IHSDM 2017 and the New IHSDM Economic Analyses Tool

EDC / DDSA Webinar
November 1, 2017
Agenda

- EDC / DDSA Overview
- IHSDM Overview
- IHSDM 2017: New Economic Analyses Tool
- Case Study / Demonstration
- IHSDM Future Plans
- Why use IHSDM to implement HSM Part C?
- IHSDM Training Opportunities
- Q & A
Data-Driven Safety Analysis

Using evidence-based tools to evaluate the current and future safety performance of roadways, allowing agencies to target investments with more confidence and reduce severe crashes on their system.
Data-Driven Safety Analysis

• These tools help agencies quantify the safety impacts of transportation decisions, similar to the way agencies quantify:
  – traffic growth
  – environmental impacts
  – traffic operations
  – pavement life
  – construction costs
DDSA can be applied throughout the Project Development Process


1. Planning
2. Alternatives Analysis
3. Design
4. Construction, Operations & Maintenance

Source: FHWA
DDSA tools can predict the number and severity of crashes for each project alternative, allowing safety performance to be considered along with other project criteria.
Integrating Safety into NEPA Analysis

Safety Planning Process (Pre-NEPA)

Scoping
- Solicit input from safety stakeholders

Purpose-and-Need
- Include safety; link to safety planning processes

Alternatives Analysis
- Evaluate safety performance

Affected Environment
- Define the context

Environmental Consequences
- Evaluate safety impacts

Mitigation
- Propose mitigation to address safety impacts

Policy/Stakeholder Involvement
- Include safety stakeholders
- Provide safety analysis to the public

Source: FHWA

http://safety.fhwa.dot.gov/tsp/fhwasa1136/fhwasa1136.pdf
DDSA in the Design Process

- DDSA can be used to determine *optimal* design criteria, considering both safety and cost.
- DDSA helps justify flexibility in design
  - design exceptions
  - performance-based practical design
Performance-Based Practical Design

- An approach to decision-making that encourages *engineered solutions* rather than reliance on maximum values or limits found in design specifications

- **Characteristics**
  - grounded in performance management
  - exercises engineering judgment to address purpose and need
  - uses appropriate performance-analysis tools
  - considers both short- and long-term project and system goals
Version 13.0.0 (Sept 2017)
IHSDM Development Team

FHWA Geometric Design Lab (GDL) Manager
  • Abdul Zineddin

GDL Staff (Genex Systems)
  • Mike Dimaiuta
  • Mohamad Banihashemi

IHSDM Software Developer
  • Peter Holm (Peraton)

FHWA Resource Center
  • Norah Ocel
  FHWA Office of Safety
  • Jerry Roche
What is IHSDM?

• A powerful tool for implementing HSM Part C Predictive Methods…and more!

• A suite of software tools that support project-level geometric design decisions by providing quantitative information on the expected safety performance
What Benefits does IHSDM Provide?

- Assists agencies in making decisions on where to invest limited resources in ways that will clearly improve the expected safety performance (e.g., IHSDM supports Performance-Based Practical Design)

- Helps project planners, designers, and reviewers justify and defend geometric design decisions
Potential IHSDM Applications

- As a tool to identify facilities with the greatest potential for safety improvement
- As a tool to assess design options:
  - Evaluate alternatives
  - Evaluate proposed design exceptions
  - Evaluate and refine preliminary geometry
Potential IHSDM Applications

- As an integral part of the Road Safety Audit (RSA) process
- As a tool to assess the safety “benefit” when conducting a B/C analysis (predict crashes before and after reconstructing or improving a facility)
<table>
<thead>
<tr>
<th>IHSDM Evaluation Module</th>
<th>Relationship to HSM</th>
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<tbody>
<tr>
<td><strong>Crash Prediction</strong></td>
<td>Faithful implementation of HSM Part C Predictive Method</td>
</tr>
<tr>
<td><strong>Policy Review</strong></td>
<td>Evaluates nominal safety; use in conjunction with – not in place of – HSM Part C methods</td>
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<tr>
<td><strong>Design Consistency</strong></td>
<td>Diagnostic tools that can support HSM Part C evaluations</td>
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<td><strong>Traffic Analysis</strong></td>
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<td><strong>Intersection Review</strong></td>
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<td><strong>Driver/Vehicle</strong></td>
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New for 2017!

