Project Management for Scientists

Risk Management

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Outline

- Project Risks
- Risk Analysis
- Risk Mitigation

Risks in Projects

- *Risk* = any uncertainty in project
- Not everything will go according to plan
- Risks and their mitigation part of project plan
- Ask: “What could go wrong in this project?”
- Important even for small projects
- *Risk Management* = systematic, disciplined approach to increase likelihood of project success
- “project management = risk management”

Risk Management

- Be ready for the unexpected
- *known risks:* be prepared
- *unknown risks:* realize that they will occur, reserve contingency to deal with them
- Insurance companies:
  - Risk management is main business
  - Prepare for uncertain event
  - Reduce uncertainty, impact

Questions to Ask

- Requirements well understood and documented?
- Cost and time estimates detailed or top-down?
- How likely is scope to change?
- Dedicated resources or part-time basis?
- Key resources assigned or being lost to other projects?
- Will deadlines be pushed out?
- Will sponsor and stakeholders be responsive, meet milestones?
- Will there be technical problems?
- Optimism of single-point estimates addressed?

Path Convergence

- WBS element has >1 predecessors
- Often due to merging of activities or parallel tasks
- Joint probability that one predecessor is late is much higher than for single predecessor
- 2 predecessors with 50% change of being late
- Chance for delay is 75%

Scientific Project Risks

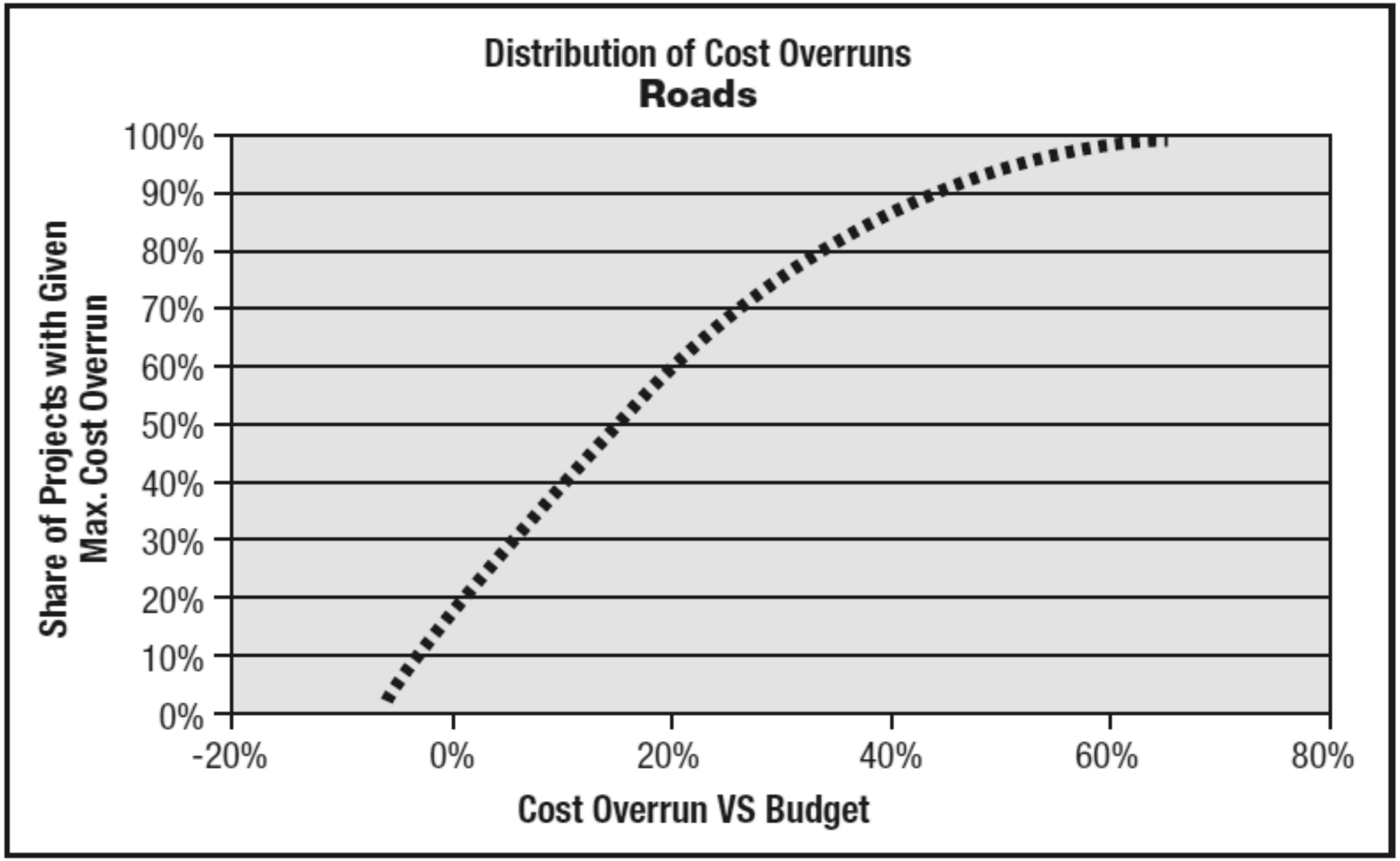
- Fuzzy requirements
- Scope creep
- Technical difficulties
- Underestimated budget, resource requirements
- Insufficient funding commitments

