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Project Risk Management: A New Approach

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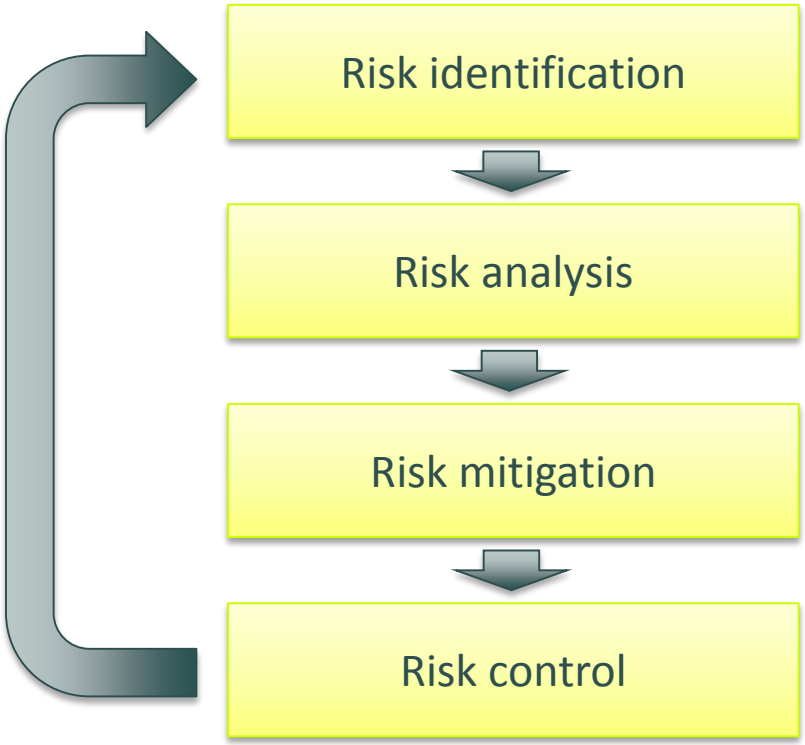
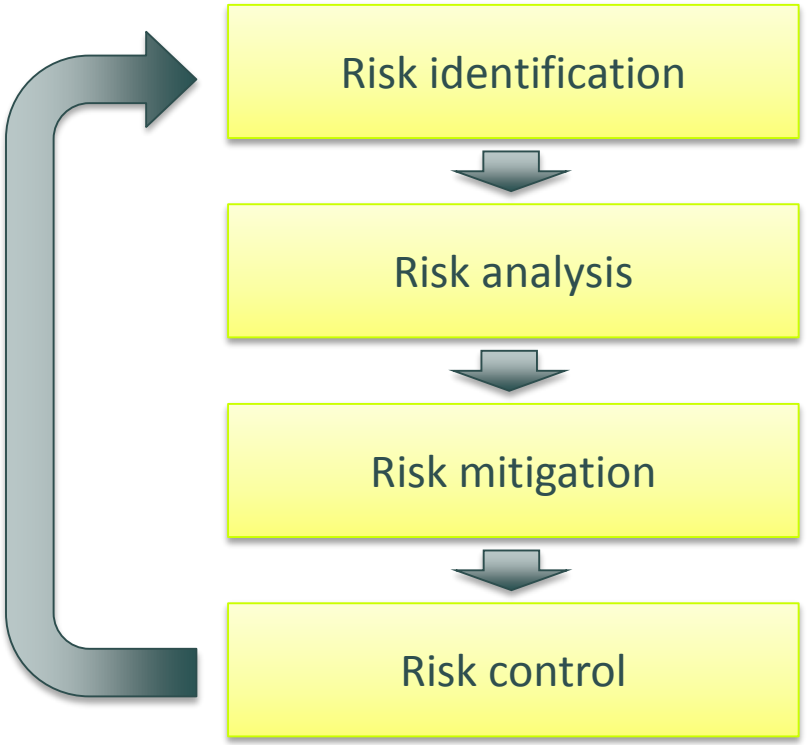
Risk management 101

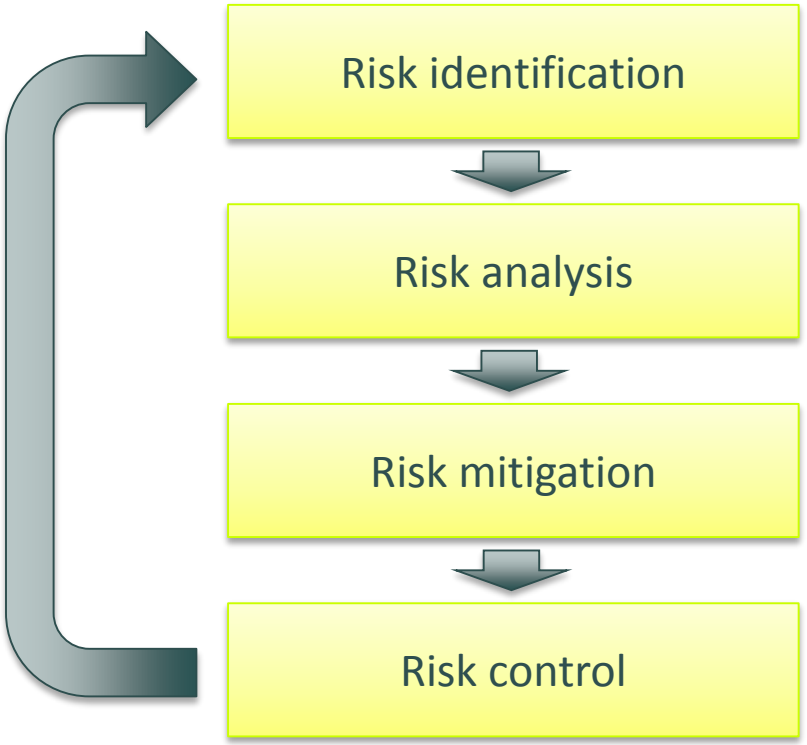


Risk management 101



- Quantify probabilities and impacts of risks
- Assess the impact on project objectives
- Calculate the project objectives

Risk management 101



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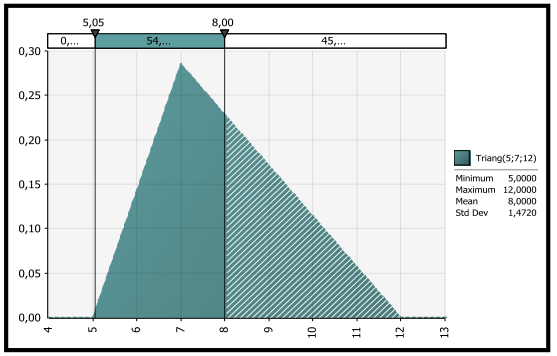
Where to start?