- IHSDM Economic Analyses Tool
IHSDM Economic Analyses Tool

**Purpose**

• To allow IHSDM users to do economic analyses within IHSDM, using Crash Prediction Module (CPM) evaluation results (i.e., crash frequencies and severities)
EA Tool v. 1 supports the following economic analyses types for **freeways**:

- **Benefit / Cost (B/C) Analysis**, including measures such as:
  - Net Present Value (NPV) of Benefits (B) (*i.e.*, crash cost reduction of an alternative case as compared with the "base case")
  - Net Present Value (NPV) of Costs (C) (*e.g.* initial construction costs, maintenance costs)
  - Benefit/Cost Ratios (B/C)
  - Present Value of Net Benefits (B-C)
Default values are provided for:

- Crash Unit Costs *(i.e., costs per crash for KABCO severities)*
- Discount rate (3%)
- Crash Cost Index (2%)

Users can enter their own values via the IHSDM Administration Tool (AdminTool)
The EA Tool will eventually apply to all facility types currently covered by the CPM:

- Rural 2–Lane Highways
- Rural Multilane Highways
- Urban/Suburban Arterials (including arterials with 5 or fewer lanes, 6+ lanes and 1–way arterials)
- Freeway Segments and interchange components (ramps, C–D roads, and ramp terminals)
IHSDM Economic Analyses Tool

IHSDM-HSM Predictive Method (IHSDM 2017 Release, v13.0.0)

- Email: michael.dimaiutia

Economic Analyses
- EAPProject 1 (v1)
  - [v1] EAAnalysis 1 (Benefit/Cost)
- PA I-70 (v1)
  - [v1] PA I-70 EA 1 (Benefit/Cost)
  - [v1] PA I-70 Alt2A vs Alt3 (Benefit/Cost)

Bookmarks
- PennDOT I-70-Alt-2A
  - I-70 Alternative 2A (Imported v1)
  - Huntington Rd (Imported v1)
  - SR 3010 (Imported v1)
  - Markeys Rd (Imported v1)
  - SR 3037 Waltz Mill Rd (Imported v1)
  - SR 3014 (Imported v1)
  - Huntington Rd -Existing (Imported v1)
  - SR 3010 -Existing (Imported v1)
  - SR 3037 Waltz Mill Rd -Existing (Imported v1)
  - Interchange I-70 and Huntington Rd
  - Interchange I-70 and SR 3037
    - Intersection SR 3010 and Huntington Rd (Imported v1)
    - Intersection 3010 and Markeys Rd (Imported v1)
    - Intersection SR 3037 and SR 3010 (Imported v1)
    - Intersection SR 3037 and SR 3014 (Imported v1)
    - Intersection SR 3010 and Huntington Rd -Existing (Imported v1)
    - Intersection SR 3037 and SR 3010 -Existing (Imported v1)
IHSDM Economic Analyses Tool

- Economic Analyses Main Node
- EA Project
- EA Analysis
• IHSDM Help Browser: EA Tool User Guide
• IHSDM Tutorial: New Lesson on EA Tool
• Sample Project included with the software:
  – “Example Freeway–Economic Analysis”
Case Study: PA I-70 Yukon / Madison Interchanges Project
Case Study: PA I-70 Yukon / Madison Interchanges Project

- Freeway alternatives analysis project
- Existing:
  - 2 closely spaced rural interchanges, roughly 4,000’ apart; AASHTO recommends 3 mi spacing in rural areas.
PA I-70 Typical Conditions
PA I-70 Typical Conditions

Acceleration and Deceleration Lanes
PennDOT focused primarily on two alternatives:

- **Alternative 2A**: retained and redesigned the two closely spaced interchanges with some mainline improvements

- **Alternative 3**: removed one of the interchanges, redesigned the other, and included a new connector road and local roadway network improvements
Alternative 2A
Alternative 3
## CPM Results

