Feasibility of Visualization and Simulation Applications to Improve Work Zone Safety and Mobility

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Background

- Extensive public involvement
- Current highway Work Zone visualization
  - 2D drawings showing different staging

Image courtesy of HDR, Inc.
Survey

• 40 item online survey
  – Demographics
  – Job duties and computer usage
  – Opinions regarding benefits and drawbacks of current and future technologies
Survey opinion items

- Satisfaction with current technologies
- Benefits of three-dimensional simulation in transportation projects
- Organizational adoption
- Educational programs usage

- Likert scale from 1 to 7
Survey simulation examples

Drive Through

Drive Through (poor weather)
Survey results

• 93% use computer everyday, 85% use the Internet as part of their job duties
• 50% using CAD as part of the job (54% MicroStation, 46% AutoCAD)
• 80% use standard 2D drawings routinely in their jobs
• None of them using 3D drawings
Survey results (cont.)

- 27% regularly use scheduling software
  - 87% Microsoft Excel,
  - 40% Microsoft Project,
  - 14% SureTrak,
  - 7% Primavera P3
- some respondents use more than one program, so totals exceed 100
Survey results (cont.)

• 13 of 19 opinion item responses did not suggest agreement or disagreement (mean score neutral)

• Agree
  – Satisfied with technologies (5.0) dynamic message boards (5.5)
  – Inform work zone locations in advance to improve safety (5.1)
  – Use simulations for educational programs (5.8)

• Disagree
  – Use simulations for drainage design (3.7)
  – Use simulations for utility design (3.7)
Differences in Perception of Value-Added

- Government agency
- Experiences
- Drawing familiarity
- Technology familiarity
- Software familiarity
t–test results (government)

- Non-government agencies have less satisfaction than government agencies with current technologies.
- Non-government agencies tend to hold different opinions regarding the perceived benefit of work zone simulations.
t-test results (experience)

• People with less experience tend to believe the usage of 3D and 4D visualization improves work zone safety
• People with less experience consider the use of simulations more valuable to communicate with the public
• People with more experience believe that the simulation can be used to prevent possible construction conflicts
t–test results (2D drawing users)

• Persons who use 2D drawings have higher satisfaction in current technologies but less satisfaction with the dynamic message boards

• Persons who do not use 2D drawings
  – Advanced notice of a work zone location will improve traffic safety and mobility
  – Perceive benefit in using simulations for internal traffic control and delivery access points
  – Prevent construction conflicts
  – Improve drainage design during the design phase.
t–test results (CAD users)

• People familiar with CAD tend to believe that 3D drawings can improve work zone safety
t–test results (GIS users)

• People familiar with GIS have more satisfaction with current technologies

• People familiar with GIS believe that the simulation will be useful for driver education programs
t-test results (scheduling software uses)

• Persons familiar with scheduling software have higher satisfaction with current safety technologies but less satisfaction with dynamic message boards

• People who are not familiar with scheduling software have higher acceptance of the usage of simulations during the design phase on drainage and utility designs, including those that can prevent construction conflicts
Summary

• Adoption of work zone simulation may be slowed by generational and knowledge differences

• Feasibility of use is constrained more by sociological factors than by technological factors.

• Resource commitment may be an issue for small projects. (Promotes use of open exchange format)
Work Zone Visualization

*Project-Specific Models*

- The following models were made according to proposed and existing construction objects (based on 2D drawings):
  - Existing 24th Street Bridge–Four-lane undivided roadway
  - Proposed 24th Street Bridge–Six-lane undivided roadway with two-lane left turn
  - Existing 24th Street
  - Proposed widening of 24th Street
  - Interstate 80–Five-lane divided highway
  - Existing ramps
  - Proposed ramps
  - Surrounding buildings
Work Zone Visualization

3D library models

– created separately from the project-based models.
– 3D models which are reusable in any project.
– traffic signs and temporary control devices.
– Examples are tabular marker, electronic sign (chevron sign), barricade, and flagger.
Work Zone Visualization

Linking models to schedule data.

• Specify certain models to appear between the start and end dates
  – New construction to be built, start date is set according to the contractor’s schedule and end date is set from the estimated duration.
  – Existing structures to be demolished, start date is set as the project start date and end date is set according to the scheduled duration for demolition.
  – Temporary construction objects, start date is set according to the scheduled installation date and end date is set according to the scheduled date of removal of the temporary objects.
  – Surrounding environment objects, start date is set as the project start and end date is set as the project finish.
Work Zone Visualization
Traffic Work Zone Visualization

• To prepare the 4D traffic work zone visualization (3D models+schedule) from 2D PDF files in Google SketchUp and Google Earth required 32 hours

• Model 3D bridges, ramps, and roads (5 hours)
• Model 3D traffic signs and devices (10 hours - reusable)
• Setup traffic for 8 stages: lane striping, signs, and devices (15 hours)
• Computer program for Google Earth (2 hours)
Work Zone Visualization

View the visualization for 24th Street Bridge Project at:

http://itshee.com/traffic/phase1/

1) Must have Google Earth Plug In and Internet browser

2) After installing Plug In, click on link above

3) Click on “Load 3D Models” bar at top

4) May take 1-2 minutes to load

5) Navigate spatially with perspective bars on right

6) Navigate duration with the calendar bar on upper left
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Questions and Comments
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