Technology, Transportation, and Environmental Conflict Resolution

Jeremiah Dumas
Assistant Research Professor of Landscape Architecture
GeoResources Institute
Mississippi State University

National Consortium for Remote Sensing in Transportation
Streamlining Environmental and Planning Processes
Using 3D Interactive Visualization Tools for Public Participation

Dr. Laxmi Ramasubramanian  
Associate Professor  
Email: laxmi@hunter.cuny.edu

Jennifer Weeks  
Senior Planner  
Email: weeks@pbworld.com
Research Purpose

Examine the **use** and **value** of **widely available Interactive 3-D Visualization Tools** to support public involvement in transportation planning processes.
Profile of Respondents (n=393, as of 1/10/08)
Familiarity with 3 D Techniques

In 2007

- Hand-drawn Renderings
- 2-D and 3-D Graphics
- Photo-simulation
- 3-D Computer Animation
- VR Simulation
- Other
- None

I have used  Used in my organization

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3D Interactive Visualization Tools

In 2007

- Google Earth
- MS Virtual Earth
- ESRI ArcGIS Explorer
- ESRI ArcScene/ArcGlobe
- NASA World Wind
- SkylineGlobe
- Leica Geosystems Titan
- Other
- NONE

Legend:
- Blue: I have used
- Red: Used in my organization
Are 3D Tools Useful?

**IN 2007**
- Very useful: 32%
- Somewhat useful: 28%
- Neutral: 31%
- Not very useful: 6%
- Not useful at all: 3%

**ANTICIPATED FOR 2012**
- Essential: 47%
- Nice, preferable enhancement: 34%
- Unknown: 18%
- Diminishing, transitory trend: 1%
- Not very useful: 6%
- Not useful at all: 3%
Outline

• Project Background
• Community Conflict
• Environmental Conflict
Background Information

- USDOT/RITA funded research
- Streamlining of the EIS process with the use of spatial technologies and remote sensing technologies
- I-69/I-269
- NAFTA Superhighway
- Mississippi State University, Oak Ridge National Labs, Michigan Tech. Research Institute, and advisory panel
NCRST-SEPP
- remote sensing/spatial technologies
- traffic flow analysis
- wetland delineation
- environmental justice
- ecological connections
- mitigation streamlining
- context sensitive solutions
- regional economic analysis
- air, stream, cultural, and community impacts
- SAFETEA-LU Section 6001, 6002, 6004 compliance
Project Testbed

NCRST-SEPP I-69/269 SIU 9 Project Testbed
alternatives A-1,2 and B-1,2,3 shown
Alternatives

• 5 were ultimately studied and evaluated in the Final EIS.
  – A-1 (I-69) – 15.3 miles, 21 families and two businesses displaced, crosses 21 streams, fills 48 acres of wetlands, and converts 128 acres of farmland to ROW
  – A-3 (1-69) – 15.3 miles, 60 families and 5 businesses displaced, crosses 20 streams, fills 53 acres of wetlands, and converts 95 acres of farmland to ROW
  – B-1 (I-269) – 28.6 miles, 57 families and 6 businesses displaced, crosses 39 streams, fills 69 acres of wetlands, and converts 435 acres of farmland to ROW
  – B-2 (I-269) – 30.6 miles, 100+ displaced families, crosses 46 streams, fills 51 acres of wetlands, and converts 497 acres of farmlands to ROW
  – B-3 (I-269) – 26.6 miles, 52+ displaced families, crosses 37 streams, fills 6 acres of wetlands, and converts 253 acres of farmlands to ROW
• A-1 and B-1 are the preferred alternatives
Traditional Planning/EIS

- Planning
  - Improved traffic flow
  - Reduced travel time
  - Safety
  - Economic development
  - Environment concerns

- EIS
  - 56 house, 3 businesses, unavoidable fill of wetlands, etc. etc. etc.
  - Largely focused on the ROW
National Environmental Policy Act (NEPA)

- Categorical exclusion
- Environmental assessment
  - Proposal need
  - Environmental impacts
  - Consulted agency and persons list
- Environmental Impact Statement
  - Discussion of purpose and need
  - Alternatives
  - Affected environment
  - Environmental consequences
  - List of preparers, agencies, organizations, and persons to who the statement is sent
  - Index
  - Appendix (if any)
- Integrated Planning
  - Intermodalism
  - Disaster management
  - Growth management
  - Comprehensive planning
  - Regional planning
Streamlined Environmental Impact Statement