<table>
<thead>
<tr>
<th>Facility</th>
<th>Expected Crashes (2018 – 2038)</th>
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<tbody>
<tr>
<td></td>
<td>Alternative 2A</td>
</tr>
<tr>
<td><strong>Freeway</strong></td>
<td></td>
</tr>
<tr>
<td>I-70</td>
<td>422.5</td>
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<tr>
<td><strong>Ramps</strong></td>
<td></td>
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<tr>
<td>Ramp A</td>
<td>5.5</td>
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<tr>
<td>Ramp B</td>
<td>1.5</td>
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<tr>
<td>Ramp C</td>
<td>3.5</td>
</tr>
<tr>
<td>Ramp D</td>
<td>1.5</td>
</tr>
<tr>
<td>Ramp E</td>
<td>2.0</td>
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<tr>
<td>Ramp F</td>
<td>2.5</td>
</tr>
<tr>
<td>Ramp G</td>
<td>3.0</td>
</tr>
<tr>
<td>Ramp H</td>
<td>2.0</td>
</tr>
<tr>
<td><strong>Ramp Terminals</strong></td>
<td></td>
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<tr>
<td>SR 3010 &amp; Ramps B/C</td>
<td>3.0</td>
</tr>
<tr>
<td>Huntingdon St. &amp; Ramps A/D</td>
<td>4.5</td>
</tr>
<tr>
<td>SR 3037 &amp; Ramps F/G</td>
<td>21.5</td>
</tr>
<tr>
<td>SR 3037 &amp; Ramps E/H</td>
<td>16.5</td>
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<tr>
<td></td>
<td>Alternative 2A</td>
</tr>
<tr>
<td><strong>Roads (Rural 2-Lane)</strong></td>
<td></td>
</tr>
<tr>
<td>SR 3014</td>
<td>9</td>
</tr>
<tr>
<td>SR 3037</td>
<td>7</td>
</tr>
<tr>
<td>SR 3010</td>
<td>5</td>
</tr>
<tr>
<td>Huntingdon St.</td>
<td>3.5</td>
</tr>
<tr>
<td>Connector Rd.</td>
<td>-</td>
</tr>
<tr>
<td><strong>Intersection</strong></td>
<td></td>
</tr>
<tr>
<td>SR 3014 / SR 3037</td>
<td>46.5</td>
</tr>
<tr>
<td>Connector Rd. / SR 3014 / SR 3037</td>
<td>-</td>
</tr>
<tr>
<td>SR 3010 / SR 3037</td>
<td>5</td>
</tr>
<tr>
<td>Markeys Rd./SR 3010</td>
<td>5.5</td>
</tr>
<tr>
<td>Huntingdon St. / SR 3010</td>
<td>15.5</td>
</tr>
<tr>
<td>Connector Rd. / Huntingdon St.</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total Expected Crashes</strong></td>
<td>586.5</td>
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</table>
• Case study: PA I–70
  • Crash Prediction
  • Economic Analyses
IHSDM Economic Analyses Tool

Future – Phase 2

• Extend EA Tool to all facility types covered by IHSDM CPM (HSM Part C)

• Extend EA Tool to include site-based CPM Evaluations
• Expand B/C Analysis measures to include Incremental Benefit–Cost Analysis

• Expand treatment of Improvement Costs
Future Plans

• When available, implement HSM2 predictive methods for:
  • Roundabouts (NCHRP 17–70)
  • Intersection types not covered in HSM1 (NCHRP 17–68)
  • Revised Calibration procedure
• Extend EA Tool as discussed
• Expand data entry options to include input by Mileposts
• Enhance reporting capabilities
Why use IHSDM to implement HSM Part C Methods?

- **“Station-Based” Data Input** automatically segments the highway into homogeneous segments as per HSM Part C

- **“Site-Based” Data Input** – especially useful for projects where detailed, station-based geometry not available

- Can import data (alignment +) from Highway Design Software via LandXML
Why use IHSDM to implement HSM Part C Methods?

- IHSDM CPM is intended as a faithful implementation of the entire HSM Part C. So…
  - For Freeway / Interchange projects that impact non-freeway highways, can apply HSM Part C methods to other network components (e.g., cross-roads, connectors, local roads & intersections)
Why use IHSDM to implement HSM Part C Methods?

• Crash Prediction evaluation results can be used as input in Economic Analyses Tool

• Can handle complex (and simple) designs

• Seamlessly evaluates a highway that changes facility type (e.g., rural 2-lane to rural multilane)

• Implements the Empirical–Bayes procedure
Why use IHSDM to implement HSM Part C Methods?

- IHSDM “Navigation tree” helps users to organize projects, highways, evaluations, etc.
- Evaluation Reports and Graphs provide extensive documentation of results / output
- Highway Viewer provides graphical representation of design
Why use IHSDM to implement HSM Part C Methods?

- Extensive documentation in “Help Browser”
- Tutorial provides step-by-step “soup to nuts” guidance
- IHSDM Administration Tool (AdminTool) includes a Calibration Utility to help agencies implement HSM Calibration Procedures
2017 Release

- Download: [http://www.ihsdm.org](http://www.ihsdm.org)
- Technical support:
  - IHSDM.Support@dot.gov
  - (202)-493-3407
IHSDM Training

Through FHWA Resource Center (*via EDC–4 or NHI*):

- “IHSDM“ (2–day on–site)
- “Safety Analysis of Freeways and Interchanges” (2–day on–site)
For more information on DDSA…

• Fact Sheets and Case Studies
• Infographics
• Videos
• Webinars
• Informational Guides
• Training Workshops
• Technical Assistance