Architecture in Five Dimensions

Michael T. Nygard

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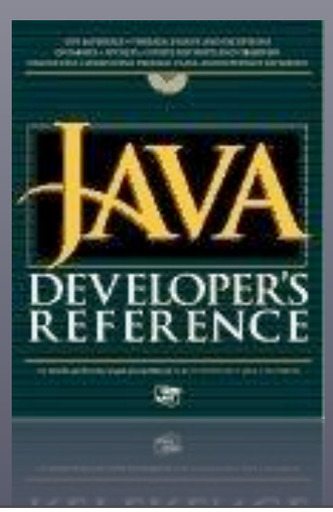
About The Speaker

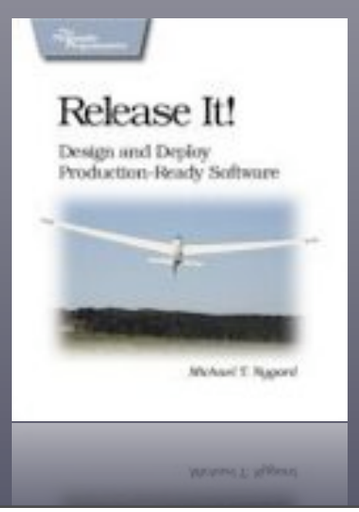
Application Developer/Architect – 20 years

Web Developer – 14 years

IT Operations – 6 years

IT Services Executive - 4 years





About This Talk

About This Talk

- Point in time view

About This Talk

- Point in time view
- Work in progress

About This Talk

- Point in time view
- Work in progress
- Architectural approach to risk management

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- Point in time view
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- Some finance

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  - Some finance
  - Some probability

About This Talk

- Point in time view
- Work in progress
- Architectural approach to risk management
  - Some finance
  - Some probability
  - Plenty of hand waving

