiong, D., Estimating County-Level Commodity Production, Consumption, and Origin-Destination Patterns Using Freight Analysis Framework Data, Report prepared for the Office of Freight Management and Operations, USDOT, July 2007.

<sup>5</sup> Xiong, D., et. al., Integrating Data and Models for Analysis of Freight Movements on Multimodal Transportation Systems for Florida, Report prepared for the Research and Development Office, Florida DOT, July 2007.

data and tools to improve efficiency, reduce redundant efforts, and streamline the transportation planning and project development/NEPA processes. To achieve the overall objectives of the project, ORNL will perform three major tasks: (1) assessment of remote sensing data and other existing data sources for the project area; (2) database development for the project site; (3) construction of the multimodal network and assessment of transportation planning options.

The first task of the project is to coordinate with UMS to evaluate the availability and applicability of exiting images and geospatial data. In this task, the project will first look into data that are already in a usable form, data such as freight modal networks, terminal and intermodal databases, Census population, freight and passenger travel patterns, and business profiles. The project will also evaluate those data that can be potentially utilized, but may require extensive data processing and conversion, data such as aerial photographs or satellite images. For the first type of data, the evaluation will put emphasis on their accuracy, availability, and procedures needed to prepare the data for the project use. For the second type of data, the project will try to work with MSU to find ways to make direct use of the data that are already extracted from the images by project partners, e.g., land use and land cover maps or environment-related data layers. The project also plans to directly extract information from images to meet the project needs, particularly information on the detailed configuration of the transportation infrastructure in the project site.

The second task of the project is to develop a multimodal transportation network database for the selected project site, I-69 SIU 9, to support the assessment of transportation planning options and their corresponding environmental impacts. The database will include images and spatial data layers that are assessed in the first project tasks and can be collected from various data sources, including those that are made available by project partners. The purpose of the database is to provide a comprehensive characterization of the multimodal freight transportation infrastructure in areas of: (1) physical characteristics, e.g., capacity, speed, travel cost; (2) flow patterns, e.g., origin-destination patterns, mode preferences, and flow distributions; (3) network connectivity, e.g., intramodal and intermodal connections; (4) socio-economic and environmental backgrounds, e.g., population distributions, business patterns, and environmental characteristics.

The third project task is to construct an analytical multimodal network and to assess transportation planning options and corresponding environmental impacts for the project site. The main purpose of the development of the analytical multimodal network is to provide an analytical representation of the multimodal infrastructure to facilitate the subsequent analysis on the network. This analytical network will lay out detailed configurations of the multimodal infrastructure, which will include highways, railways, waterways, terminals, ports, and intermodal facilities, for the project site and will also provide extended pictures of the multimodal network at the national level. Based upon this multimodal network, ORNL will work with the Mississippi State University, Mississippi Department of Transportation (DOT), and Tennessee DOT to first identify transportation options and then evaluate improvements of freight transportation options and corresponding critical environmental impacts associated with those options. For the evaluation of improvements of freight transportation, the project will focus on the use of existing tools to evaluate the improvements of transportation time and cost for the freight movements at different geographic scales, e.g., local, regional, and national scales. The environmental assessment will focus on the use of existing environment-related data from project partners to highlight critical environmental issues associated with different planning options.

## **Expected Deliverables**

The project will generate three major results as deliverables: (1) a concept paper to extend the description of the project as provided by this synthesis report (June, 2008); (2) a database for the multimodal network for the selected project site, which include a set of layers for the multimodal freight transportation infrastructure and its physical, socio-economic, and environmental backgrounds and the analytical multimodal network (March, 2009); and (3) a technical report to describe the implementation of the project and to report the results of the assessment of the improvements of freight transportation and the evaluation of critical environmental issues associated with identified transportation planning options for the project site (September, 2009).