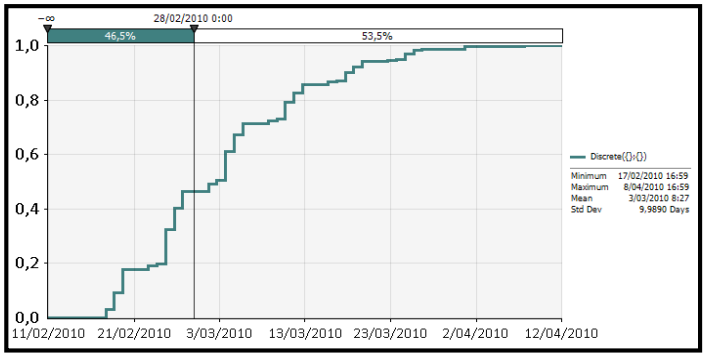
Project risk management: current approach

Uncertainty is captured in activity durations:

- Normal distribution
- Triangular distribution
- Beta distribution



Monte Carlo simulation is used to obtain estimates of project objectives (e.g. cdf of the completion time)



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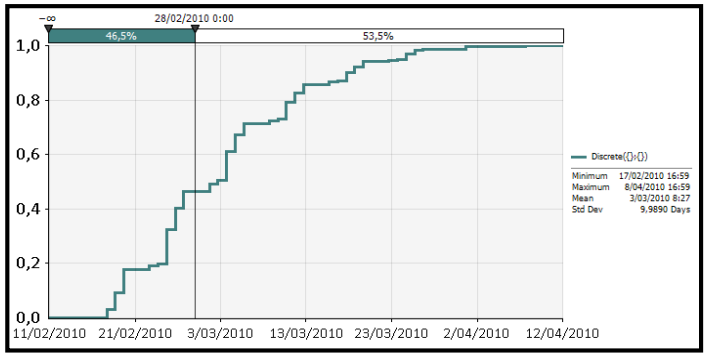
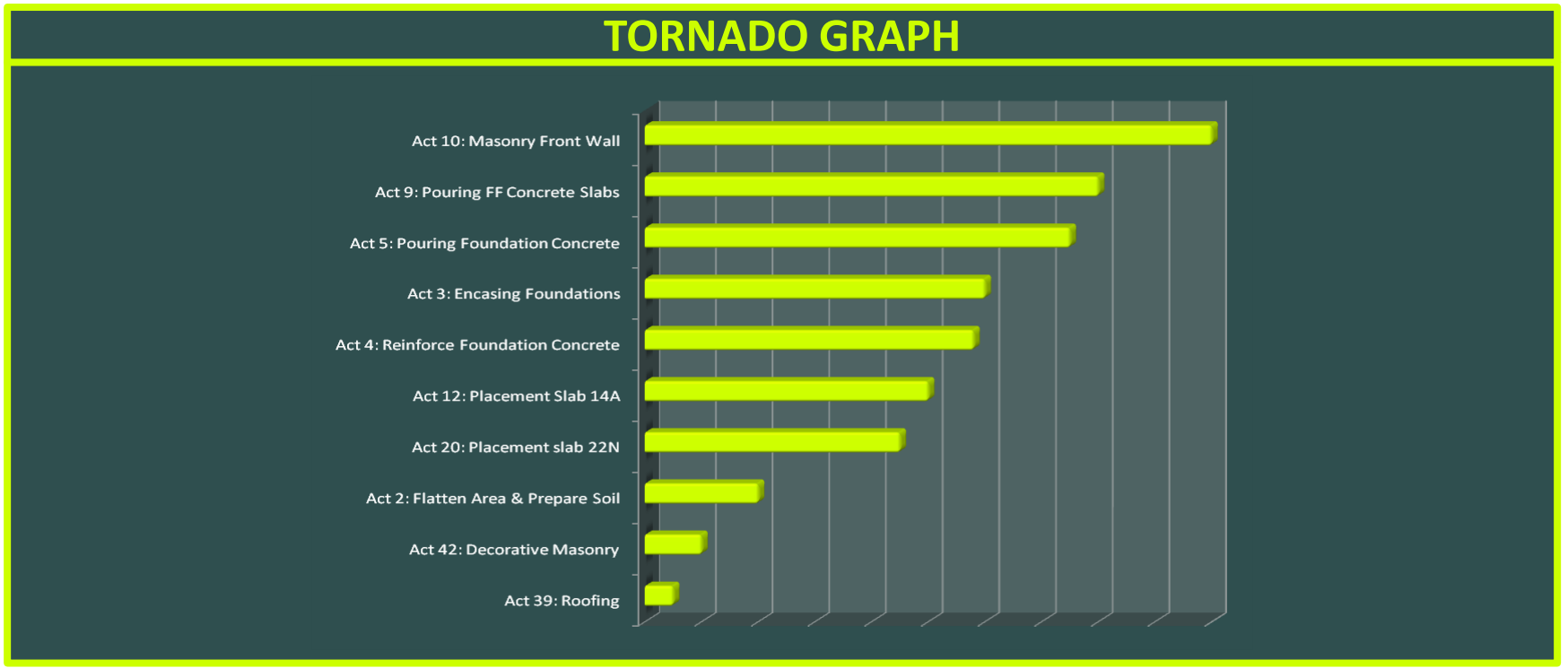


