Technical Liability: Extending the Techical Debt Metaphor

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Imagine Someone offered you the following insurance deal

- We will indemnify you organization against the following future costs resulting from shipping your software
  - Data breeches
  - Data losses
  - Excess support costs (above some deductible)
  - Down time losses
  - Maybe others
- However, it will cost you $X
- What should you do?

This is not entirely a fantasy: Some examples exist

- http://www.hiscoxusa.com/small-business-insurance/business-owner-insurance/data-loss-insurance/
  - What is covered?
    - Lost or damaged electronic data
    - Interruption of computer operations
    - E-commerce coverage
  - What is not covered?
    - Your liability due to data loss
  - Your mistakes
  - Employee actions
- Also see http://datainsurance.org

Suppose further, some accountant says:

- "Oh, I see this is like any other kind of insurance. Either we buy it or we self-insure. Either way this code creates an liability"
- This liability must be accounted for on the books (maybe)
- In any case, the fair price of the self-insurance affects the asset value of the code.

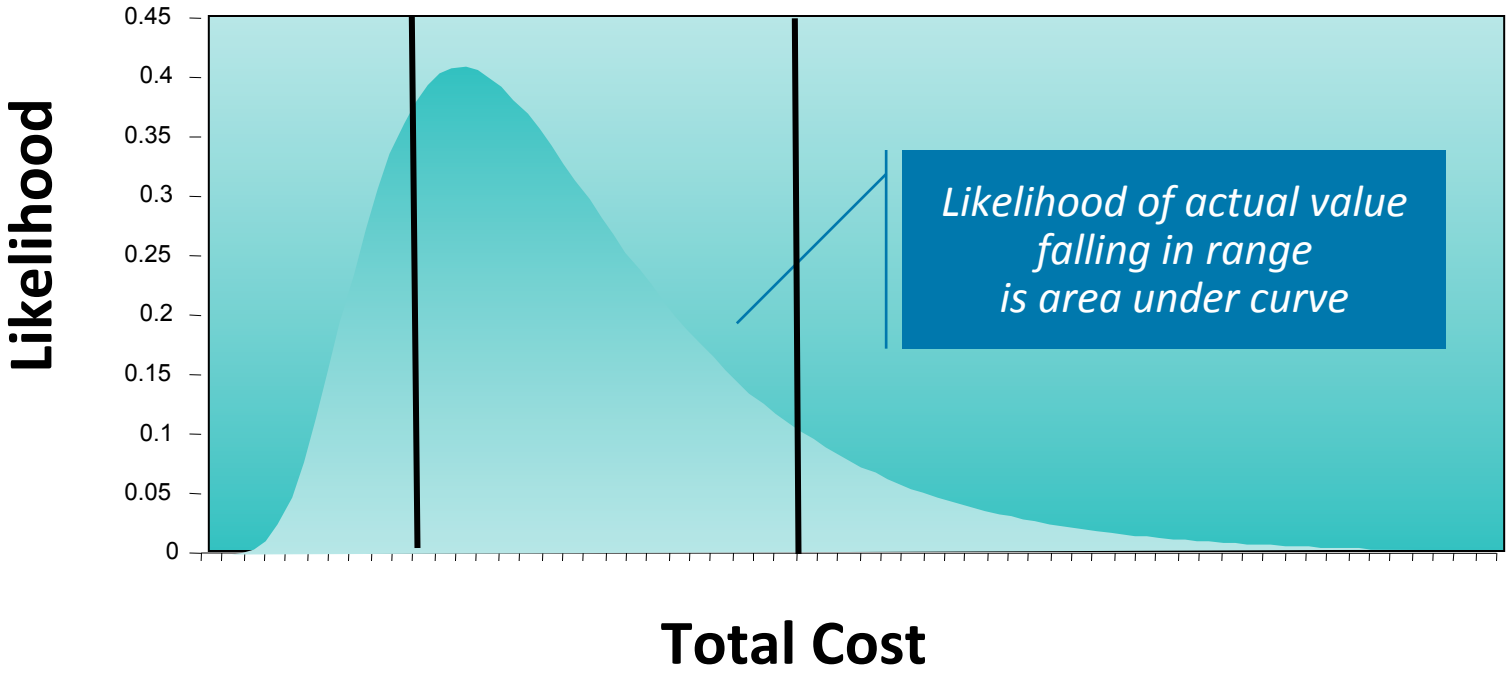
Questions arise

- How to calculate X?
- Is X like driving insurance, good drivers get better rates?
  - What can you do the code to lower X?
- Should we buy the insurance or self insure?

