INTRODUCTION TO MDT’S RISK MANAGEMENT PROCESS

DEFINITIONS
Risk is the effect of uncertainty on objectives (ISO; 2011)
Risk is an uncertain event or condition that, if occurs, has a positive or negative effect on a project objective (PMBOK)
  - Risk is the event; Uncertainty is the variability of an occurrence
Project Objectives are the scope, schedule, budget and quality

COST ESTIMATING BASICS
Determine project needs/scope
Identify project characteristics
  - Location
  - Type
  - Complexity
Determine estimate basis
Prepare base estimate
  - Don’t include risk
Determine risk/contingency
Review and approve estimate
Communicate estimate
  - Scope
  - Assumptions
  - Basis

RISK IDENTIFICATION AND ANALYSIS
Plan
Identify
Analyze

RISK MANAGEMENT
Respond
Monitor and control
Communicate

DOCUMENTATION
Risk Management Plan
Project Reports
**Risk-Based Cost Estimating**

Determine project needs/scope
   - Key requirements
   - Contextual needs
   - Enhancements

Identify project characteristics
   - Location
     - Start/end points
     - Terrain
     - Route classification
     - Urban/rural
     - Indian Reservation
     - Limitations/constraints
   - Type
     - Reconstruction/Rehabilitation/Preservation/Safety/Bridge
   - Complexity
     - High/Medium/Low

Determine estimate basis
   - Project description including requirements
   - Schematic or sketches
   - Key dimensional information

Prepare base estimate
   - Don’t include risk
   - Include estimates for big ticket items (Table 1.)

| Guardrail | Traffic signals, lighting, ITS items |
| Large culverts, irrigation facilities | Turn bays, other isolated widening |
| Storm drain | Pavement markings, signing |
| ADA ramps, curb and gutter, sidewalk work | Wetland mitigation, wildlife crossings, wildlife fencing, etc. |
| Bridge work | Unique or unusual fencing needs |
| Bridge survey | Constructability issues |
| Bridge adoption | Public relations (especially urban jobs) |
| Retaining structures | Training program |
| Contaminated soil removal/disposal | Noxious weed control |
| Railroad involvement | Extensive utility work-arounds (urban) |

*Table 1. Additional Items*

Determine risk/contingency – Risk-based cost estimating
Risk Identification and Analysis

Plan
Determine the appropriate level of project risk management (see H. Wynnlee Crisp matrix, Figure 1.)
Include time in schedule for risk management
Include costs in preliminary engineering estimate
Include appropriate costs in construction estimate
Remember triangle: Schedule/Scope/Budget or Time/Scope/Cost
Develop risk management mindset

Identify
Focus on those risks that could significantly affect project objectives (Table 2.)

| Schedule time (extra cost for expedited work, timing restrictions, time of year, A+B bids) | Traffic control issues |
| Project setting – remoteness, urban setting, tight constraints, Reservation | Railroad, utility issues |
| Availability of materials | Environmental issues and/or mitigation needs |
| Availability of contractors | Geotechnical issues |
| Project size | Potential for poor soil conditions |
| | Unknown risks/potential change orders |

Table 2. Contingency and Risk Factors

Opportunities and threats
Brainstorm and condense
Use risk element chart (Figure 2.)
Get input from local experts

Analyze individual risks
Qualitative or quantitative
Probability of occurrence
Cost impacts
Schedule impacts
Opportunities (decrease cost or time)
Threats (increase cost or time)
Overall significance (Risk Impact Matrix – Figure 3.)

Risk Management
Respond
Develop strategies
Avoid or Exploit (may need to adjust scope, schedule, or budget)
Mitigate or Enhance (may need to add PE and/or tasks to schedule)
Accept (add or remove contingency or adjust costs/schedule)
Assign task to responsible party with deadlines
Monitor and control
   Follow through on strategies
   Retire risks that have been taken care of
   Determine if additional risks have surfaced
   Revise risk management plan as needed

Communicate
   Add risk impact to cost and schedule estimates (can be range or contingency (Figure 4))
   Keep all stakeholders informed of status
   Reconvene risk management team if necessary
   Communicate positive and negative changes

**DOCUMENTATION**
Risk Management Plan

Project reports
   Scope
   Assumptions
   Basis
DECIDING THE APPROPRIATE LEVEL OF PROJECT RISK MANAGEMENT

Every project management process and tool takes time and effort. The question is always how much effort is justified by the project and the situation. For risk management, this decision revolves around how important it is to meet one or more project objectives. The more important it is to keep a project under control, the more robust the risk management process needs to be. While ignoring management of project risks is not a viable option in any situation, the depth of effort and detail depends on the unique circumstances of each particular project.