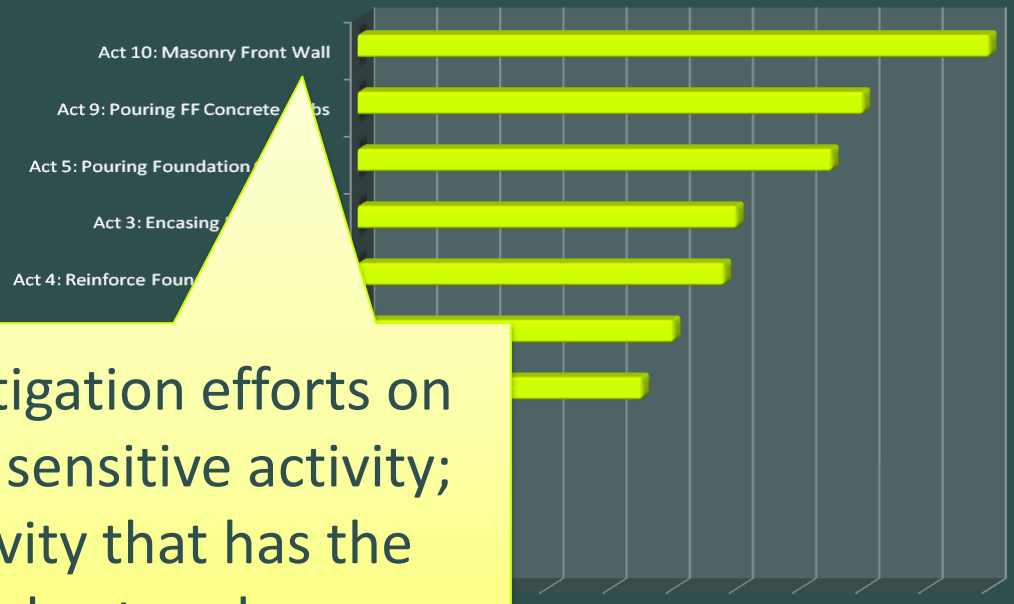
ANALYSIS NEEDS TO BE FOLLOWED BY ACTION!
=>
THERE IS A NEED FOR RISK MITIGATION!

Risk mitigation: how is it done?



Risk mitigation: how is it done?

TORNADO GRAPH



Focus mitigation efforts on the most sensitive activity; the activity that has the highest rank

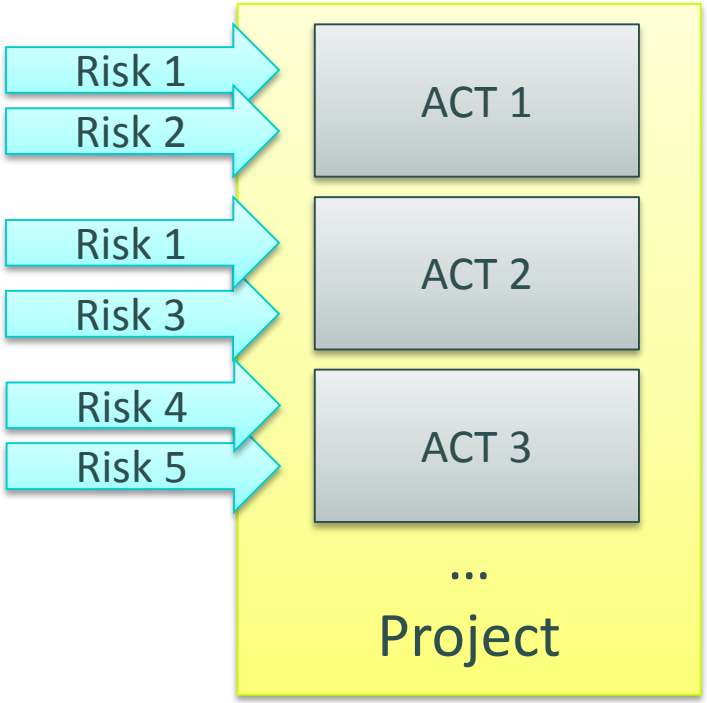
Ranking activities: existing measures

Criticality index	$CI_i = P(ES_i = LS_i)$
Significance index	$SI_i = \mathrm{E}\left[\frac{\mathrm{d_i}}{\mathrm{d_i} + \mathrm{TF_i}} \times \frac{\mathrm{C}}{\mathrm{E}(\mathbf{C})}\right]$
Cruciality index	$CRI_i = corr(\boldsymbol{d}_i, C)$
Schedule sensitivity index	$SSI_i = \sqrt{\frac{Var(\boldsymbol{d}_i)}{Var(\boldsymbol{C})}}.CI$

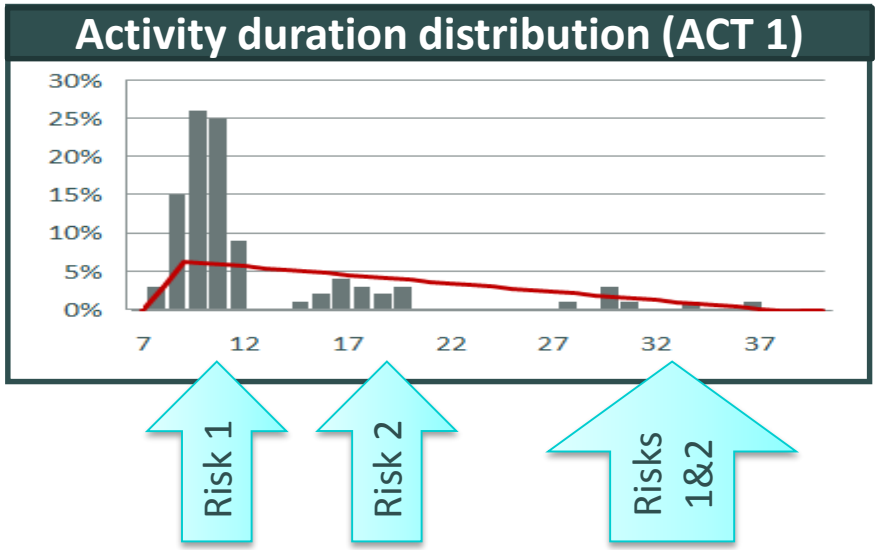
Problems with the current approach

- Project managers have a very hard time to model uncertainty
- All of the previous ranking measures have been criticized
- It is not clear where the uncertainty originates from
- It is unclear how to mitigate uncertainty