Reference Class Forecasting

- Based on theories of decision-making under uncertainty (Kahneman, Nobel prize in economics 2002)
- Comparison of project with actual performance of comparable projects (*reference class*)

1. Identify reference class: past, similar projects; broad enough to be statistically meaningful, narrow enough to be comparable with specific project
2. Establish probability distribution for reference class; requires credible, empirical data for sufficient number of projects to draw statistically meaningful conclusions
3. Compare specific project with reference class distribution to forecast most likely outcome

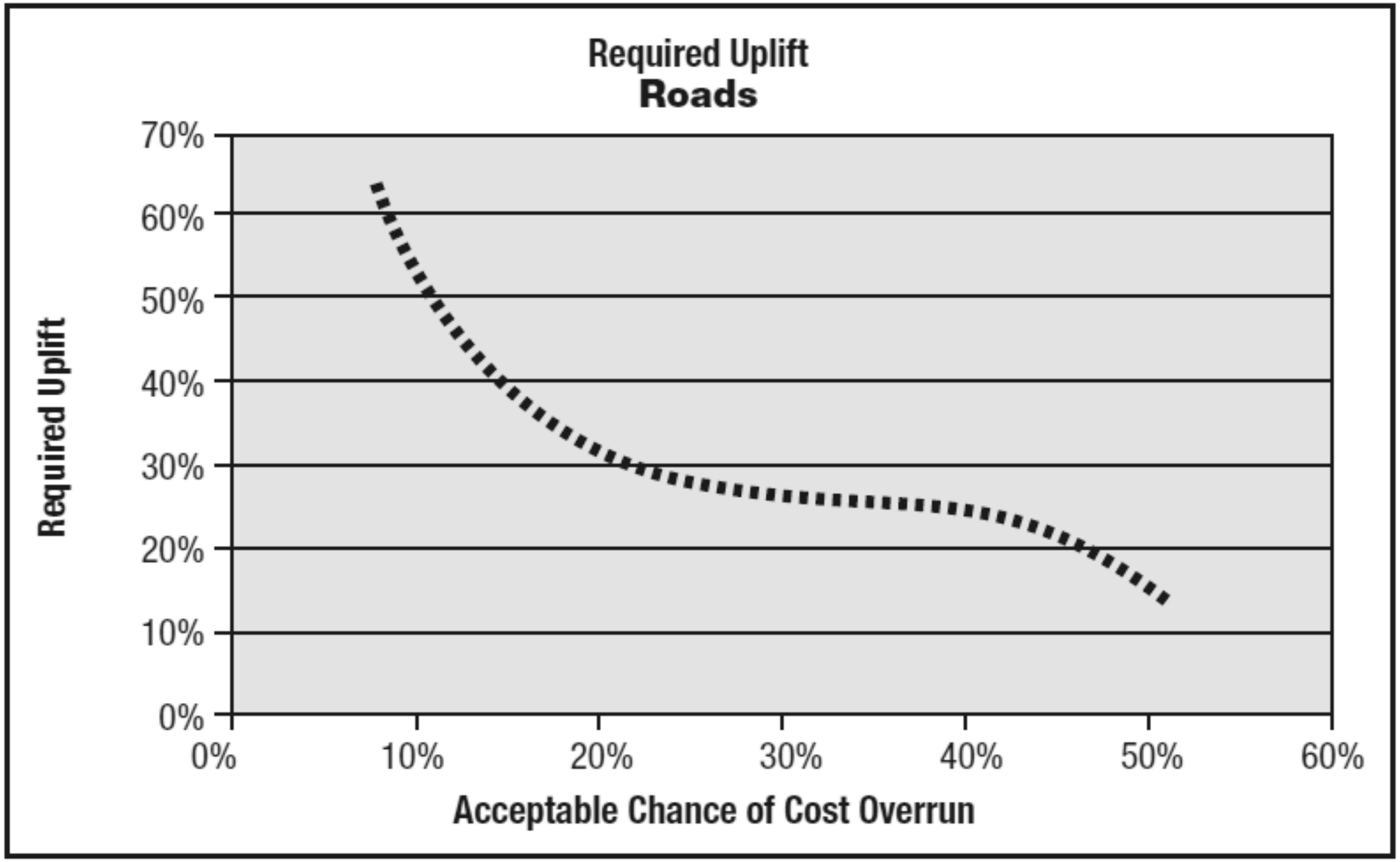
Actual Cost Overruns



Source: Flyvbjerg database on large-scale infrastructure projects.

Flyvbjerg 2006

Uplift



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Flyvbjerg 2006

Risk Management Framework

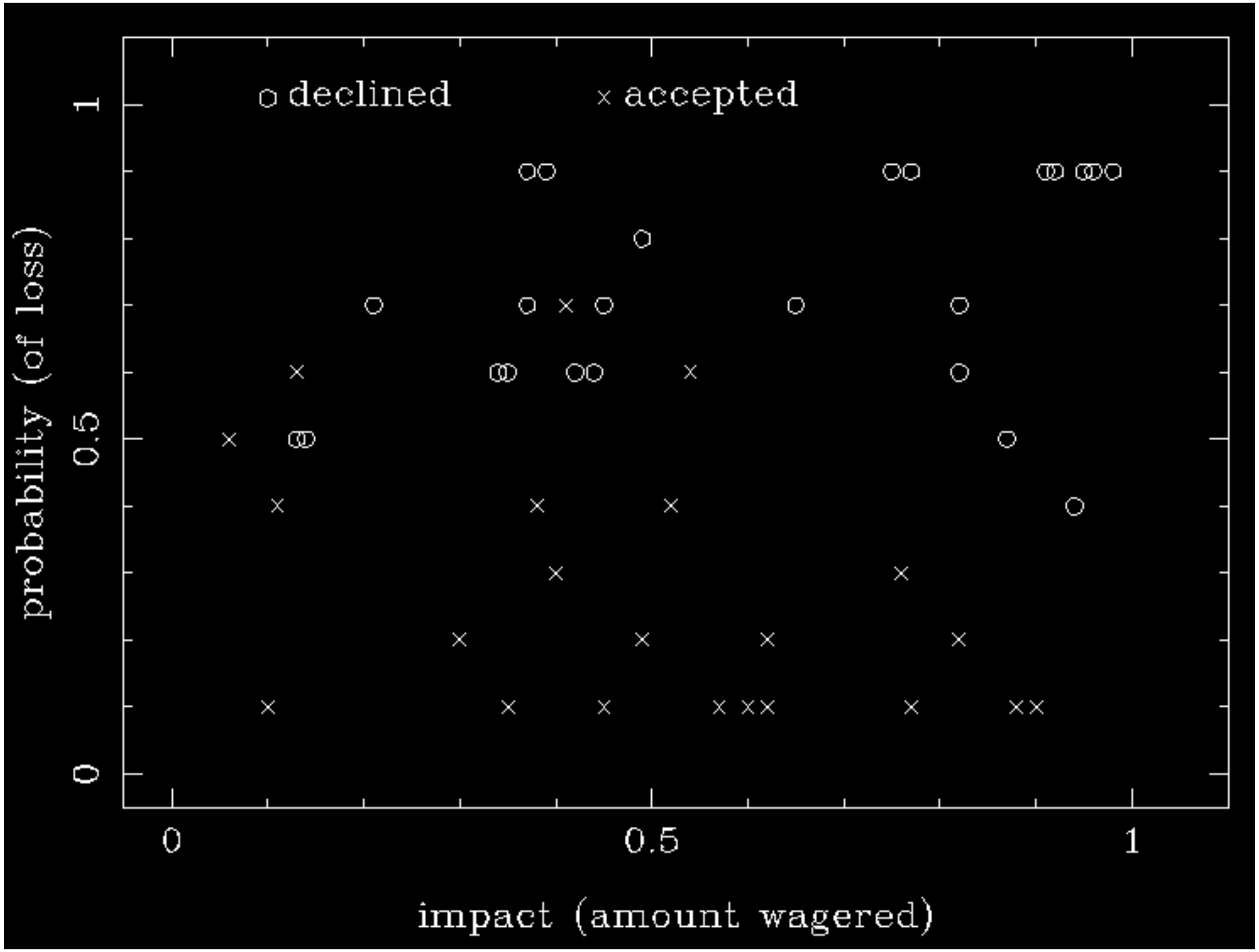
- Risks defined by 3 variables
  - **Event** that disrupts project
  - **Probability** that event will happen
  - **Impact** that event will have on project

