Marrying Risk Register with Project Trending

AACE Calgary Chinook Chapter

RISK .06

A Practical Way to Forecast Cost Overruns

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Disclaimer: This presentation is for general use only and is provided without responsibility for any subsequent use.
In a recent survey, 6 of the 10 factors that were found to be significant for project success (in terms of time, cost & scope) were related to the adequacy of the risk management practices employed!

David Greenwood, PhD
Northumbria University
Newcastle-upon-Tyne, UK
<table>
<thead>
<tr>
<th>Project</th>
<th>Budget (£millions)</th>
<th>Final Account (£millions)</th>
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</thead>
<tbody>
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<td>Thames Barrier</td>
<td>23</td>
<td>461</td>
</tr>
<tr>
<td>Barbican Arts Centre</td>
<td>17</td>
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<tr>
<td>Natwest Tower</td>
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<td>115</td>
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<tr>
<td>Humber Bridge</td>
<td>19</td>
<td>120</td>
</tr>
<tr>
<td>British Library</td>
<td>164</td>
<td>450</td>
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<tr>
<td>Sydney Opera House</td>
<td>2.5</td>
<td>87</td>
</tr>
<tr>
<td>BNFL Thorpe</td>
<td>300</td>
<td>2800</td>
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<td>Trans-Alaska Pipeline</td>
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<td>Channel Tunnel</td>
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<tr>
<td>Scottish Parliament</td>
<td>40</td>
<td>400</td>
</tr>
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</table>

**How About:**
“RESPECT” Is the Key Word

R: Risk Tracking and Management
E: Education and Enhancement
S: Standards and Benchmarking
P: People and Human Factors
E: Experiences and Lessons Learned
C: Change Controls and Management
T: Teamwork and Allies

Keynote Speaker, AACEi 49th Conference
Joe M. Koppelman
CEO, Primavera Systems
Migration from Tradition to Evolution

“In That Old Hammer and Nail Days”

“Change Order” and “Trends” dominate Management of Change (MOC) Process

“When 32-Bit Computer Is Everywhere”

“Formal Risk Management is preferred with the help of Monte Carlo Simulation”

“What is the Next”

Where are we going now?

Aren’t we getting married?

Risk + Trend
Prelude of The Tradition

Being “Singles”
- Project Risk Management is a practice independent of Project Cost Forecast via Trending process
- Project Trending process does not systematically capture Risk Response Action costs and / or time
- Project Risk Quantification is a one time deal using Monte Carlo simulation technique for the contingency

Potential Risks
- Costs to “mitigate” project risks are not timely and properly captured in the project estimate or forecast
- Inadequate funds to conduct rigorous project risk response actions due to “missed / omitted” risk budgets;
- Trending Process is not used effectively to capture “future cost” but used to record the “actual cost”

Proposed Marriage
- Project Risk Register and Project Trending Process
- The functions of Project Risk Management and Project Controls
Change Management by Trending

Trending
- Trend is a tool, a methodology, and a process to capture changes that are about to happen
- Project Trending provides an effective forewarning of potential changes and cost / schedule forecasts

Trend Log
- It serves as a discussion paper to present changes to higher management for alternatives or decision-makings
- It records the impact of additional cost and extra time required if the change is physically implemented

Figure 1: Simple Trend Log

<table>
<thead>
<tr>
<th>Trend No.</th>
<th>Trend Description</th>
<th>Dated</th>
<th>Change Requester</th>
<th>$ Cost Impact</th>
<th>Trend Status</th>
<th>WBS / COA</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fnds increase</td>
<td>06-05</td>
<td>Civil Eng.</td>
<td>$500K</td>
<td>Pending</td>
<td>0110-02</td>
<td>Vessel sizes change</td>
</tr>
<tr>
<td>2</td>
<td>HDFE Pipe to CS</td>
<td>05-05</td>
<td>Process Eng.</td>
<td>$2.5M</td>
<td>Potential</td>
<td>0110-05</td>
<td>Design Pressure change</td>
</tr>
</tbody>
</table>
Trending Pitfalls - Tricks of the Trade