New approach: risk-driven (instead of activity-based)!



$$\boldsymbol{d}_i = f(d_i, \boldsymbol{r}_{ij})$$



Ranking risks: proposed measures

Cruciality index

$$CRI_j = corr(\boldsymbol{r}_j, C)$$

Critical Delay Contribution (CDC)

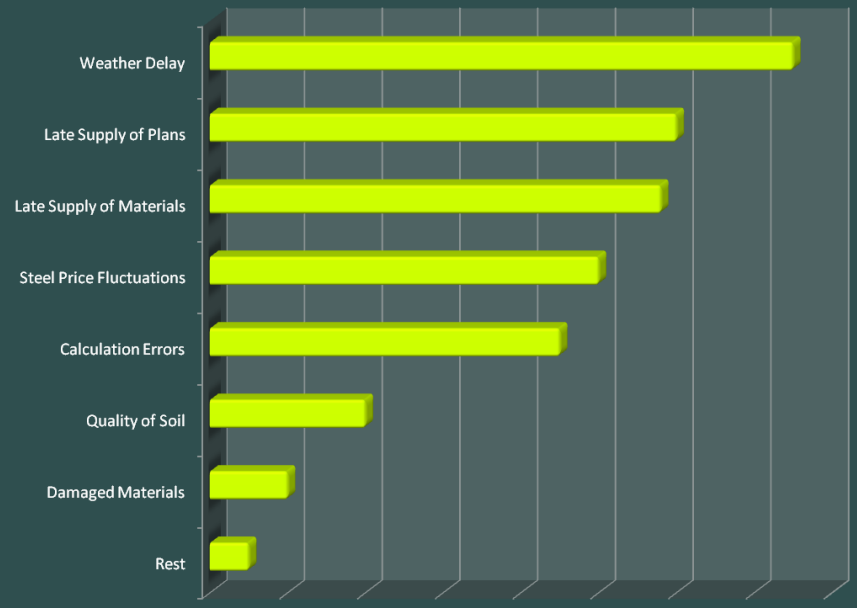
$$CDC_{ij} = E\left[\frac{\boldsymbol{r}_{ij} \cdot y_{ij}}{\sum_i \sum_j \boldsymbol{r}_{ij} \cdot y_{ij}} \cdot (\boldsymbol{C} - \delta)\right]$$

Advantages of the new approach

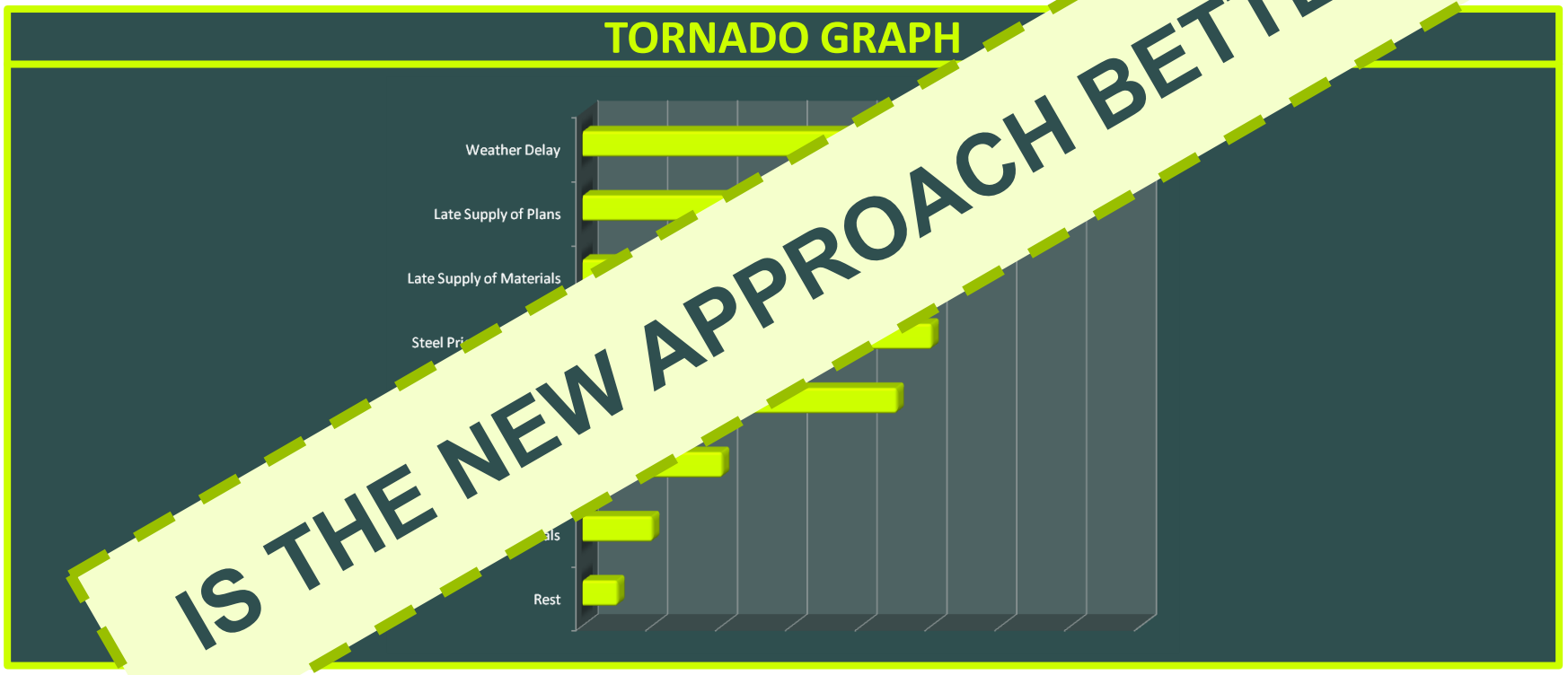
- Risks are much easier to predict than uncertainty
- CDC is calculated on risk per activity basis and can be aggregated on the level of risks and activities
- Risks **root** causes are ranked => we know which risk to mitigate!