1. Identify events by asking "what if ... ?"
2. Analyze probability and potential impact of events and prioritize (high, moderate, low risks)
3. Mitigate (reduce) high and moderate risk events
4. Ignore low risk events

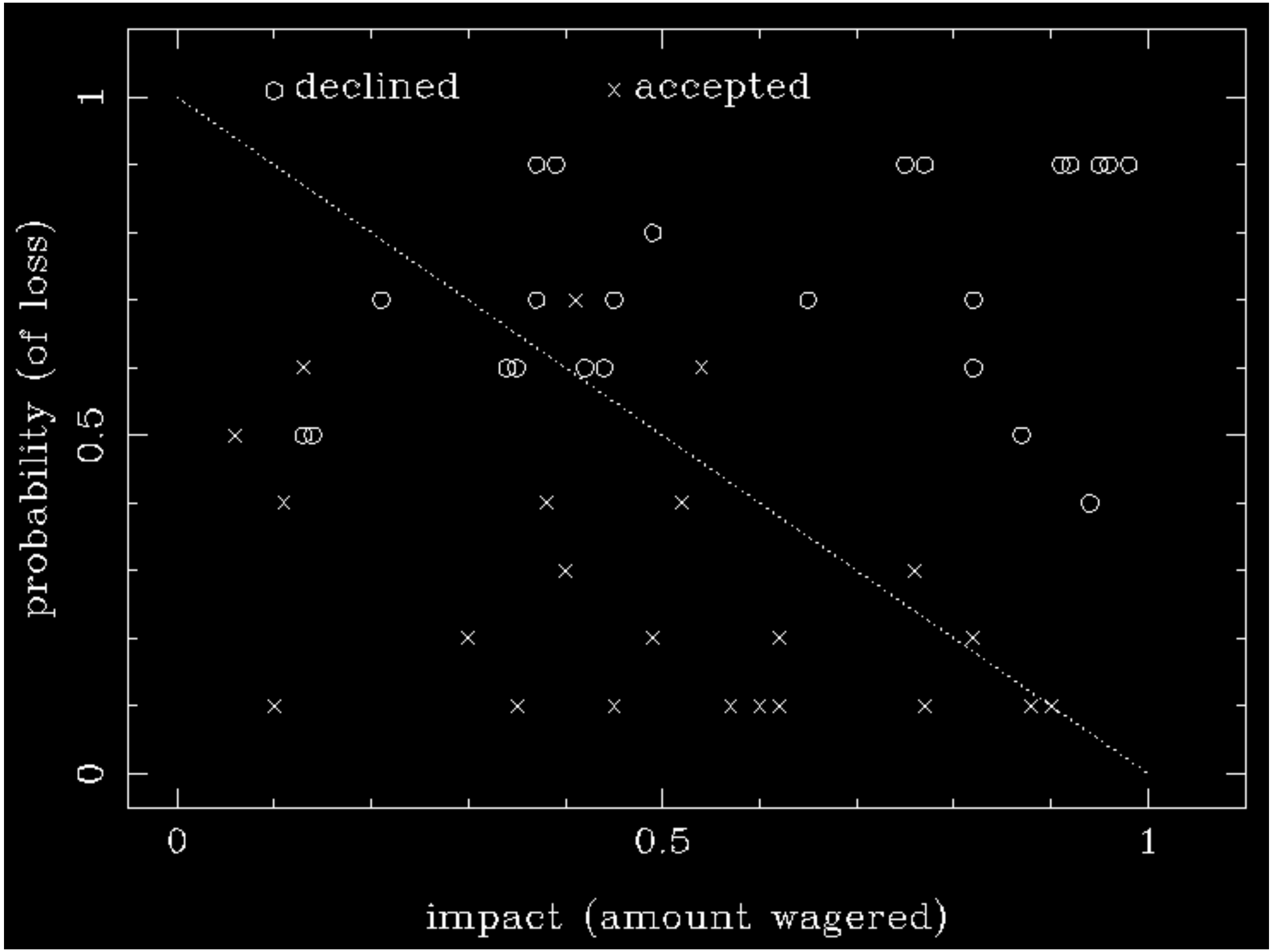
Risk Identification

- Requires skill, experience, knowledge of project management techniques
- Ask stakeholders (brainstorming)
  - No analysis, responses, mitigation etc.
  - Combine similar risks and sort
  - Remove unlikely risks
- Interview individuals with list of questions
- "Anything that can go wrong will go wrong"
- Learn from past, similar projects
- Consider schedule and budget risks