Wednesday, October 7, 2009

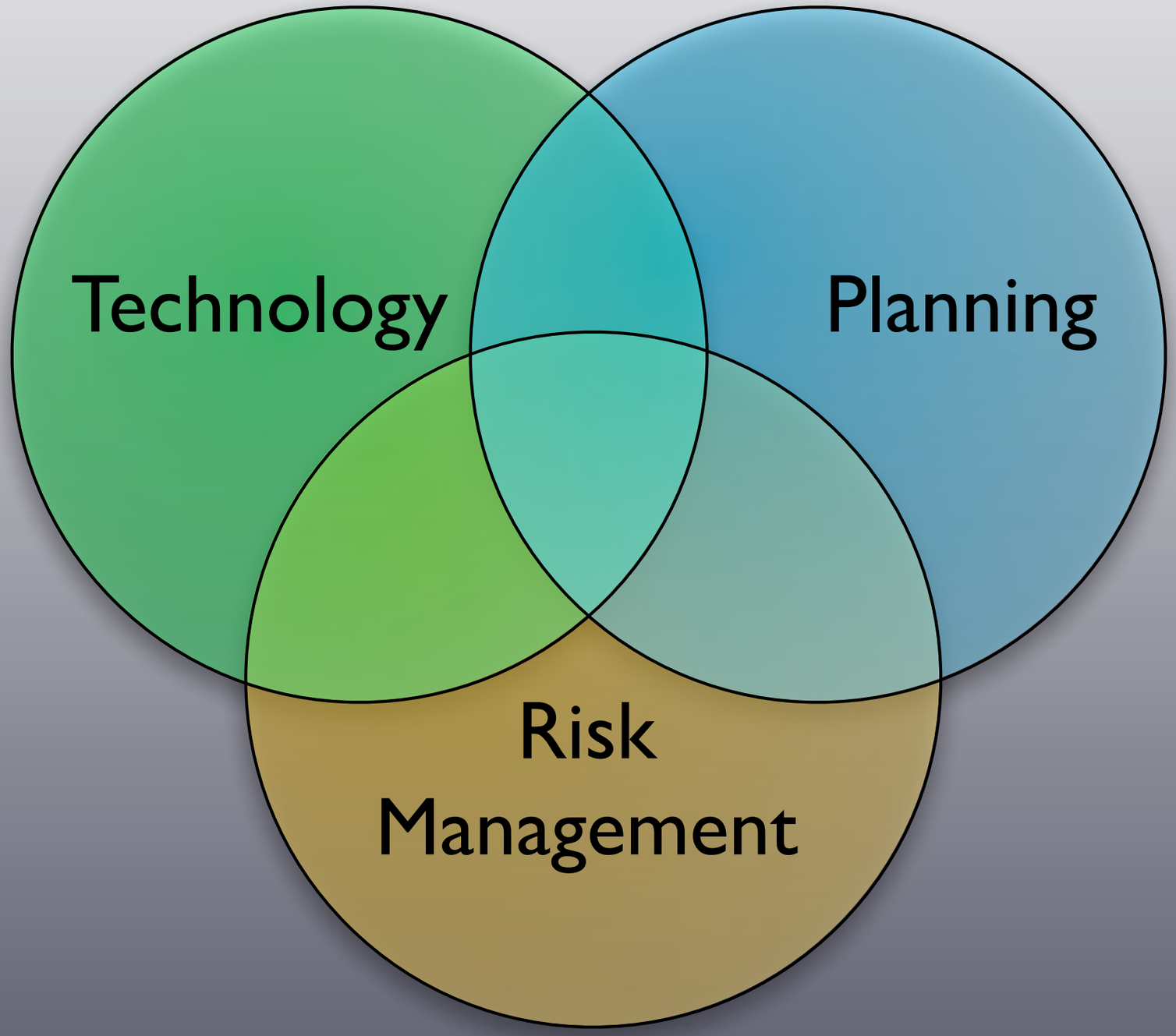
Type of System Covered

- High-consequence
- Distributed
- Transactional
- Commercial

Type of System Covered

- Commercial Web Sites

Focus of This Session



Projects are Experiments
Requirements are Ignorance
Guessing is Truth
Time is Space

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Requirements are Ignorance
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Time is Space

Some Real Examples

Some Real Examples

Planned	
Software	$14M
Hardware	$7.5M
Schedule	18 mo.

Some Real Examples

Planned	Actual
Software $14M Hardware $7.5M Schedule 18 mo.	Software $50M Hardware $12M Schedule 28 mo.

Some Real Examples

Planned	Actual	Outcome
Software $14M Hardware $7.5M Schedule 18 mo.	Software $50M Hardware $12M Schedule 28 mo.	Emergency hardware added due to capacity shortage. Management purged. All developers fired.

Some Real Examples

Some Real Examples

Planned	
Software	$35M
Schedule	24 mo.

Some Real Examples

Planned	Actual
Software $35M	Software $100M+
Schedule 24 mo.	Schedule 60 mo. (and counting)

Some Real Examples

Planned	Actual	Outcome
Software $35M Schedule 24 mo.	Software $100M+ Schedule 60 mo. (and counting)	Revolving chairs. Redshirt syndrome. Business loss of focus.