Risk-driven = ranking of risks rather than activities

TORNADO GRAPH



Risk-driven = ranking of risks rather than a



IS THE NEW APPROACH BETTER?

Evaluation of the new approach using a computational experiment

For a large set of projects (600 projects of PSPLIB 120):

- Model uncertainty (i.e. define risks, impacts, probabilities…)
- Simulate the project execution
- For each ranking measure:
  - Calculate the highest-ranked risk according to the measure
  - Eliminate the highest-ranked risk (i.e. focus our mitigation efforts on this risk

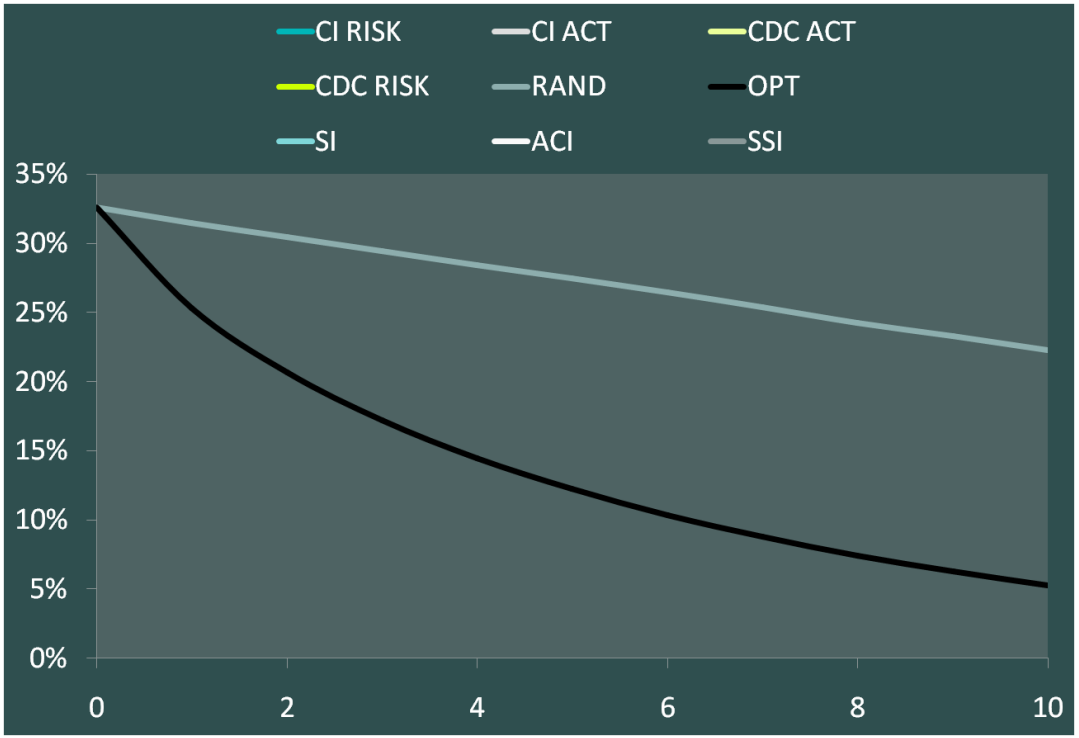
How good do the measures perform when mitigating 10 risks?

Computational experiment: ranking measures

ACTIVITY-BASED => SELECT THE LARGEST RISK THAT IMPACTS THE HIGHEST-RANKED ACTIVITY
CDC ACT
CI ACT
SSI
SI
ACI

RISK-DRIVEN => SELECT THE LARGEST RISK
CDC RISK
CI RISK

Results


CI RISK
CI ACT
CDC ACT
CDC RISK
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SI
ACI
SSI
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4
6
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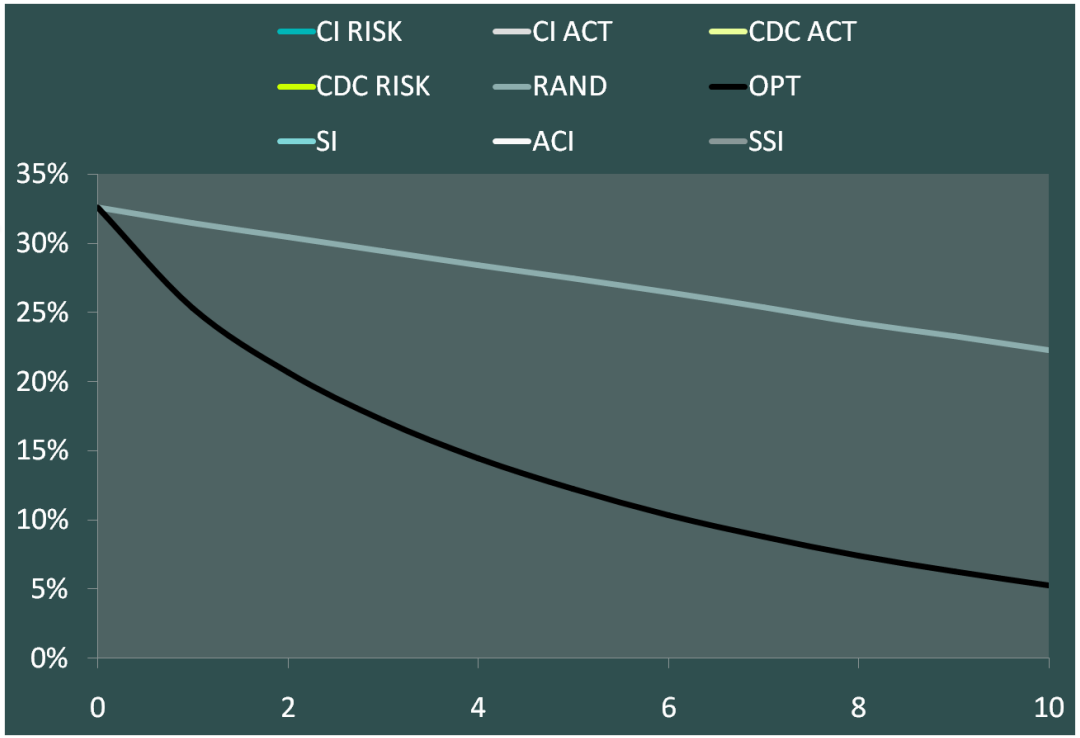
10