So how to compute X: Some observations

- Context dependent
  - More liability assumed for next release of an avionics dashboard than the next release of angry birds
  - Explore the range of future costs
- The liability involves the likelihood of future events:
  - X has to be approached probabilistically, in particular it requires predictive analytics
  - X depends on the lifetime of the code or at least
  - X is measured in currency

Uncertain values are captured as ‘Random Variables’ characterized by a probability distribution functions

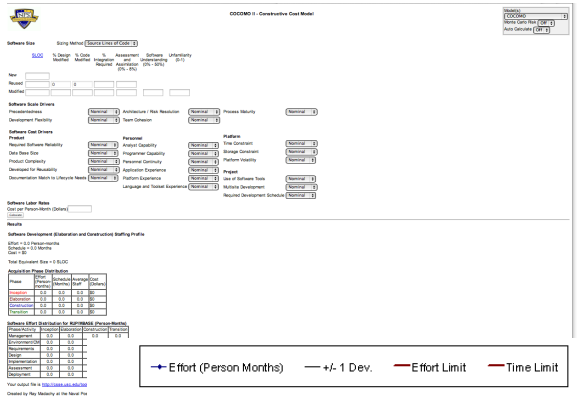


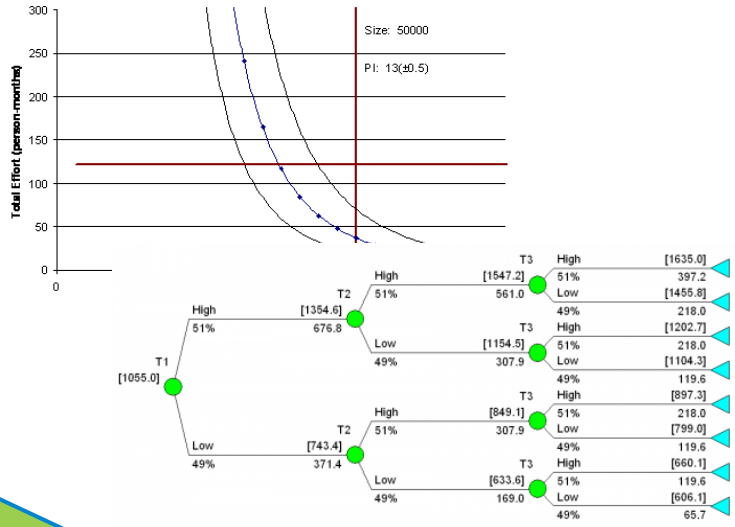
How to find the distributions

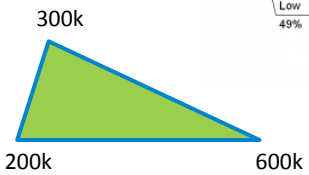
- **Initial**
  - **Build some sort of model of the future with random variables**
  - **Apply Monte Carlo simulation to get initial distribution**
- **Refine**
  - **Gather actuals as they occur**
  - **Use Bayesian techniques to refine estimates using actuals as evidence**

Some approaches to predictive analytics

- **Parametric models, curve fitting**
  - Assume some *a priori* function of project duration based on program parameters (klocs, staff members, complexity, nature of program, ….)
  - Fit multivariate curves to actuals over project population
  - Examples
    - Exponential curves: COCOMO[1], SEER[2]
    - Rayleigh Distribution: SLIM[3]
  - Note: dispersion is captured as cone of uncertainty
- **Decision trees[4]**
  - Model development as a set of decision points
  - Each decision point is specified as a discrete probability distribution.
  - Outcome distribution is found applying Monte Carlo simulation
  - Related to Real Options, Black-Scholes
- **Expert opinion[5]**
  - Ask experts for best case, worse case, likely case
  - Train and calibrate organization using feedback from actuals
  - Convert experts opinion to triangular distributions