The Business Case

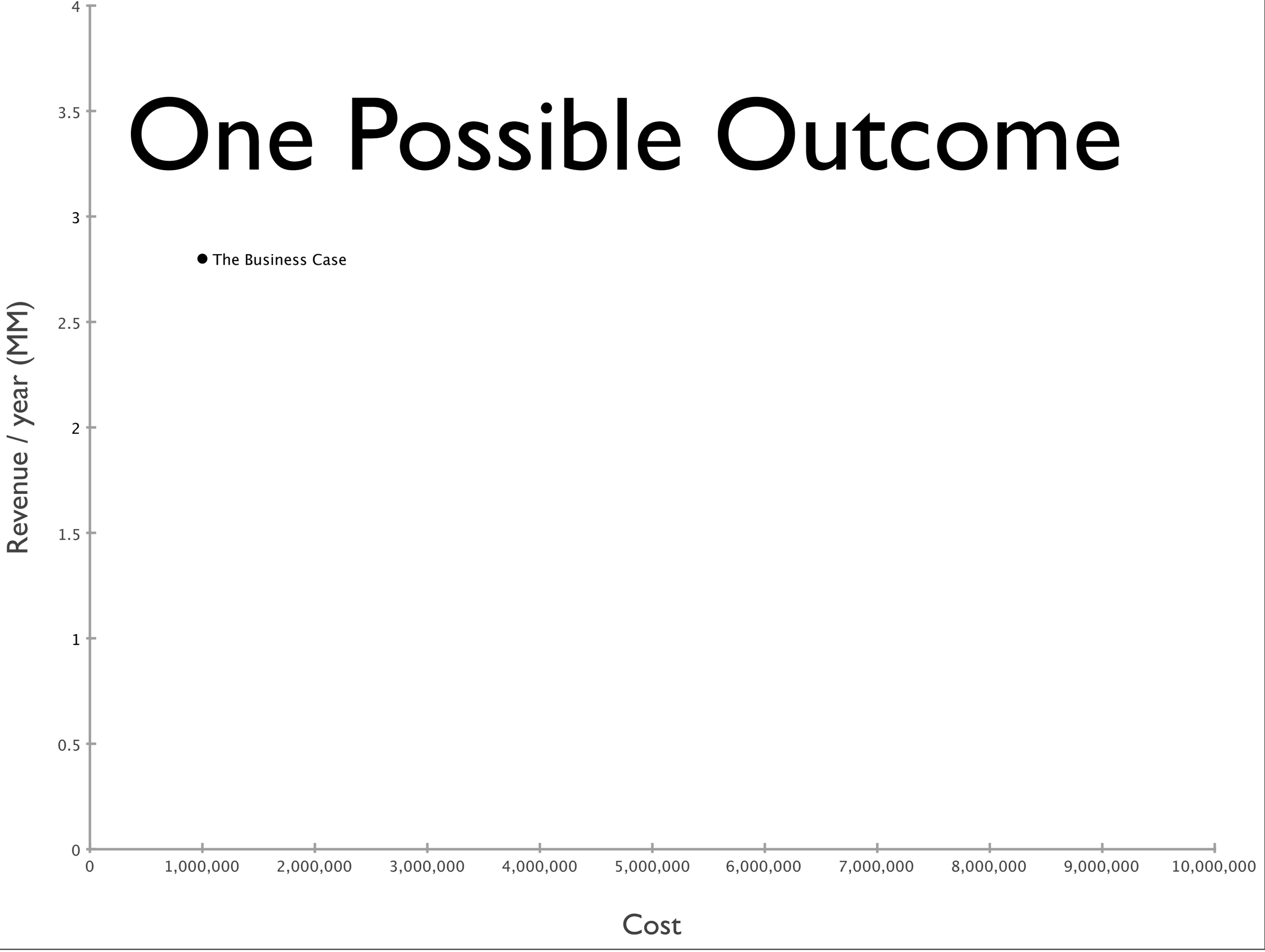
The Business Case

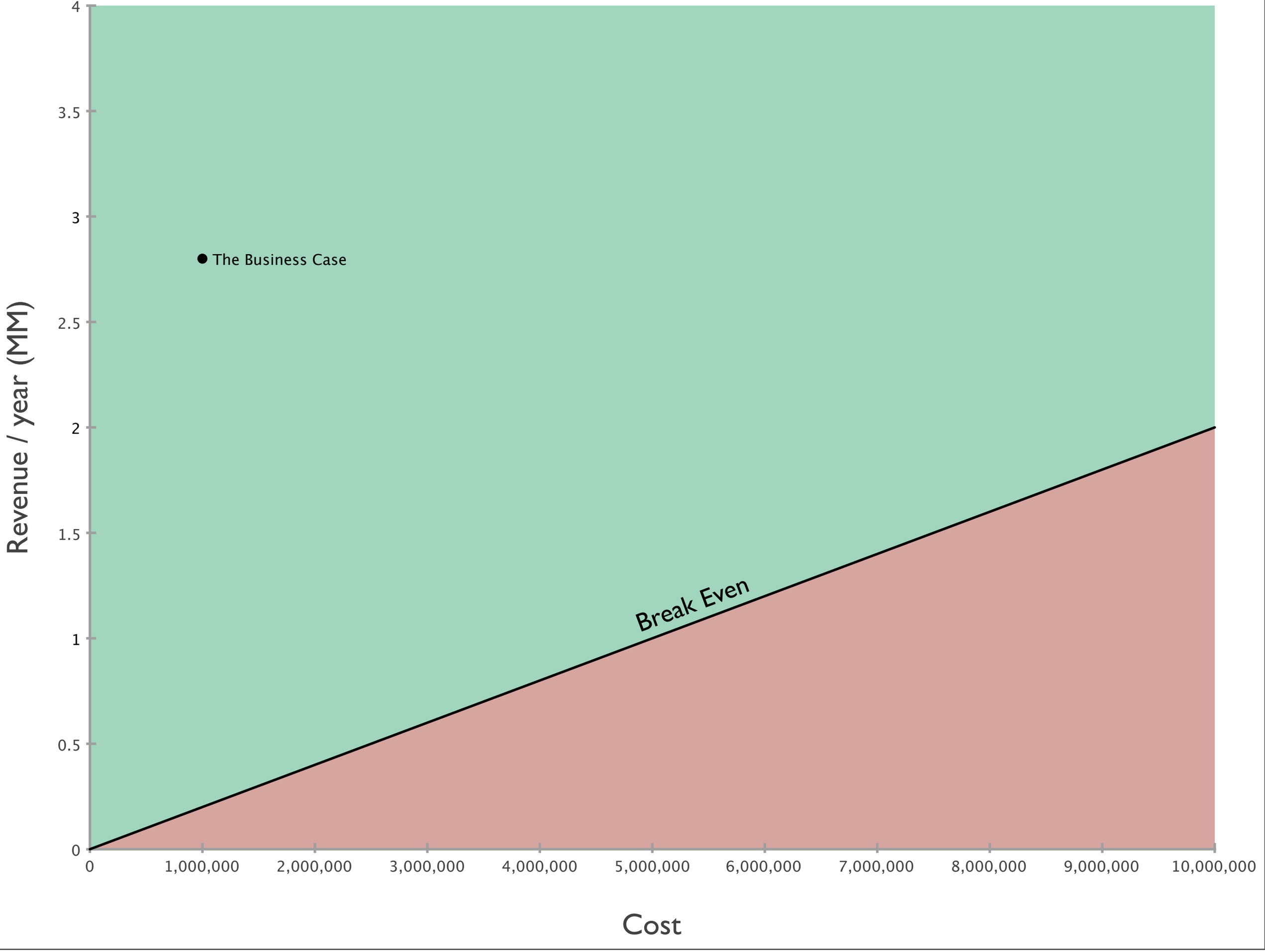
System Blah-de-blah will revolutionize the synergies, exploiting our leveraged positioning with out of the box thinking in a strategic go-to-market posture. Utilizing our 70-70-70 sourcing partnership model, Blah-de-blah 1.0 will be delivered in 8 months at a cost of 1.000.000 with a five year ROI of 1.400,00%.

The Business Case

System Blah-de-blah will revolutionize the synergies, exploiting our leveraged positioning with out of the box thinking in a strategic go-to-market posture. Utilizing our 70-70-70 sourcing partnership model, Blah-de-blah 1.0 will be delivered in 8 months at a cost of 1.000.000 with a five year ROI of 1.400,00%.