Results

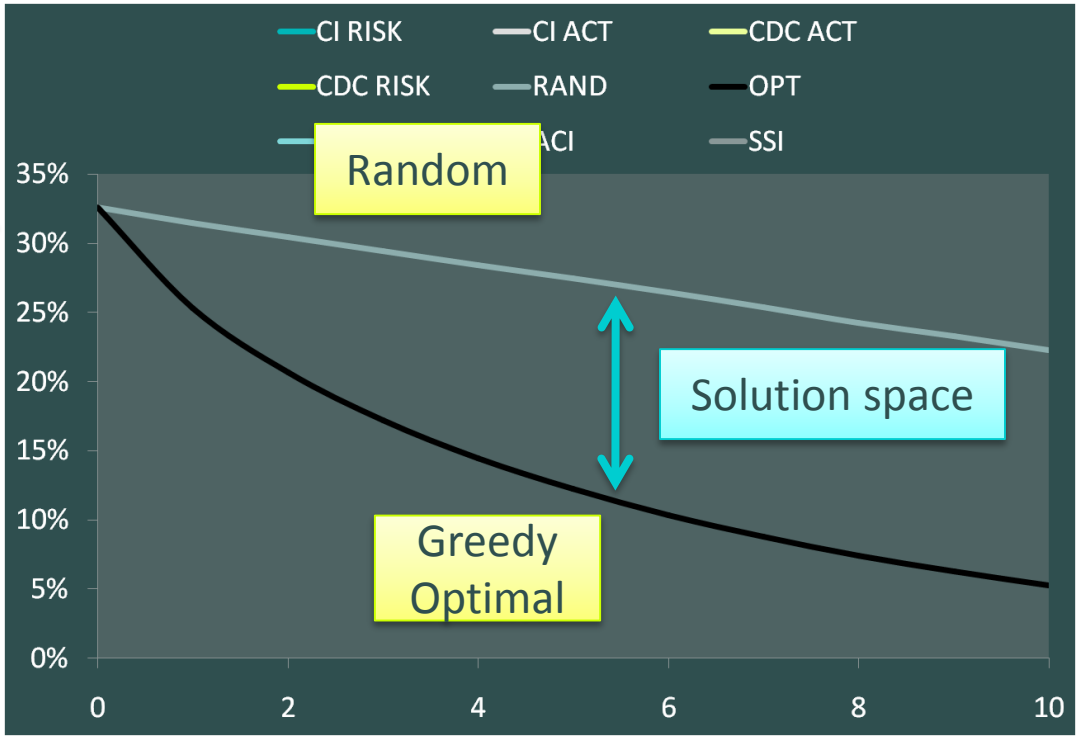
Project Delay



Number of risks eliminated

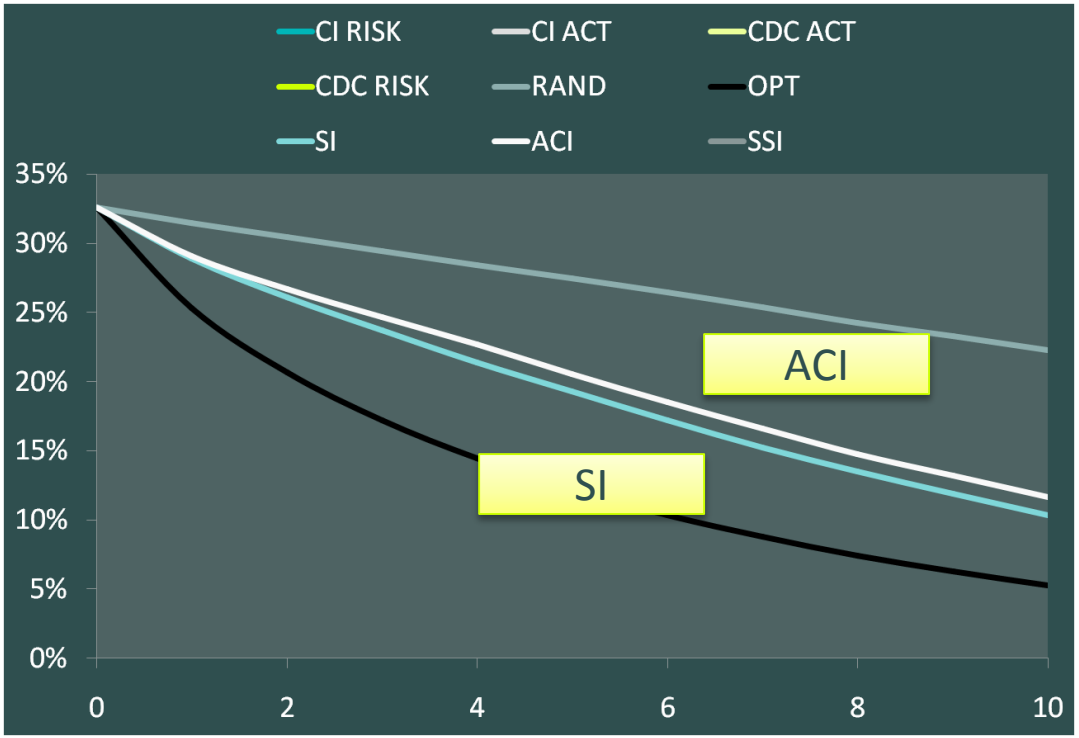
Results

Project Delay



Number of risks eliminated

