Transportation and Visualization

SEEING IS BELIEVING … OR IS IT?
Today transportation projects are under much more scrutiny than ever before. Not only for their technical merits but also based on how well they fit into the social and natural environment.

Responsible for things that are not project planning related such as asset management or educational presentations.

Use of visualization is not new but it is evolving as an ever-present and fundamental part of everyday technology.

New challenges for transportation professionals to develop standards and methods for visualization in today's world.
What is Visualization?

- The term is used in many ways
  - Image in the human mind
  - Process of interpreting in visual terms or form
  - Process of transforming data into graphics or illustrations that convey information to aid in understanding (static, animated, interactive, colorful, monochrome)
- Is now a type of umbrella term.
- It can represent a conceptual framework (organizational chart), a dataset or datasets (census data, charts, graphs, tables, histograms)
- Important to remember that the visualization process and its products cannot be only about something people will look but it must also be about how it works
- Visualization techniques are defined by FHWA and FTA as “methods employed by states and MPOs in the development of transportation plans and programs with the public, elected officials, and other stakeholders in a clear and easily-accessible format”
Why are Visualization Products Important?

- A picture is worth a thousand words - but only when the story is best told graphically rather than verbally and the product is well designed.
- Aids with more informed decision making by understanding trends, patterns, and relationships.
- Provides the capability to draw insights.
- Provides the ability to convey to an individual much more complex information than what our visual or verbal memory can generally hold.
- The best types of visualization are really about story telling.
Ghosts of Visualization Past

- Main users were graphic artists and 3D specialists
- Sole domain of the military, defense, and intelligence communities
- 2D concepts such as plan views - photo realistic renderings of end products of those plans
- Mainly consisted or thought of 3D and simplistic models of how they may operate or function
- Consisted of low resolution graphics, created from large mainframe computer systems, very limited scene content, limited real time high resolution graphics
- Very costly
- Utilized sparingly and only on larger scale projects
- Not used throughout the process as a decision making tool
Ghosts of Visualization Present

- Evolved into more mainstream uses such as in news broadcasts, modeling, ability to portray more spatial aspects and visualization of current events, etc.
- Transportation is a field and industry built for visualization
- Now utilized by more and more transportation professionals - especially to help with context sensitive design solutions, environmental concerns, system design, public involvement, and asset management
- More PC driven and uses more real time high resolution graphics, crowd sourcing, ability to provide in real time, drive/fly/walk through visuals from multiple viewpoints when warranted
Ghosts of Visualization Yet to Come

- As the costs of visualization software/hardware continue to drop it becomes more accessible.
- Rapidly evolving technology and as more staff who have grown up using technology increases this will allow for more use in all parts of DOT directives.
- Ability to use in the engineering realm to aid in the communication of operational design concepts.
- Increased communication between designers, planners, DOT staff from all types of disciplines, coordinating agencies, stakeholders, elected officials, and the public.
- Now addressing a generational issue - computer graphics, apps, maps, real time, gaming, social media, etc., are an everyday part of their lives. Now an expected part of our job.
Transportation planning is a decision driven endeavor
- Mandates from above
- Context sensitive design
- Data is growing at exponential rates - need to make use of the data
- Important to visualize early and to visualize often
- Communicate reasons for change
- We have to in order to keep up with the changing technology age
Facts about the Process

- Successful visualizations require an understanding of the human perceptual system
- We do not see visuals with our eyes really, we see them with our brains
- People will only remember one picture from a presentation
- If picture is worth a thousand words - make it count!
- Sad fact: 1 in 3 decision-makers are frequently making decisions based on information/data they do not have, cannot visualize, or cannot trust
- 90 percent of all information transmitted to our brains is visual, but people remember 80% of what they see and only 20% of what they read
**The Power of Visualization**

**Data Visualization**
- Decision making using Performance Measures
- Collaborative Visual Analytics
- High Dimensional Data Visualization
- Categorical data visualization and clustering/ranking
- Issues relating to resolution and massive data set visualization
- Quantifying "good" visualizations
- Automating and simplifying the visualization process
- Interactive Trees, Node-network graphs, 3D, and Comparisons of Datasets

**Planning**
- Environmental
- Public Involvement
- Context Sensitive Solutions
- Early, continued and substantive involvement
- Focus on comprehensive planning
- An integrated process, with public participation
- Performance reporting

**Construction**
- Design Criteria
- IP and ownership issues
- Best practices
- Quantification of benefits

**Operations**
- Usability & Ergonomics in operations centers
- User interface design best practices
- Situational Awareness
- Decision Making in complex environments
- Asset management/tracking
- Communications (both internally and to the traveling public)
- Value of better visualizations in operations centers

**BENEFITS**
Advantages of Visualization

- Improve ability to inform funding decisions in planning, outreach, design, construction
- Develop and deliver timely, cost-effective, and safe transportation systems in sync with society’s needs
- Assess complex planning scenarios and proposed alternatives
- Identify and evaluate alternatives faster
- Facilitate early public involvement and feedback
- Effectiveness with early public acceptance
- Improved quality and safety
- Reduction - manual tasks, costs, and time
- Informed and intelligent (smart) decision making
Potential Obstacles for Implementation and Processes