One Possible Outcome




Revenue / year (MM)
4
3.5
3
2.5
2
1.5
1
0.5
0
The Business Case
Break Even
0
1,000,000
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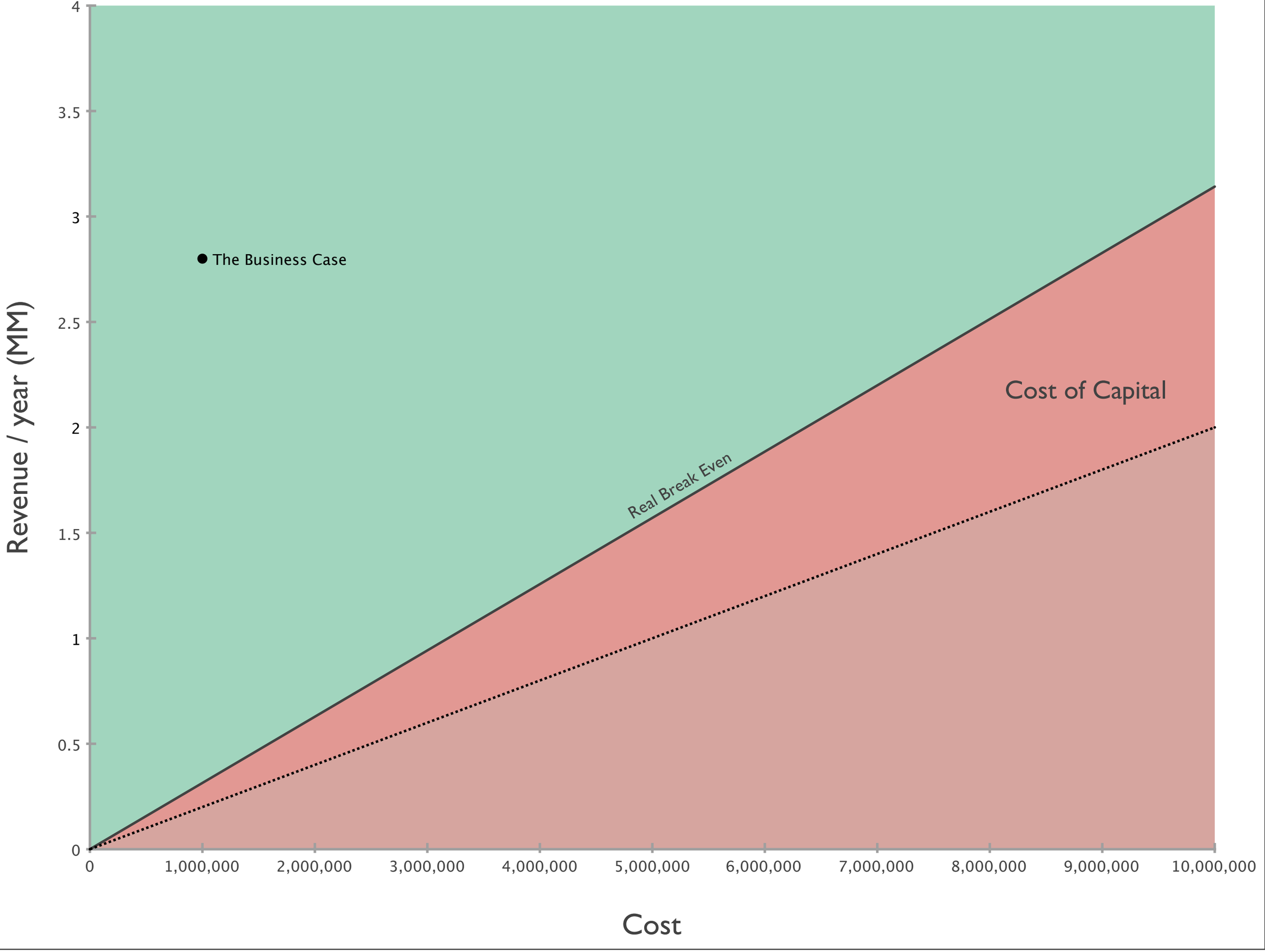
Cost