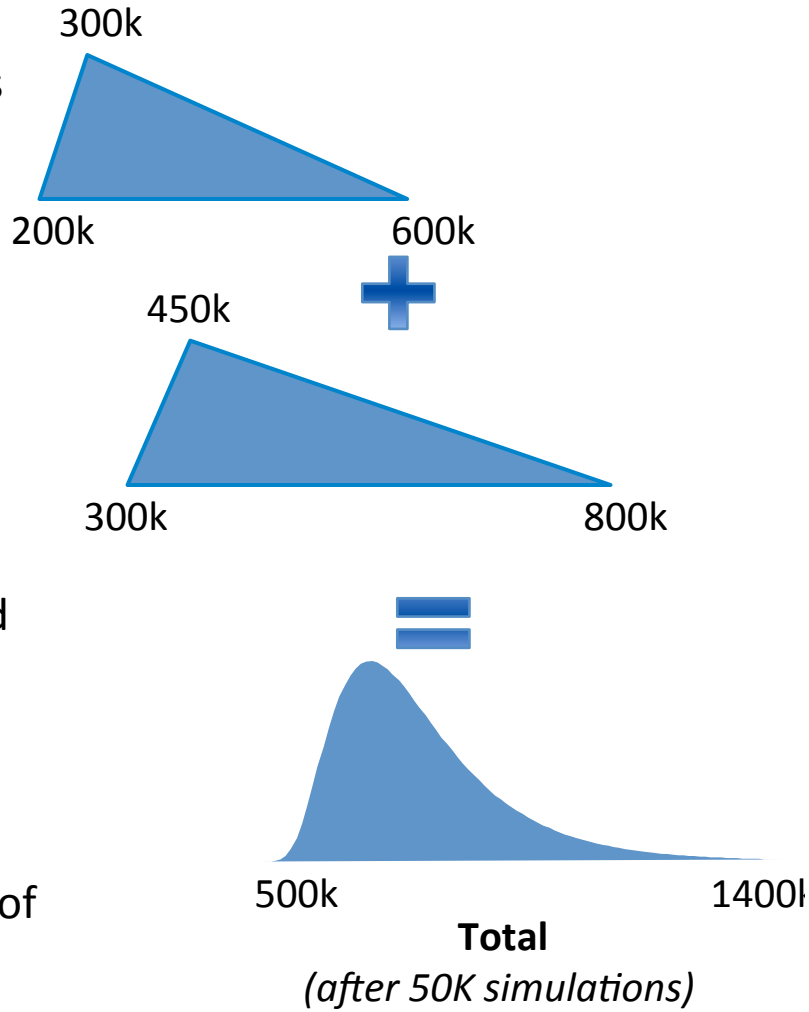




[1]http://csse.usc.edu/csse/research/COCOMOII/cocomo_main.html
[2]http://galorath.com/?gclid=CKChxejH9bgCFYai4AodhiAAHw
[3]http://www.qsm.com/tools/slim-estimate?gclid=CL3RxJHI9bgCFQai4AodrTwARg
[4]Hakan Erdogmus, "Valuation of learning options in software development under private and market risk." The Engineering Economist 47(3):308-353 (2002).
[5]Douglas Hubbard, *How to Measure Anything: Finding the Value of Intangibles in Business,* Wiley; 2 edition (April 7, 2010)