- Experienced/dedicated staff
- Perception that visualization is too expensive
- Thought of as a standalone technology rather than an integrated way of thinking, communicating, and transportation planning
- Projecting expected returns on investment vs. not using visualization at all
- Developing standards for the content, accuracy, and quality of in-house and contracted visualization
- Keeping up with rapidly evolving technology (software, hardware, data maintenance)
- Need to understand who within the DOT possesses visualization and data management skills and who builds visualizations
- Just because it is becoming readily available, does not mean that every person can utilize the technology
- People creating all types of visualizations are only human and humans make mistakes
- The design process, even with the increased use of visualization, remains highly compartmentalized
- Visualization continues to be used in most instances to present final designs to the public for its approval rather early on
Different Types of Visualization

- **Modeling** - 3D design models, virtual design and construction
- **Animation** - Traffic modeling, walk/fly/drive-throughs,
- **Simulation** - 2D, 3D, and 4D...
- **Data mining**
- **Performance Measures**
- **Virtual Reality/Augmented Reality**
- **Charts**
- **Automated Machine Guidance**
- **3D Printing**
- **Maps**
- **Graphics**

Multi-Dimensional Data

- *Introduction to what 4D, 5D, 6D & 7D can mean*
- 2D - 2D plans
- 3D - 3D models
- 4D - Time / scheduling / Programme
- 5D - Cost
- 6D - Sustainability (Energy use, Carbon etc)
- 7D - Use / Facilities Manager (FM)
- 8D - This is getting silly! – it’s all decision-making
- What are your Decision points?
- What information do you need to make decisions?
Visualization Toolbox – Choosing the Appropriate Tool or Tools

- What software/tools do you have available
- Choice depends on chosen strategy, expertise, time, and money dependent
- Project dependent - resolution of data available, how much detail to add, how and will the data be consumed, will the project need the 3D design techniques and at what levels,
- Often there is not a one size fits all solution - need to use multiple tools from your available tools in your toolbox

- Skillsets Available
  - Hardware
  - Software
    - Microsoft Office Products
    - Adobe Creative Suite (Illustrator, Photoshop, InDesign)
    - Graphic Design Software
    - Bentley Products, AutoDesk products
    - GIS (Esri products, QGIS)
    - SketchUp (Google - now Trimble owned), Blender
Remember...

- Understand your audience
- Understand your data
- Understand your technology/tools
- Know the intent
- Understand what your data can and cannot be made to communicate
- Understand where/if uncertainty in your data may exist
- Understand visualization/presentation basics
Uses Around the Department

- Transportation Planning - all stages
- Environmental Planning/Documents
- Public Involvement
  - Two-way communication between citizen and government
  - Can be used at all stages
- Traffic Simulation
- Modeling
- Visibility
- Terrain Analysis
- Visualizing a Story - Storyboards
- Idrive Arkansas website
- Asset Management
- Laser Scanning
- ...
The intent of this analysis was to determine how much of the surrounding area could be viewed as a driver was traveling along Highway 123 over Haw Creek.
Data visualization may focus on point of view or line of sight perspectives, in order to provide an idea of how a user will perceive a project.
Visualization products are made for Public Involvement meetings to illustrate future development of highway projects
Public Involvement

Videos for educating the public regarding transportation projects in their area
Traffic Visuals and Simulations

Visualization products can be used as instructional and informative aids.
Photorealization techniques allow us to show how a project will look like after completion.

2008 Visualization model was loaded into Google Earth

2017 A view from Google Earth
Data visualization includes visibility analyses.
Elevation datasets, such as the Surveys Division digital terrain model, can be used to generate other types of terrain models that help conceptualize the effect topography can have on an area.
Story maps allow us to customize a visual showcase of a specific project that can be shared within the Department, with other agencies, and with the world.....

The Old River Bridge

- Old River Bridge was scanned around 2007 - 2008
- Closed to vehicles in 1974
- Abandoned and unsafe to physically measure – laser scanning was a better option to create measured drawings
- Pin-connected steel Pratt through truss so it is important to get the detail of these connections for the drawings
- Some of you may also recognize it from the 1996 movie, "Slingblade"
Webmaps and Webapps
Laser Scanning
Maps/Graphics

Crash Locations
Highway 118, Section 4, LM 3.48
West Memphis, Crittenden County
Successful Data Visualization Strategies

- Understand the project delivery process
- Staffing
- Management
- Define the scope of work
- What type of visualization product
- Selecting a medium (poster, presentation board, PowerPoint slide, document, book, video, web-based, interactive, etc)
- Have a knowledge of basic design principles such as fonts, color, schemes, contrast, and any federal requirements/standards for communication products (simple, clear, and consistent)
- Determining the best visualization methods can be challenging - funding, time, desired output, audience, expertise
- Production schedule
- Rendering and Post Production Processes
- Products can consist of simple graphs, maps, charts - storyboards - to advanced analytics
THE VISUALIZATION AND TRANSPORTATION PRESENTATION WAS AWESOME
THOSE PRESENTERS NEED A RAISE!