Revenue / year (MM)
4
3.5
3
2.5
2
1.5
1
0.5
0
The Business Case
Real Break Even
Cost of Capital
0
1,000,000
2,000,000
3,000,000
4,000,000
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7,000,000
8,000,000
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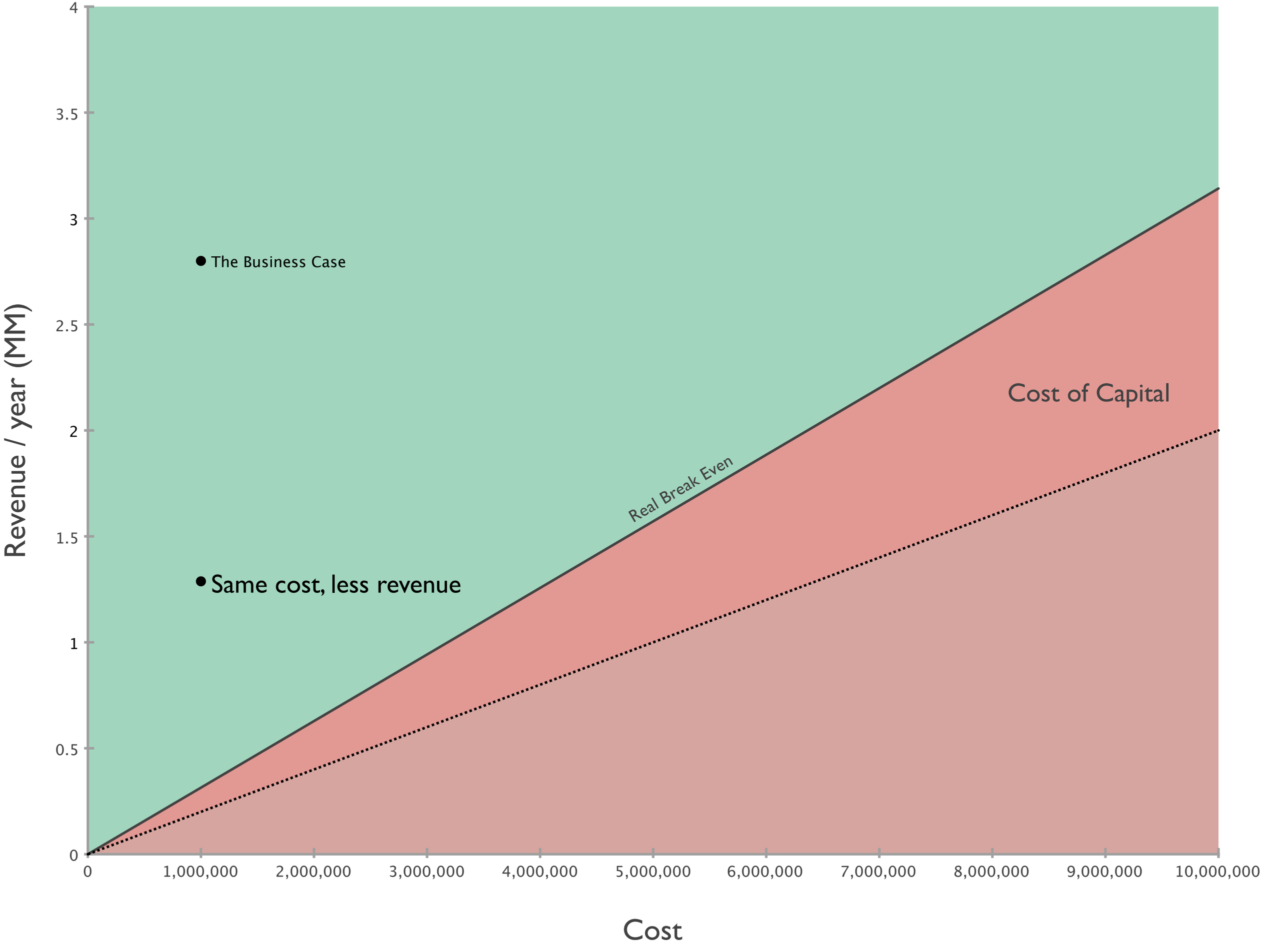
10,000,000
Cost