Proposed Action

Background and Purpose/Needs
- Planning

Alternatives Considered
- Communication with
  - Resource Agencies
  - Citizens
  - Gathering of data

Background Data Conversion to GIS

Impact Analysis
- Land Use
- Economic impacts
- Environmental Justice

Wetland Impacts
- Protected Species
- Habitat
- Cultural Impacts

Hazardous Materials

Distribution of Data
- Communication

Preferred Alternative Selection and Data Warehousing

Permitting

Signed Environmental Impact Statement

Construction and Design Phase

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Enhanced Planning – Background

- Existing use/plans
  - corridor
    - Wildlife
    - Greenway (existing and potential)
    - Historic and cultural corridors
    - Social corridors at urban nodes
    - Bike/Pedestrian corridors
    - Other transportation corridors
      - These all influence the economic, social, and environmental success of a corridor’s development
  - Context [more than just ROW]
    - all the above
    - Existing plans – land use, neighborhood plans, etc., etc. etc.
Context Sensitive Solutions (CSS) process and design

- Engage stakeholders and partners
- Purpose and need/problem definition and project visioning
- Alternative development, evaluation and selection
- Final design
- Review and approvals process
- Construction
- Maintenance and operations
- Evaluation: CSS performance measures

“Context sensitive solutions (CSS) is a collaborative, interdisciplinary approach that involves all stakeholders to develop a transportation facility that fits its physical setting and preserves scenic, aesthetic, historic and environmental resources, while maintaining safety and mobility. CSS is an approach that considers the total context within which a transportation improvement project will exist.”

Federal Highway Administration

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Community Conflict
CSS = Smart Growth

- From the 9 general principles, 8 specific principles directly related to the project area were developed
  - These principles help develop a selection matrix
    - Tool that selects model towns along the project corridor to examine the applicability of smart growth techniques to rural communities

1. Provide a variety of transportation choices
2. Direct development towards existing communities
3. Mix land uses
4. Take advantage of compact building design
5. Preserve open space, farmland, and critical environmental areas
6. Create a range of housing opportunities
7. Create walkable neighborhood
8. Create distinctive, attractive communities with a strong sense of place.

- Through evaluation and testing, we found that principles I-III, IV, VIII were the most relevant for transportation corridor planning.
Environmental Conflict
Environmental Conflict
Least Cost-Path Methods

• Generation of cost-of-passage surface grid where cells are given weights using multi-criteria decision analysis to calculate the least cost paths

• Creation of accumulated-cost-surface grid from a cost-of-passage where friction values are stored

• Weights represent the resistance, friction or difficulty in crossing the cell which is expressed as cost

• Generation of path of least cost from the accumulated-cost-surface
Route Generation

$R = f(C_1, C_2, C_3, C_4)$

Optimized Route generation

CONSTRAINTS
- Physical
- Environmental
- Economic
- Political

OPPORTUNITY

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Cost-Path Optimization

Costs
Efficiency
Compromise

Low
High

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Least Cost Use

- Alternative selection
- Wildlife corridor mapping – Critter Crossings, etc.
- Etc.
New Data and Enhanced Analysis: Wetland Mapping Analysis Based on Surrogate Representations From Remote Sensing Data Processing

- The assessment of vegetation, soils, and hydrology forms the basis of standard wetlands field assessment work.
- Determining how those assessments are made facilitates the development of surrogate processes using RS and geospatial technologies within algorithms developed to produce similar analytical map-based results.
Combining high-resolution image data with LIDAR digital surface models provided means of creating excellent views of areas of interest on the landscape!
True color with lidar overlay (left)
Classified image (right).
Red = Obligate wetland
In conclusion!
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<td>Total Cost ($ million)</td>
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<td>818.1</td>
<td>708.5</td>
<td>801.6</td>
<td>855.2</td>
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Impacts are based on a 300-foot wide corridor.
Cost data has been updated since the Draft EIS to reflect the most recent cost estimates.
* Because of the recent residential development along this alignment, B-3 has the potential to displace several hundred new homes in the Forest Hill Community subdivision.
† Does not include future noise impacted residences in the Forest Hill Community subdivision that is currently under construction.
Summary

• How are environment conflicts avoided?
• Integrated planning
• Effective alternatives for public and resource agency involvement and engagement
• Design a process that moves from “56 house, 3 businesses, 45 acres of unavoidable acres of wetlands..... to more qualitative as well as quantitative context sensitive solutions.