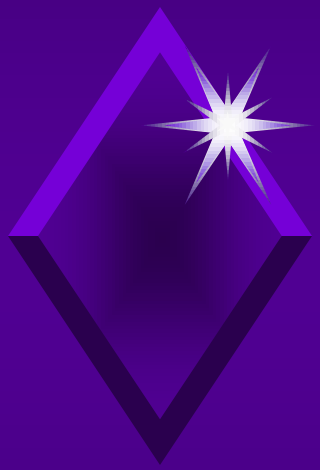
Why Did Risk Analysis Fail?



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Did Risk Analyses Fail?

- Financial crisis: “Kill All the Quants”
- Models underrated growing risk
- Managers didn’t believe models
- Some deliberate misstatement
- Some genuine modeling errors
- Questionable assessment of predictions

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Did Risk Analyses Fail?

- BP Spill: “Why didn’t we know?”
- Gov’t. ignored pattern of risky practice
- Gov’t. lacked in-house expertise
- BP underestimated risks and under-prepared
- Some genuine modeling errors
- Questionable assessment of predictions

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Did Risk Analyses Fail?

- Katrina: “Who should have acted?”
- Gov’t. postponed needed repairs to levees
- Gov’t. shifted expertise to other risks
- Louisiana and New Orleans underestimated risks and under-prepared
- Serious modeling error: understated risk from Lake Pontchartrain side of the city
- Questionable assessment of predictions

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Unduly Limiting Assumptions

- Financial crisis: credit scores based on recent experience, which saw no downturns
- In a crisis, usually uncorrelated behaviors become correlated (e.g. urgent selling)
- BP: Is the geologic structure unusual here?
- Katrina: How do people without cars evacuate after the buses stop running?

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Over-Reliance on Inappropriate Theory

- Estimating oil spill risks from tankers: analyst wanted data from entire distribution, including very small spills
- Question: how much do small spills tell you about large spills?
- Response: “You don’t understand statistics”

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Underestimating Probabilities and Effects of Rare Events

- Unknown rare events may be overlooked entirely
- Some locations have had three or four "hundred-year floods" in past century
- Confidence intervals overstate precision when rare events are not included
- Expert judgments are often uncalibrated

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Excessive Trust in Markets

- FNMA: CEO believed market price, not model's
- Markets are myopic, tend not to give sufficient weight to sketchy information
- Assumption of equal information among parties may not hold -- hard to pin down

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Over-Specialization, Resistance Among Disciplines

- FNMA: CEO trusted conventional economics over risk models
- BP: economists, geologists, risk analysts tend not to talk, or to talk past each other
- Early credit scoring: resistance to letting models override loan officers' judgment
- FICO first tried medical risk: no takers

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Insufficient Empiricism About Quantitative Methods

- D. W. Hubbard survey: several popular techniques increase comfort far more than they improve actual results
- Examples he cites: balanced scorecards, AHP
- We should insist on assessing how accurate our models' predictions were

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Data Problems By Design

- Are the data required available and good?
  (Example: relying on ER diagnostic codes)
- Enough effort spent on data quality?
- Whose responsibility?
- Are key data series available enough ahead of time to make forecasts ?

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Data Needs Poorly Addressed

- Modeling may indicate need for more data
- Additional data collection rarely done
- Tend to collect more of the kinds of data we can get easily, already have
- Should be guided by Expected Value of Perfect Information (EVPI): how much better could we do if we had this measurement precisely?

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Exacerbating Factor: Over-Specialization

- Scott Page: “Diversity trumps ability” (from agent-based simulation of traders)
- We all have our blind spots, both as individuals and as disciplines / professions
- Example: Forrester / Meadows World III model omitted all price effects, so economists simply dismissed it; geologists dismiss econometric models that assume prices dominate

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Suggested Corrective Action For Blind Spots

Have design and findings checked by:

- Scenario experts
- Domain experts
- Modelers
- Users

(NRC / NAS, *Behavioral Modeling and Simulation*)

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Another "Feel-Good but…" Technique: Accreditation

- By definition, accreditation means that a model can yield no more surprises -- every result is supported by external sources
- Theorem: A model that can yield no more surprises is of no further analytical use
- Can be a way for opponents to stifle all models
- Often dealt with by stacking the committee, thereby defeating the purpose

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Overly Powerful Assumptions

- System Dynamics: feedback loops structure essentially determines model behavior
- Advantage: insensitive to data problems
- Disadvantage: insensitive to data, period!
- Useful for exploring relationships, very difficult to calibrate predictions

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Overly Powerful Assumptions

- Agent-Based Simulation: agent structure essentially determines model behavior
- Many of the same issues as System Dynamics
- Useful for exploring relationships, very difficult to calibrate predictions
- “Story-telling” output is most useful

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Complexity Validation Theorem

The more closely a model approximates the complexity of reality, the harder it becomes to distinguish genuine rare events from programming deficiencies.

(Proof follows “Scott Effect” reasoning)

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Conservation of Uncertainty

The more an analyst thinks he knows about a situation, the more evidence it takes to convince him to change his assessment.

Rather than reducing uncertainty, modeling relocates uncertainty from the calculations to the assumptions.

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Helpful Methods

- Exploratory methods (SD, ABS) coupled with SME reviews, other more data-driven approaches
- Wargaming
- Better pattern recognition, especially supervised data mining, spatial-temporal

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Some Useful Ideas

- Pay attention to non-random missing (examples: leaving “employer” blank on a consumer credit application, country that stops keeping good demographic statistics)
- Understand process behind apparent data anomalies (example: discontinuities in manpower modeling are often the events)

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Additional Useful Ideas

- Calculate value of expending additional resources to get more data, and allocate accordingly (EVPI)
- Collect data that would most reduce your uncertainty about critical consequences
- Collect data about facts, not perceptions
- Integrate qualitative and quantitative

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The Basis of Good Analysis

Analysis rests on a tripod:

- Technique
- Subject matter knowledge
- Just plain good thinking

No two are a good substitute for the third.

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A War Game Example

- Yellow: 1000 land-based ICBMs, 20 missile submarines, 300,000-man army
- Purple: 1000 land-based ICBMs, 900,000-man army
- Between them is a neutral area they covet
- ICBMs have 95% kill probability
- Who wants to start a war?

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War Game Example: Scenario 1

- Guaranteed enforceable no-first-use plan: limit throw weights of ICBMs so that it would take two to kill one
- Do both parties like this plan?

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War Game Example: Scenario 2

- Give Purple 5000 ICBMs
- Give Yellow 1000 interceptors that can shoot down an incoming ICBM with 80% probability
- Interceptors can choose their targets after incoming missiles' targets are apparent
- Who likes this plan?

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Findings

- Powerful method to illuminate issues and highlight previously unsuspected outcomes
- Critically dependent on quality of scenario, diversity and skill of players
- Tends to make quantitative methods seem less relevant and useful
- Hard to identify and estimate remaining unknown risks

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Conclusions

- Many modeling methods understate risks because of data problems, bad assumptions
- Exploratory methods can help identify low-probability, high-consequence threats to include in consideration
- Cross-cutting multidisciplinary analyses help find blind spots and reduce their effect
- Methodology is no substitute for thinking!

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