“Already Happened”
- Trends are used as a justification to explain for cost overruns
- Trends are used to capture what has happened & incurred
- Trends are used as “forgiveness” for errors and omissions etc.
- Trends are used to increase “budgets” instead of forecasts

“Decisions for Alternatives”
- It stays as a trend pending “further study” and “decisions”
- It evolves to a “major scope change” but is treated as a trend
- It can not support potential claims; lacking of detailed changes

Figure 2: Trend Input and Output

Design Change Notice (DCN)  
Project Change Notice (PCN)  
Owner Requested Changes (ORC)  
Risk & Uncertainty Evaluation  

TREND  

Cost  
Schedule  
Other
Compromised Trended Forecast

“Out, you are excluded!”
- FAC (Forecast at Completion) is regularly updated
- FAC entails only trended amounts approved by Project Mgr.
- FAC excludes pending and potential trends recorded in the log
- FAC discounts cost engineer’s “gut feeling” towards changes

“More Holes, More Traps”
- Variance Analysis is not available as an input to FAC process
- Earned Value and Progress Measurements are not validated
- External Influential factors causing uncertainties not considered

Figure 3: Compromised Forecast at Completion

<table>
<thead>
<tr>
<th>Major Accounts</th>
<th>Budget</th>
<th>Approved Trends</th>
<th>Pending Trends</th>
<th>Potential Trends</th>
<th>Risk Action</th>
<th>Current Forecast</th>
<th>To-date Committed</th>
<th>To-date Incurred</th>
<th>To-date Expended</th>
<th>Deviation Variance</th>
<th>Earned Value</th>
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</thead>
<tbody>
<tr>
<td>Direct Labor</td>
<td>100,000</td>
<td></td>
<td>5,000</td>
<td></td>
<td></td>
<td>100,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Direct Materials</td>
<td>100,000</td>
<td>15,000</td>
<td></td>
<td></td>
<td></td>
<td>115,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct Subcontracts</td>
<td>100,000</td>
<td>20,000</td>
<td></td>
<td></td>
<td></td>
<td>100,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct Other</td>
<td>100,000</td>
<td></td>
<td>2,500</td>
<td></td>
<td></td>
<td>100,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field Indirects</td>
<td>120,000</td>
<td>6,000</td>
<td></td>
<td></td>
<td></td>
<td>120,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>H.O. Eng. &amp; PM</td>
<td>104,000</td>
<td>10,000</td>
<td></td>
<td></td>
<td></td>
<td>114,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C&amp;SU</td>
<td>49,920</td>
<td></td>
<td>3,500</td>
<td></td>
<td></td>
<td>49,920</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>673,920</strong></td>
<td><strong>25,000</strong></td>
<td><strong>20,000</strong></td>
<td><strong>11,000</strong></td>
<td><strong>6,000</strong></td>
<td><strong>690,920</strong></td>
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<td><strong>0</strong></td>
<td><strong>0</strong></td>
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</table>
Risks and Risk Management

"Being Practiced"
- Risks are future events with potential “probability” of occurrence
- Risks have been identified and recorded in Risk Register
- Risks are ranked to assess their severity of impact to “goals”
- Risks are assigned with appropriate response actions & costs

"Playing Solo"
- The process is exercised, efficiently, independent of “others”
- Decisions made to “mitigate” risks are not passed on as trends
- Risks being accepted have no “contingency plans” for “what-if”

Figure 4: Project Risk Register
**Risk Assessment and Action Plan**

“Find Big Rocks!”
- There are numerous risks in a project; where do we start?
- Risks are to be ranked for “probability and consequence”
- Pareto’s Law:
  
  Roughly 80% of your headaches are caused by just 20% of your problems!

“Action Costs Money”
- It costs you extra to make changes to avoid risks!
- It costs you extra to take actions to mitigate risks!
- It costs you extra to revise strategy to transfer risks!