Revenue / year (MM)
4
3.5
3
2.5
2
1.5
1
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0
The Business Case
Same cost, less revenue
Real Break Even
Cost of Capital
0
1,000,000
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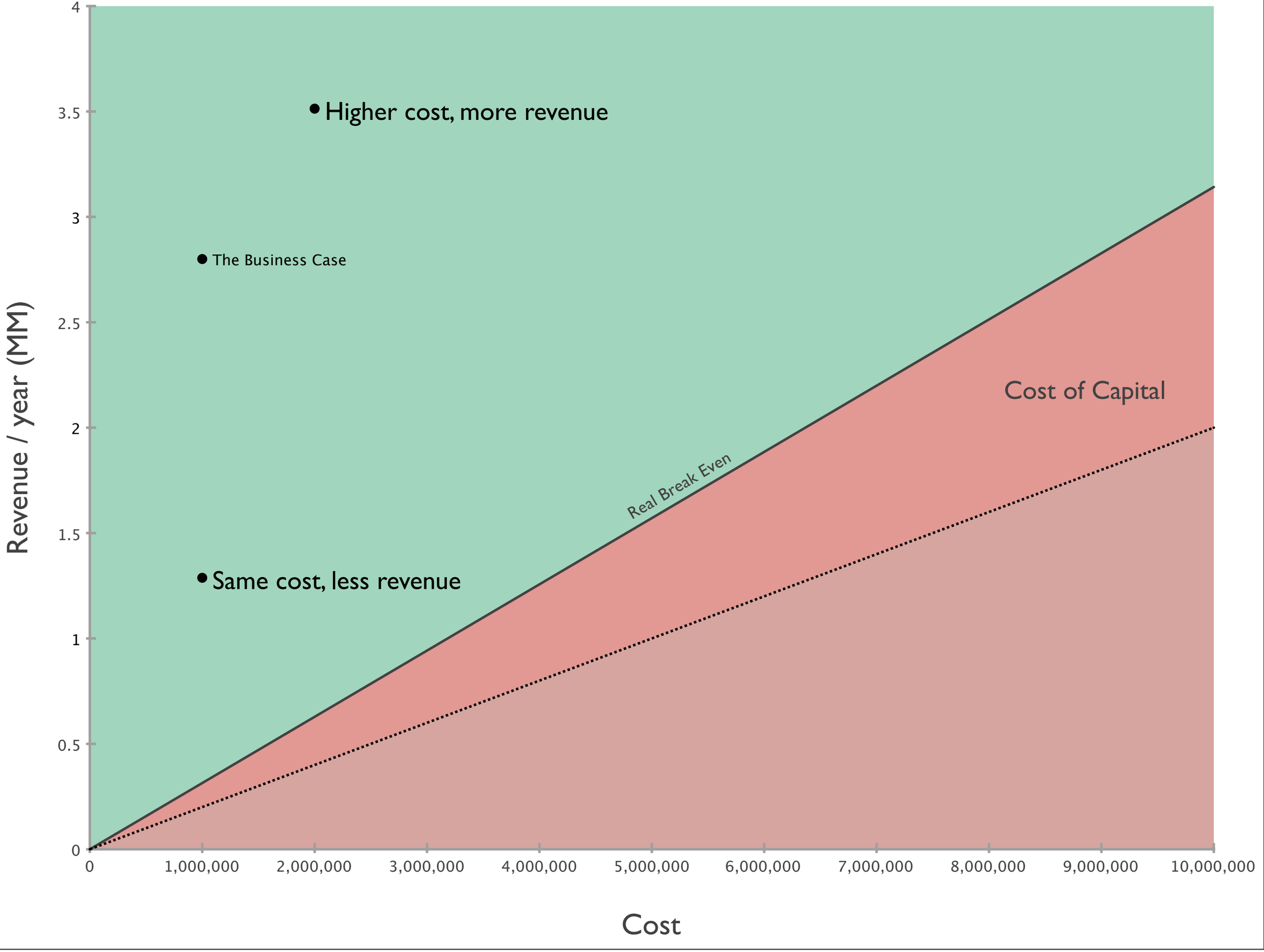
Cost


