Protecting, Promoting and Enhancing our Commonwealth: Assisting MassDOT to deliver projects on Time and on Budget

Active Risk Management - Charles River Basin

September 18, 2013
Massachusetts’ Accelerated Bridge Program & History with the Charles River Basin’s ABP

- Governor Patrick advances an act financing an accelerated structurally-deficient bridge improvement program in 2008
- $3 Billion allocated ($2B MassHighway/$1B DCR)
- Geocomp (along with VHB and HDR) selected to perform risk assessment/management for DCR’s program (primarily Charles River Basin bridges)
- Massachusetts passes transportation reform legislation in 2009 - full $3 Billion transferred to MassDOT along with the risk management contract
- Numerous risk assessments completed for bridges within the CRB along with detailed construction staging and traffic analyses.
Charles River Basin: Project Area
Risk Management: What are the sources of Risk?

Budget Risk Assessment
- Engineering & Environmental
  - Final Design
  - Construction Management
  - Right of Way
  - Subgrade Construction
  - Surface Construction
  - Separate Access Road
  - Bridges / Structures
  - Signals / Communications
  - Unit Prices and Quantities
  - Constructability

Event Risks
- Archeology
- Construction
- Environmental
- Utilities
- Engineering
- Executive
- Funding
- Geotechnical
- Hydrology
- Materials
- Maintenance
- Operations
- Permits
- Right of Way
- Schedule
- Traffic

Comprehensive Risk Register
The Basics of Active Risk Management

- *Project risk* is an uncertain event or condition that potentially impacts the project objectives for cost, schedule, and quality.

- **Active Risk Management™**
  - quantify all significant risks potentially affecting a project
  - monitor these risks
  - mitigate risks early to minimize project impacts

- **Active Risk Management™** goes beyond risk assessment
  - it actively helps manage risks throughout the life of the project.
Objectives of ARM contract

- Identify larger sources of risk so management efforts can focus on these.
- Encourage pro-active and early planning
- Build confidence and credibility in project’s plans and estimates
- Develop targeted mitigation strategies for the significant risks
- Support optimal allocation of risks and project delivery methods
- Help ensure transparency, integrity, and accountability throughout the life-cycle of the project
- Helps maximize the likelihood of meeting ABP’s on-time, on-budget mandates.
Some outcomes

- Early Action contract for Longfellow Bridge to determine condition of arches and remove uncertainties from main contract.
- Enhancement of noise control specifications.
- Identification of interfacing issues with MBTA for Longfellow.
- Analysis of the sequencing of the Charles River Basin ABP construction projects to help MassDOT minimize total program construction costs.
- Cost, constructability, and schedule reviews for Anderson Memorial, River, Western, and Longfellow.
- Identified key factors affecting cost, schedule, and construction risks for 3 alternatives to rehabilitate or reconstruct the Commonwealth Avenue Bridge.
- Traffic......
PHASE I – Previous Transportation Analysis (completed by BETA Group, Inc. et al)

- Completed August ’08
- Traffic Operations (vehicle) focused
- CTPS Select Link O-D Analysis
- Phase I Initial Sequence
- Useful first step
- APWA Innovation Award
PHASE II – Expanded Transportation/Traffic Analysis and Evaluation

PHASE II GOAL

Keep traffic moving, maintain emergency response capability and provide a safe and accessible environment for pedestrians and bicyclists

- Multi-modal review – not just vehicles
- Revisited the Phase I sequencing conclusions
- Consider total CRB ABP and possible interactions with other planned projects in the area
PHASE II – Development of a Travel Demand Model

- Functionality – what does it do?
  - understands origin-destination trip patterns
  - calibrated against actual traffic volume data
  - select link in previous (Phase I) analysis
  - critical with numerous, concurrent projects

- Limitations – TransCAD link based model/no transit

- Aspects of local versus regional modeling
CTPS’ Regional Travel Demand Model – Participation and Coordination

- Regional traffic shifts
- Transit component
- Mode shift determinations
- Detailed pedestrian and bicycle modeling
- Regional and local models linked (disaggregated TAZ structure)
PHASE II - Local Travel Demand Model
Study Area
PHASE II - Local Travel Demand Model
Network Features

Links coded = 821
Intersections = 651
Zones = 837 total
(811 internal/26 external)
PHASE II - Local Travel Demand Model

Data Sources

- EOT
- MassDOT
- Phase 1 Study (BETA)
- CTPS
- City of Boston (BTD)
- City of Cambridge
- Town of Brookline
- Private developments (Assembly Square and Harvard University)
PHASE II – Transportation/Traffic Analysis and Evaluation

- Travel demand model runs for individual construction stages – bridge by bridge to establish anticipated traffic diversions and recirculation
PHASE II – Intersection Operational Analysis
Synchro (tied to Travel Demand Model)
PHASE II – Transportation/Traffic Analysis and Evaluation

- Generated revised intersection turning movements and operation analyses to identify “impacted” intersections

  - Volume increase to any movement of 50 vph or more
    - AND -
    - Existing LOS E/F
    - OR -
    - Intersection Degrades to LOS E/F
    - OR -
    - Intersection Degrades 2 LOS Levels
    - OR -
    - Queue Impacts
    - OR -
    - Coordination
    - OR -
    - Construction
    - OR -
    - Monitoring
PHASE II – Transportation/Traffic Analysis and Evaluation

- Assisted MassDOT in developing mitigation and traffic management strategies
### Developed user cost delay estimates related to construction-related congestion