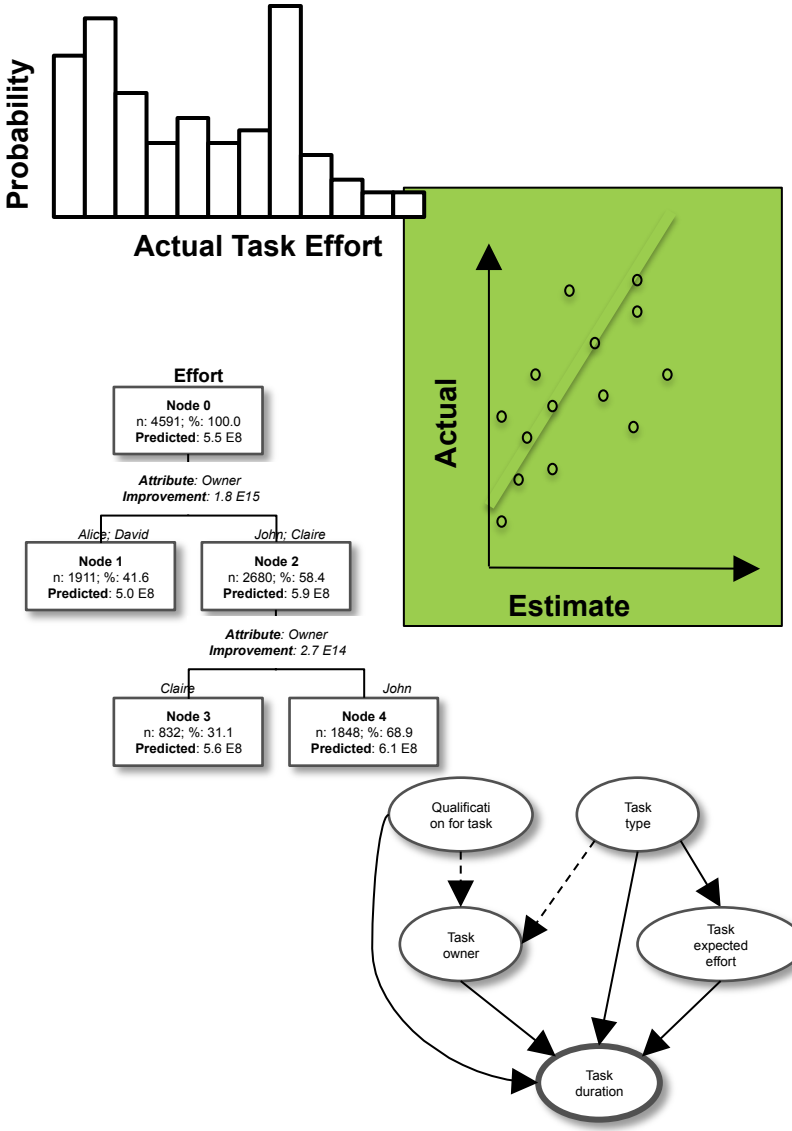
Monte Carlo simulation helps us find the distributions

- Monte Carlo simulation allows us to understand the possible outcomes of a process, and their likelihoods
- For example, suppose service costs for
  - 2014 is estimated: Best case $200K, Likely $300K and Worse Case $600K
  - 2015 is estimated: Best case $300K, Likely $450K and Worse Case $800K
  - …
- To find the distribution of the sum, convert informed guesses into triangular distributions.
- Thousands of times sample the distributions and record the sums.
- Normalize histogram of the sums to get distribution of outcomes.



Techniques for Learning From Actuals

1. Leverage actual distribution
   - The actuals form a distribution
   - We can sample from this distribution during Monte Carlo simulation
2. Predicting based on relationships between estimates and actuals *(regression)*
   - If estimates and actuals are strongly correlated, regression analysis can be useful in predicting actuals from estimates
3. Predicting based on learned relationships between multiple variables and actuals
4. Bayesian Networks
   - After 50 tasks complete, we have new evidence:
     - DB tasks: effort = [11d, 16d, 42d], type = 20%
     - Analytics tasks: effort = [4d, 16d, 20d], type = 75%
     - Mobile tasks: effort = [1d, 2d, 4d], type = 5%
   - We can update the conditional probabilities to reflect this learned evidence



Proposal

Technical liability **is the cost of insuring against all of the future costs that may result over the lifetime of the code.**

Technical Liability Extends the Technical Debt Metaphor: It is cost assumed by delivering code

Technical Debt

- Deterministic (mostly)
- Based on what is known
- Relatively simple computations

Technical Liability

- Probabilistic
- Includes management of uncertainty
- Requires more advanced predictive analytics

Challenges

- Unlike an insurance company, an IT shop may not have big population across which to distribute the risks
- People on their own are not very good at assessing risk.
  - We have biases
  - Hence the rise of predictive decision support tools
- Each kind of liability has its own predictive model: Support, security, data integrity, …
- These models involve skills not common in our community

Discussion: Next Steps

- **Agree on and characterize the problem**
- **Agree on the taxonomy, flavors of liability**
- **Collaborate with subject matter experts to build out models for each flavor of liability (there is a lot of expertise out there)**
  - **Total support costs including executives getting on airplanes**
  - **Product liabilities, recalls, ….**
  - **Security**
  - **…**
- **…**

"The only way to predict the future is to have power to shape the future."

~ Eric Hoffer

Questions