<table>
<thead>
<tr>
<th>Level of Project Risk Management</th>
<th>VERY LOW</th>
<th>LOW</th>
<th>MEDIUM</th>
<th>HIGH</th>
<th>VERY HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not important</td>
<td>Nice to achieve; but not critical</td>
<td>Consequences of failure are low to mod.</td>
<td>Consequences of failure significant</td>
<td>Critical; failure isn’t an option</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>How important is it to</th>
<th>(circle your rating)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete on budget</td>
<td>1 1 10 25 50 100</td>
</tr>
<tr>
<td>Complete on schedule</td>
<td>1 1 10 25 50 100</td>
</tr>
<tr>
<td>Fulfill all the requirements of the scope</td>
<td>1 1 10 25 50 100</td>
</tr>
<tr>
<td>Meet the quality expectation</td>
<td>1 1 10 25 50 100</td>
</tr>
<tr>
<td>Have a fully functional finished product</td>
<td>1 1 10 25 50 100</td>
</tr>
<tr>
<td>Have a satisfied Owner</td>
<td>1 1 10 25 50 100</td>
</tr>
<tr>
<td>Know if a &quot;high&quot; risk is unreasonably high</td>
<td>1 1 10 25 50 100</td>
</tr>
<tr>
<td>Understand the probability of completing on schedule</td>
<td>1 1 10 25 50 100</td>
</tr>
<tr>
<td>Understand the probability of completing on budget</td>
<td>1 1 10 25 50 100</td>
</tr>
<tr>
<td>Know which tasks impose the greatest risk on the overall project</td>
<td>1 1 10 25 50 100</td>
</tr>
<tr>
<td>Communicate the probability of success/failure to others</td>
<td>1 1 10 25 50 100</td>
</tr>
<tr>
<td>Demonstrate that a tight schedule is actually inadequate</td>
<td>1 1 10 25 50 100</td>
</tr>
<tr>
<td>Demonstrate that a tight budget is actually inadequate</td>
<td>1 1 10 25 50 100</td>
</tr>
<tr>
<td>Avoid damaging your reputation</td>
<td>1 1 10 25 50 100</td>
</tr>
<tr>
<td>Avoid damaging your organization's reputation</td>
<td>1 1 10 25 50 100</td>
</tr>
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</table>

**TOTAL RATING**

<table>
<thead>
<tr>
<th>Level of Project Risk Management</th>
<th>0 – 15</th>
<th>16 – 150</th>
<th>151 – 375</th>
<th>376 – 750</th>
<th>751 –950</th>
<th>&gt;950</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Risk Management not required. The most basic project control techniques are adequate.</td>
<td>Minimal effort to manage risks is warranted. Project Manager should think about what might go wrong and how to avoid the consequences, devising a response for the high probability and high severity risks.</td>
<td>A small team of knowledgeable individuals, including the Project Manager, should implement all of the Risk Management processes. Rely on Qualitative analysis.</td>
<td>Implement all of the Risk Management processes. Use a team that is well qualified in each key area of risk or technology. Update the risk analysis periodically and each time there is a fundamental project change. Elevate the importance of managing risks in accordance with the plan in the minds of team members. Consider using Quantitative Analysis.</td>
<td>In-depth Risk Management is needed using robust processes. High level of effort is justified. Quantitative analysis is recommended.</td>
<td>Same as 751-950, except that Quantitative analysis is required.</td>
</tr>
</tbody>
</table>

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H. Wynnlee Crisp Matrix

Figure 1
Right-of-Way
- Disagreement on highway access
- Objections to R/W appraisal
- Acquisition issues
- Volatile real estate market
- Staffing issues
- Other

Environmental
- Permits / agency actions delayed
- Agency disputes not resolved in a timely manner
- New information required for permits
- Environmental regulations change
- Additional environmental analysis required
- Design changes initiated by Resource Agencies
- Tribal issues
- Staffing issues
- Other

Engineering / Construction
- Sufficiency of plans and specifications
- Change in seismic criteria
- Soil / geotechnical conditions / mat'1 availability
- Soil contamination
- Contractors / subcontractors capability
- Work zone safety and mobility
- Site specific requirements
- Drainage / hydraulic issues
- Staffing issues
- Other

Traffic
- Design change
- Traffic growth
- Land use changes / developments
- Staffing issues
- Other

Stakeholders
- Objections from local communities
- Late changes requested by stakeholders
- New stakeholders demanding new work
- Staffing issues
- Other

Unforeseen Events
- Objections from local communities
- Late changes requested by stakeholders
- New stakeholders demanding new work
- Staffing issues
- Other

Market Conditions
- Forest fires
- Weather related incidents
- Earthquake
- Man-made disasters
- Economic changes / funding availability
- Other

Utilities
- Labor
- Fuel
- Materials
- Land
- Railroad involvement by utility conflict
- Staffing issues
- Other

Risk elements categories are modified from Appendix A. Data Request Template, Highway Project Cost Estimating and Management Final Report, February 2009, Alavi, et. al.

Risk Element Categories
Figure 2
<table>
<thead>
<tr>
<th>Probability of Occurrence</th>
<th>Very Low</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
<th>Very High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very High</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very Low</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Potential Impact

Risk Impact Matrix

Figure 3
% Contingency Range by Project Level of Risk

<table>
<thead>
<tr>
<th>Project Stage</th>
<th>% Plan Completion</th>
<th>High Risk</th>
<th>Low Risk</th>
<th>High Risk</th>
<th>Low Range</th>
<th>High Range</th>
<th>Low Range</th>
<th>High Range</th>
<th>Low Range</th>
</tr>
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<tbody>
<tr>
<td>Planning</td>
<td>0-5%</td>
<td>110</td>
<td>40</td>
<td>80</td>
<td>30</td>
<td>45</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PFR</td>
<td>0-15%</td>
<td>100</td>
<td>40</td>
<td>60</td>
<td>25</td>
<td>40</td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AGR</td>
<td>10-40%</td>
<td>80</td>
<td>35</td>
<td>40</td>
<td>20</td>
<td>40</td>
<td>10</td>
<td></td>
<td></td>
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<tr>
<td>SOW</td>
<td>30-70%</td>
<td>70</td>
<td>35</td>
<td>35</td>
<td>15</td>
<td>30</td>
<td>10</td>
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<tr>
<td>PIH</td>
<td>60-90%</td>
<td>55</td>
<td>20</td>
<td>25</td>
<td>10</td>
<td>20</td>
<td>5</td>
<td></td>
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<tr>
<td>FPR</td>
<td>85-100%</td>
<td>20</td>
<td>5</td>
<td>10</td>
<td>3</td>
<td>5</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td>(Misc. work)</td>
<td>20</td>
<td>5</td>
<td>10</td>
<td>0</td>
<td>5</td>
<td>0</td>
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Contingency Assignments

Figure 4