<table>
<thead>
<tr>
<th></th>
<th>Longfellow Bridge Stage 1 – Phase 1</th>
<th>Longfellow Bridge Stage 1 – Phase 2, Stage 2 – Phase 1 and Stage 3 – Phase 1</th>
<th>Western Avenue/ River Street Bridges</th>
<th>Anderson Memorial Bridge</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Morning Peak Hour VHT Differential</strong></td>
<td>28.13</td>
<td>32.45</td>
<td>13.35</td>
<td>3.84</td>
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<td><strong>Evening Peak Hour VHT Differential</strong></td>
<td>23.12</td>
<td>39.33</td>
<td>27.01</td>
<td>10.59</td>
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<td><strong>Average Peak Hour VHT Differential</strong></td>
<td>25.63</td>
<td>35.89</td>
<td>20.18</td>
<td>7.22</td>
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<td><strong>3 Hour Peak Period VHT Differential</strong></td>
<td>70.21</td>
<td>98.34</td>
<td>55.29</td>
<td>19.78</td>
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<td><strong>Daily VHT Differential</strong></td>
<td>146.04</td>
<td>204.54</td>
<td>115.01</td>
<td>41.13</td>
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<tr>
<td><strong>Annual VHT Differential</strong></td>
<td>49,718.76</td>
<td>69,637.24</td>
<td>39,153.88</td>
<td>14,003.45</td>
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<tr>
<td><strong>Annual Delay Cost</strong></td>
<td>$ 934,715</td>
<td>$ 1,309,180</td>
<td>$ 736,095</td>
<td>$ 263,265</td>
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<tr>
<td><strong>Estimated Project Duration (months)</strong></td>
<td>9</td>
<td>40</td>
<td>18</td>
<td>18</td>
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<tr>
<td><strong>Total Delay Cost</strong></td>
<td>$ 701,035</td>
<td>$ 4,363,935</td>
<td>$1,104,140</td>
<td>$ 394,900</td>
</tr>
</tbody>
</table>

*a. In Hours as Compared to the Base Scenario*
PHASE II – Traffic Management Plan Evaluation

- Review/Support of proposed contractor/designer construction staging and plans – bridge by bridge
- Integration of individual project plans into overall traffic management plan.
- Consistency of traffic management treatments throughout basin
- Safety and compliance with Federal and State standards
Collaborative Review Process

- Traffic review committee formed
- Being proactive (versus reactive) in Design Development
- Real-time review and approval process for proposed construction work and staging
Status of Work Completed to Date

- **Craigie Drawbridge** - construction completed
  - implementation of one-way operation for 4 mo.
- **BU Bridge** - construction completed
  - extensive pedestrian and bicycle accommodation evaluation
- **Anderson Memorial Bridge** - construction ongoing
  - evaluated proposed construction sequencing
- **Longfellow Bridge** – construction ongoing
  - review of BTC staging alternatives
  - extensive pedestrian, bicycle and transit review
Status of Work Completed to Date, Con’t

- **Western Avenue/River Street Bridges** – advancing to final design
- **Magazine Beach Pedestrian Bridge** – construction complete
- **Commonwealth Ave. Bridge over I-90** – design ongoing
  - Accelerated construction techniques evaluated
  - Evaluated impacts to I-90
- **Neponset River Bridge** – construction complete
  - Implemented lane configuration by time-of-day
- **Bowker Overpass** – design complete
  - Evaluated proposed construction sequencing
Questions?
Extra Slides from here to end
PHASE II – Traffic Management Plan Evaluation
Emergency Vehicle Response
The essential idea of sequence optimization is to develop a schedule of start times for projects which would minimize the overall impacts of disruptions.

The disruptions can be broadly classified as:
- Highway traffic delays
- Water transport delays
- Labor and material shortfalls
- Budget shortfalls
- Mode shift issues
- Permitting and community reactions
When multiple projects are undertaken simultaneously, the individual impacts are amplified depending upon the interactions among them.

Example: If a closure of Bridge 1 results in a significant portion of its traffic being diverted to Bridge 2, the effect of closing both bridges simultaneously is significantly higher than the sum of individual closures. On the other hand, if there is little diversion potential, simultaneous closure has no additional traffic impacts.
For a given schedule,
* Calculate impact
  • Find sum of individual impacts of projects for each time interval being considered
  • Find impacts of interaction among projects within each time interval being considered
  • Find overall impacts by aggregating over all time periods being considered (discounted if needed)
* Find a better schedule
  • Adjust start times of individual projects to reduce the overall impact

Repeat the algorithm until adjustment does not yield material reduction in impacts
Current Task Status on Risk Assessment

Longfellow Bridge Phase one
• Developed risks for the execution of the Early Actions contract
• Risk Mitigation recommended active Noise Monitoring outside GC
• Identifying schedule and cost risks to the Main contract

Longfellow Bridge Phase two
• Longfellow Bridge Preservation Main Contract Risk Assessment Workshop Date TBD
• Start @ 25% design, identify top risks
• Provide recommendations to mitigate, manage and, where possible eliminate risks throughout design and construction

Sequencing Model
• Model framework is established
• Gathering data to populate model for initial run.
• As more detailed data becomes available, the model is updated and re-run
The values in the matrix represent the diversion potential between bridges.

For example, closure of Br 1 results in 40% of its traffic being diverted to Br 2 and 30% each to Br 3 and 4.

If Br 1 and Br 2 are simultaneously closed, the total traffic diversion impacts would be estimated as
Traffic on Br1 + Traffic on Br 2 + 0.4 *(Traffic on Br 1) + 0.3 * Traffic on Br 2