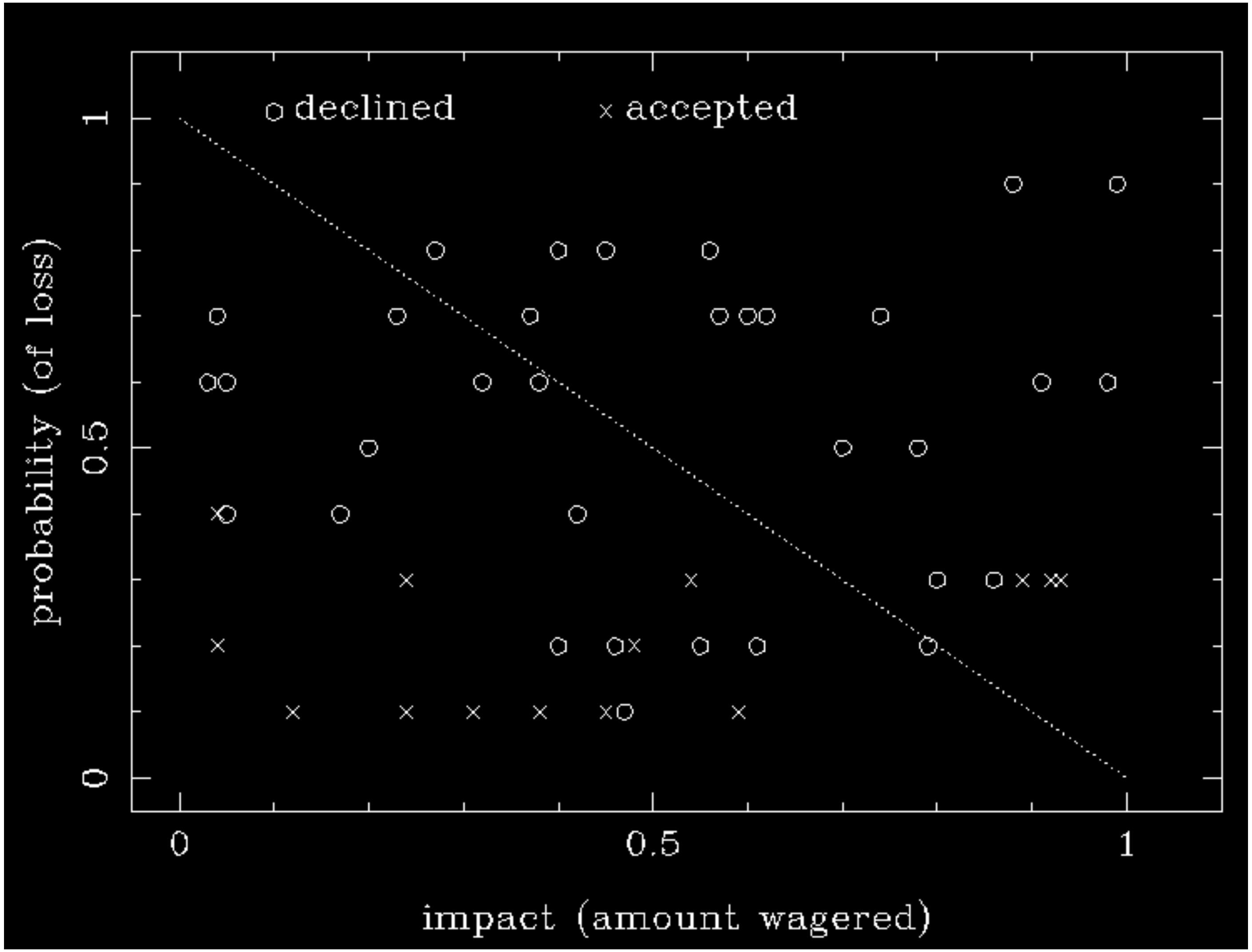
Intuitive Risk Analysis



Intuitive Risk Analysis



Intuitive Risk Analysis



Risk Analysis

- Assign numerical value to probability of occurrence (high = high probability of occurrence)
- Assign numerical value to impact of event on project (high = high cost/schedule/science impact)
- Probability, impact should be assessed by group
- Draw values on 2-D graph, work from top right
- Or multiply 2 values, work top down

Risk Analysis Example

risk	likelihood	impact	rank
spectrograph design not working	6	8	**48**
calibration not precise enough	3	10	**30**
influence of temperature variations on FLC	6	5	**30**
pointing too critical	4	7	**28**
degradation of liquid crystal components	8	3	**24**
alignment too critical	3	7	**21**
camera read-out too slow	3	5	**15**
stiffness requirements too critical	3	3	**9**

Dealing with Risks

- Avoid: don’t do it! (don’t get anything)
- Accept: do you feel lucky? (consequences < cure)
- Mitigate: take action to reduce probability and/or impact (plan B, contingency)
- Transfer: have another party share or take over the risk (insurance)
- Continuous risk (reduction) control

Risk Mitigation

- Reduce impact, probability, or both
- If probability cannot be reduced:
  - Reduce negative impact
  - Monitor risk (detect in due time, trigger implementation of planned actions)
  - Plan alternative (contingency plan: money set aside, etc.)
- If impact cannot be reduced:
  - Reduce probability
  - Phased development
  - Prototyping

Risk Mitigation Example

risk	likeli hood	impact	rank	mitigation
spectrograph design	6	8	**48**	- learn from experts - reduce spectral resolution at edges of spectral range
calibration not precise enough	3	10	**30**	- test on prototype - more manual calibrations
influence of temperature variations on FLC	6	5	**30**	- test on prototype - thermal measurements - thermal isolation - thermal control
pointing too critical	4	7	**28**	- improve hardware/software
degradation of liquid crystal components	8	3	**24**	- regular checks - spare parts
alignment too critical	3	7	**21**	- alignment plan high priority - use tapered fibers - use precision translation stages
camera read-out too slow	3	5	**15**	- accept reduced polarimetric sensitivity
stiffness requirements too critical	3	3	**9**	- move spectrograph to fixed position