**Figure 5: Risk Evaluation Matrix**

<table>
<thead>
<tr>
<th>6</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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<td>III</td>
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<td>4</td>
<td>IV</td>
<td>III</td>
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<td>II</td>
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<tr>
<td>3</td>
<td>IV</td>
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<tr>
<td>2</td>
<td>IV</td>
<td>IV</td>
<td>IV</td>
<td>III</td>
<td>I</td>
<td>II</td>
</tr>
<tr>
<td>1</td>
<td>IV</td>
<td>IV</td>
<td>IV</td>
<td>IV</td>
<td>III</td>
<td>III</td>
</tr>
</tbody>
</table>

1 2 3 4 5 6
A Big Deal!
- Without numbers, Risk is wholly a matter of Gut!
- Certainty (Math) – Risk (Simulation) – Uncertainty (Regret)
- Murphy’s Law:
  Things will go wrong when they are deemed to go wrong!

Old concept, Modern use
- It forewarns you what could go wrong and how likely!
- It alerts you to what impact it would be when things go wrong!
- Pareto’s law marries Murphy’s law: which 20% will go wrong!

Figure 6: Tornado Diagram

<table>
<thead>
<tr>
<th>Subcomponent</th>
<th>Correlation Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exchanger Rate</td>
<td>-0.73</td>
</tr>
<tr>
<td>COVID-19 - PB ECC</td>
<td>0.73</td>
</tr>
<tr>
<td>COVID-19 - PB EFC</td>
<td>-0.73</td>
</tr>
<tr>
<td>ICM Physical Factors</td>
<td>-0.73</td>
</tr>
<tr>
<td>Other</td>
<td>0.73</td>
</tr>
<tr>
<td>General Labor</td>
<td>-0.73</td>
</tr>
<tr>
<td>Normal</td>
<td>0.73</td>
</tr>
<tr>
<td>Labor</td>
<td>-0.73</td>
</tr>
<tr>
<td>Equipment</td>
<td>-0.73</td>
</tr>
<tr>
<td>ICM</td>
<td>-0.73</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>-0.73</td>
</tr>
<tr>
<td>Regression Sensitivity</td>
<td>-0.73</td>
</tr>
<tr>
<td>Overall Project TIC$/K87</td>
<td>-0.73</td>
</tr>
</tbody>
</table>

SUNCOR

ENERGY

Rocket Science - Monte Carlo

Correlation Coefficients

1.00
0.75
0.50
0.25
0.00
-0.25
-0.50
-0.75
-1.00

-1
-0.75
-0.50
-0.25
0
0.25
0.50
0.75
1

15%
10%
9%
9%
9%
9%
9%
9%
9%
9%
9%
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**Risks to be Simulated Not Calculated**

“Enough is Enough!”

- Variables that will significantly impact your “bottom line” number
- Total Installed Cost (TIC) must be justifiable to IRR and ROCE
- Central Limit Theorem (in layman’s words):
  
  Too Many variables will nullify the true meanings of simulation!

**Controversial “Contingency”**

- Contingency amount is determined by Risk Tolerance Level
- An organization’s Risk Tolerability drives TIC, not cost engineer
- Philosophical and definitive concept: Contingency is for Risks

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**Figure 7: Cumulative Distribution Function**

![Cumulative Distribution Function Diagram](image)
Strong Views from Two Families

“Project Controls”
- The centre of Universe: we will control estimate and schedule
- We will generate “cost contingency” by running Monte Carlo
- We will trend changes to derive total project cost forecast

“Project Management”
- The centre of Power: we decide how much and by when
- We have the processes to determine how to run risk program
- We tell you what is a trend and how it is included in the forecast

Figure 8: Two Families’ View
Marriage: Bride and Groom

“Risky Groom”
- Risk Triggers & Action Details are available as input to trend
- Rough Order of Magnitude cost estimate (+/-50%) is done
- Why PRM? - Risks are contained before they are materialized

“Trendy Bride”
- Trend system set up to receive inputs from Risk Register
- Further sanctioning (+/-30%) by PM to authorize extra money
- A true “Cost Forecast” that reflects all changes made to-date

Figure 9: Sharing Commonalities

<table>
<thead>
<tr>
<th>Risk</th>
<th>Response</th>
<th>Risk Response</th>
<th>Action</th>
<th>Action</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trigger / Causes (T.E.A.M.)</td>
<td>Action Plan</td>
<td>Owner</td>
<td>Due Date</td>
<td>Cost $</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Trend No.</th>
<th>Trend Description</th>
<th>Dated</th>
<th>Change Requester</th>
<th>$ Cost Impact</th>
<th>Trend Status</th>
<th>WBS / COA</th>
<th>Notes</th>
</tr>
</thead>
</table>


Post Marriage Discussions

What types of Risk go to the Trend Log?
- Risks with high probability of occurrence and intolerable impact must be handled with actions, that cost is significant enough as a trend.