Results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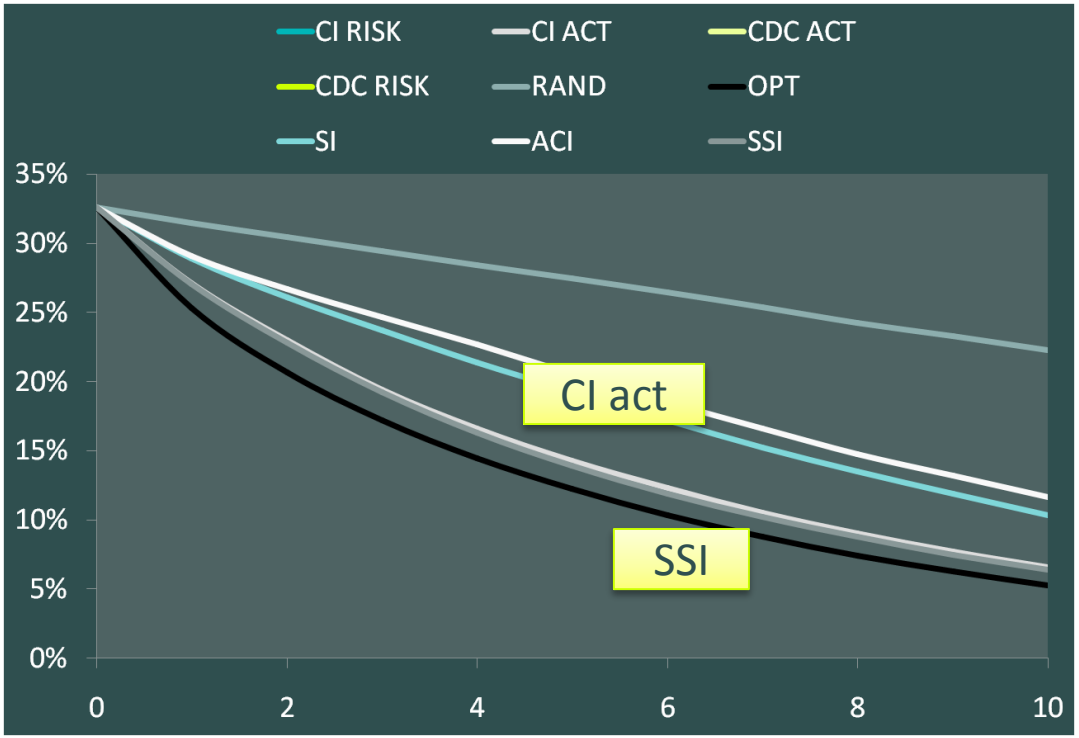
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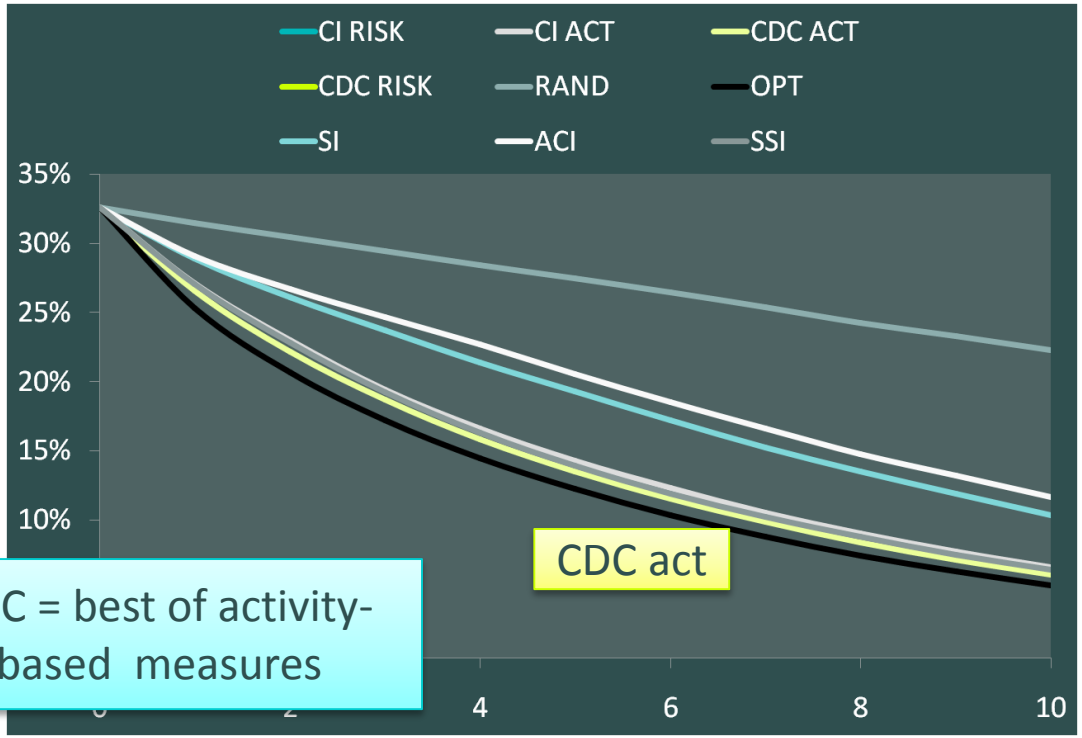
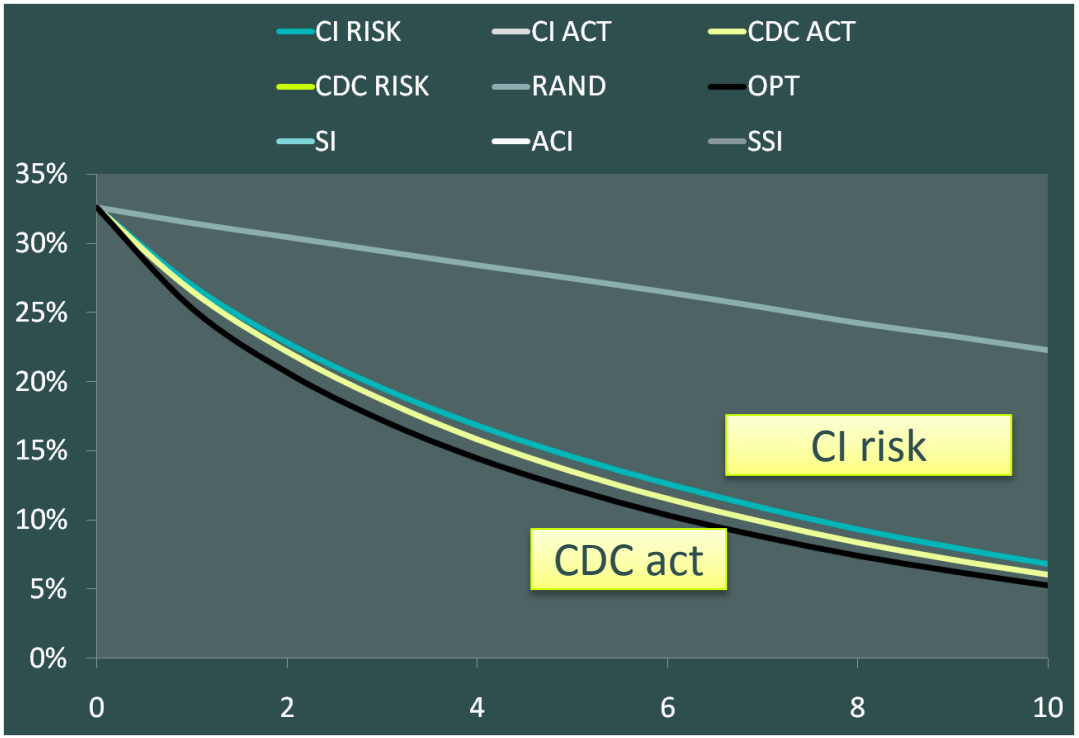


CDC = best of activity-based measures

Results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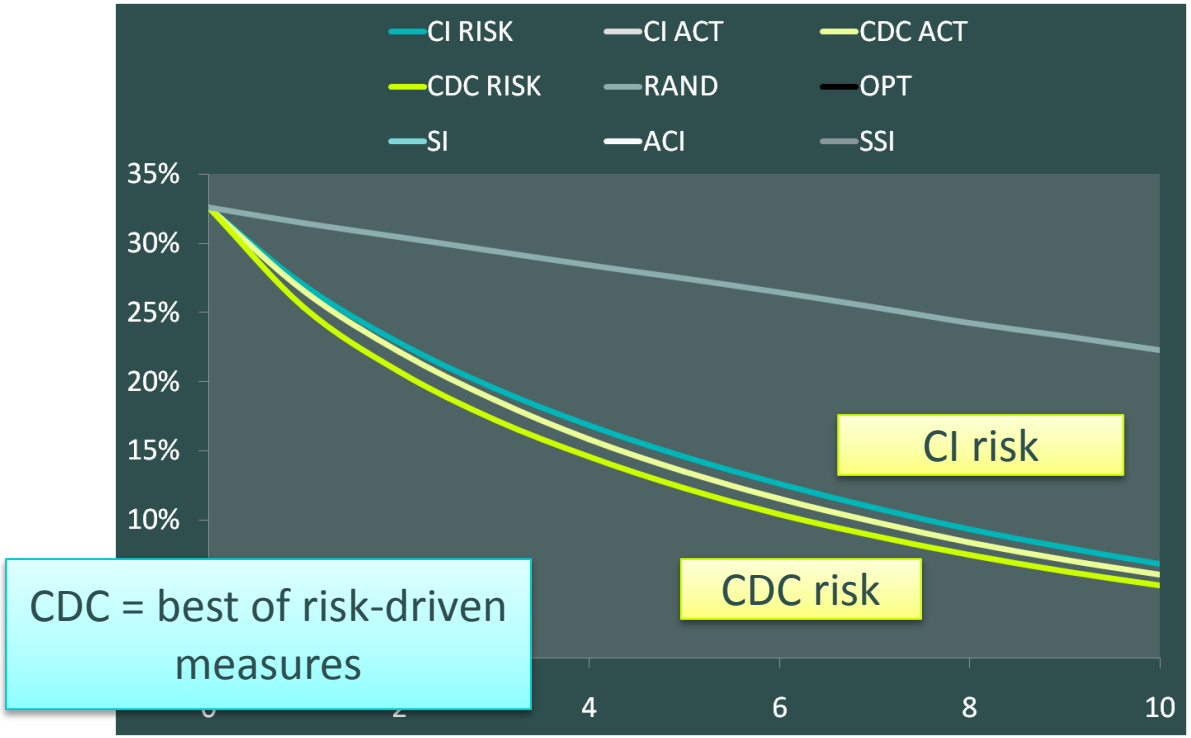

CDC = best of risk-driven measures

Conclusions

- A risk-driven approach to project risk analysis is better than a activity-based approach
- CDC is able to outperform current best practice measures (activity-based AND risk-driven)
- CDC is very close to greedy optimal
- Results are robust/hold for a wide variety of settings