What happens if risks are not in the Trend Log?
- A wonderful execution plan may end up without adequate funds to support it, unless the AFE estimate has identified & included money.

When can I remove the risk from Risk Register?
- Performing cost and benefit analysis, the initial risk needs to be mitigated to a tolerable residual risk level before it shall be taken out.

How do I place Risk inputs into the Trend Log?
- Ideally Risk and Trend review meetings shall be scheduled together and the Risk and Trend Coordinators shall sit in both meetings.

Can a trend item become a Risk?
- Absolutely; any change to plan will trigger a risk occurrence.
Measures to Enhance Marriage Life

Contingency Funds
- They are designed to support identified risk mitigation efforts
- They are identified as a result of Monte Carlo simulation
- They are used to effectively and efficiently handle “top risks”
- They are forecasted up and down following the shift of risks
- They help stabilize project forecast by offsetting “Trends”

Sensitivity Tables
- They make project team realize what are top rank risks
- They may direct on how contingency funds are allocated
- They provide a tool to measure the adequacy of contingency
- They identify problematic “variables” and place in Trend Log

Trend Log or Risk Register
- Place in Register if appropriate actions need to be detailed
- Place in Log if significant costs need to be included in forecast
- Place in both Log and Register if “big risks” need money to fix
Sour Marriage: Alarming Forecast

“Legitimate Trends”
- FAC only includes In-scope changes and risk containment costs
- FAC to include extra costs for Schedule acceleration (fixed end date)
- Scope Changes MUST be estimated to increase “the budget”

“Definitive Estimate”
- Perhaps, an IFC-based check cost estimate is necessary
- Perhaps, the original base-line is not realistic to start with
- Perhaps, a risk simulation for Forecast-to-Go is required

Figure 10: Total Cost Forecast

<table>
<thead>
<tr>
<th></th>
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<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>X</td>
<td>E</td>
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<tr>
<td>Direct Labor</td>
<td>100,000</td>
<td>5,000</td>
<td></td>
<td>25,000</td>
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<td></td>
<td>130,000</td>
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<td>Direct Materials</td>
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<td>Direct Other</td>
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<tr>
<td>C&amp;SU</td>
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<td></td>
<td>53,420</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>673,920</td>
<td>25,000</td>
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<td>11,000</td>
<td>30,000</td>
<td>6,000</td>
<td><strong>765,920</strong></td>
</tr>
</tbody>
</table>
A long Way to Go - Mindset

Sequential Order
- (1) complete Risk Identification and Ranking (all hazards)
- (2) conduct Schedule Risk analysis (how likely to meet schedule)
- (3) conclude Cost Risk analysis (total $TIC as-built)

Integration
- seamlessly combine schedule & cost risk analysis in 1 exercise
- input risk data into trend log and include into 1 cost forecast

Processes
- Monte Carlo Simulation, Benchmarking and Earned Value
- Active Risk Management (ARM), PRISM Risk & Cost Manager
- Risk-savvy Project Controls cost engineer & schedule planner

What risks are ahead of us?
How Long will it take us?
How much will it cost us?
What can we do to risks?
Do we change the plan?
How much more will it cost us?
Summary and Conclusion

Look Ahead into Future

Risk Management deals with future uncertainty; Trending Systems handle changes for the future;

Reliance on the ability to Predict

Both Risk Management and Trending System are about Future Predictability of project outcome;

Accurate, Defensible Forecast

Risk Management provides a scientific way to better predict the Forecast At Completion (FAC).
Questions and Answers