Higher cost, more revenue
The Business Case
Same cost, less revenue
Cost of Capital
Real Break Even
Revenue / year (MM)
Cost
0
0.5
1
1.5
2
2.5
3
3.5
4
0
1,000,000
2,000,000
3,000,000
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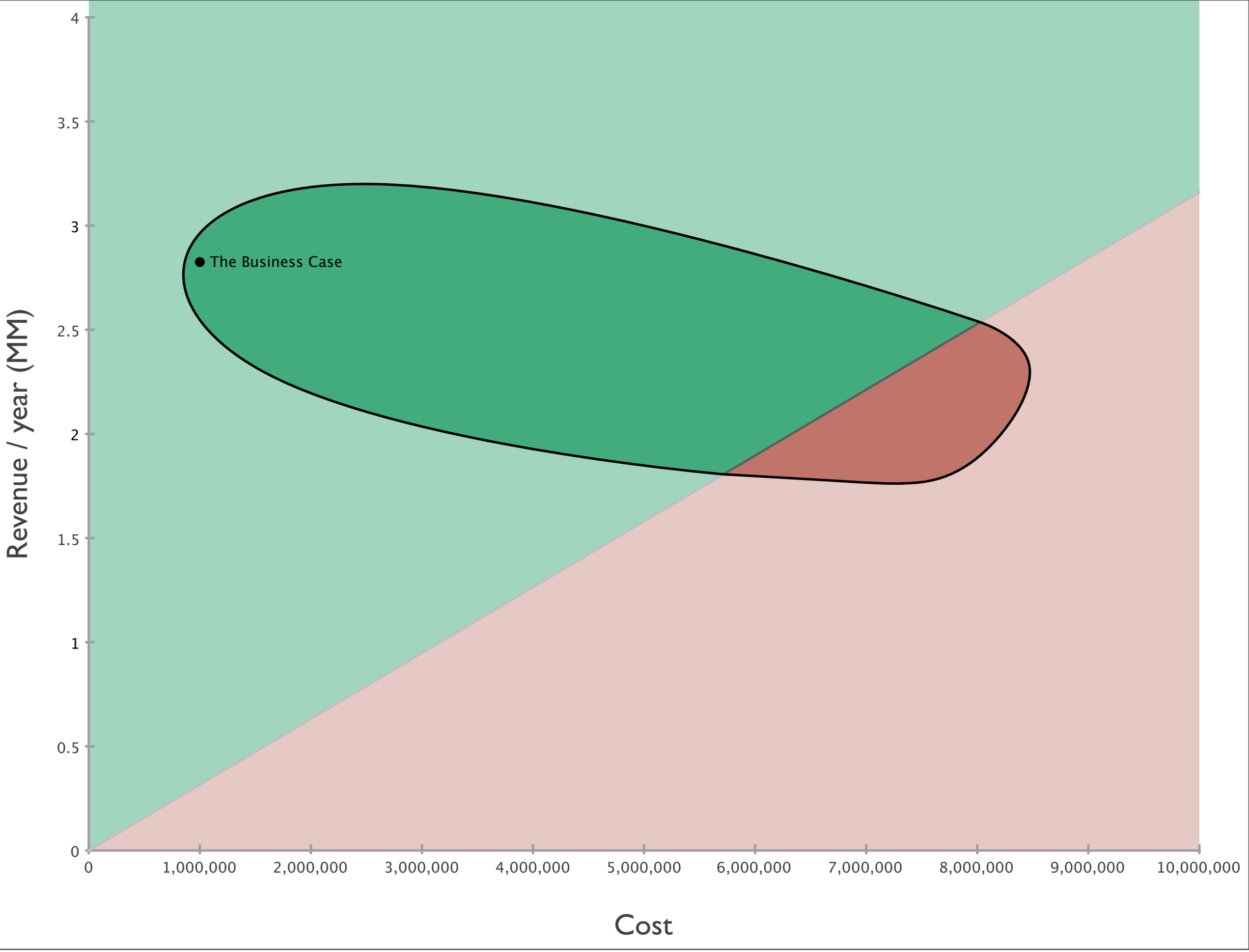
Executing a project

=

Sampling a random variable


The Business Case
Revenue / year (MM)
4
3.5
3
2.5
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3,000,000
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Cost

Risk and Risk Management

Wednesday, October 7, 2009

Risk

Risk

“A state of uncertainty where some of the possibilities involve loss, catastrophe, or other undesirable outcome.”

“How to Measure Anything,” Douglas Hubbard, Wiley 2007

Typical Risk Management

Risk	Impact	Likelihood	Mitigation
ESB late	Medium	High	Personal chef per developer
Data center hit by asteroid	High	Low	Build laser defense grid
Many severe defects	Medium	Medium	Daily bug triage
Worldwide zombie attack	Very high	Low	Stockpile food & ammo

Typical Risk Management

Risk	Impact	Likelihood	Mitigation
ESB late	Medium	High	Personal chef per developer
Data center hit by asteroid	High	Low	Build laser defense grid
Many severe defects	Medium	Medium	Daily bug triage
Worldwide zombie attack	Very high	Low	Stockpile food & ammo

Typical Risk Management

Too specific

	act	Likelihood	Mitigation
E	ium	High	Personal chef per developer
Data center hit by asteroid	High	Low	Build laser defense grid
Many severe defects	Medium	Medium	Daily bug triage
Worldwide zombie attack	Very high	Low	Stockpile food & ammo

Typical Risk Management

Too specific

Too optimistic

	act	Likelihood	Mitigation
E	ium		al chef eloper
Data center hit by asteroid	High		laser e grid
Many severe defects	Medium	Medium	Daily bug triage
Worldwide zombie attack	Very high	Low	Stockpile food & ammo

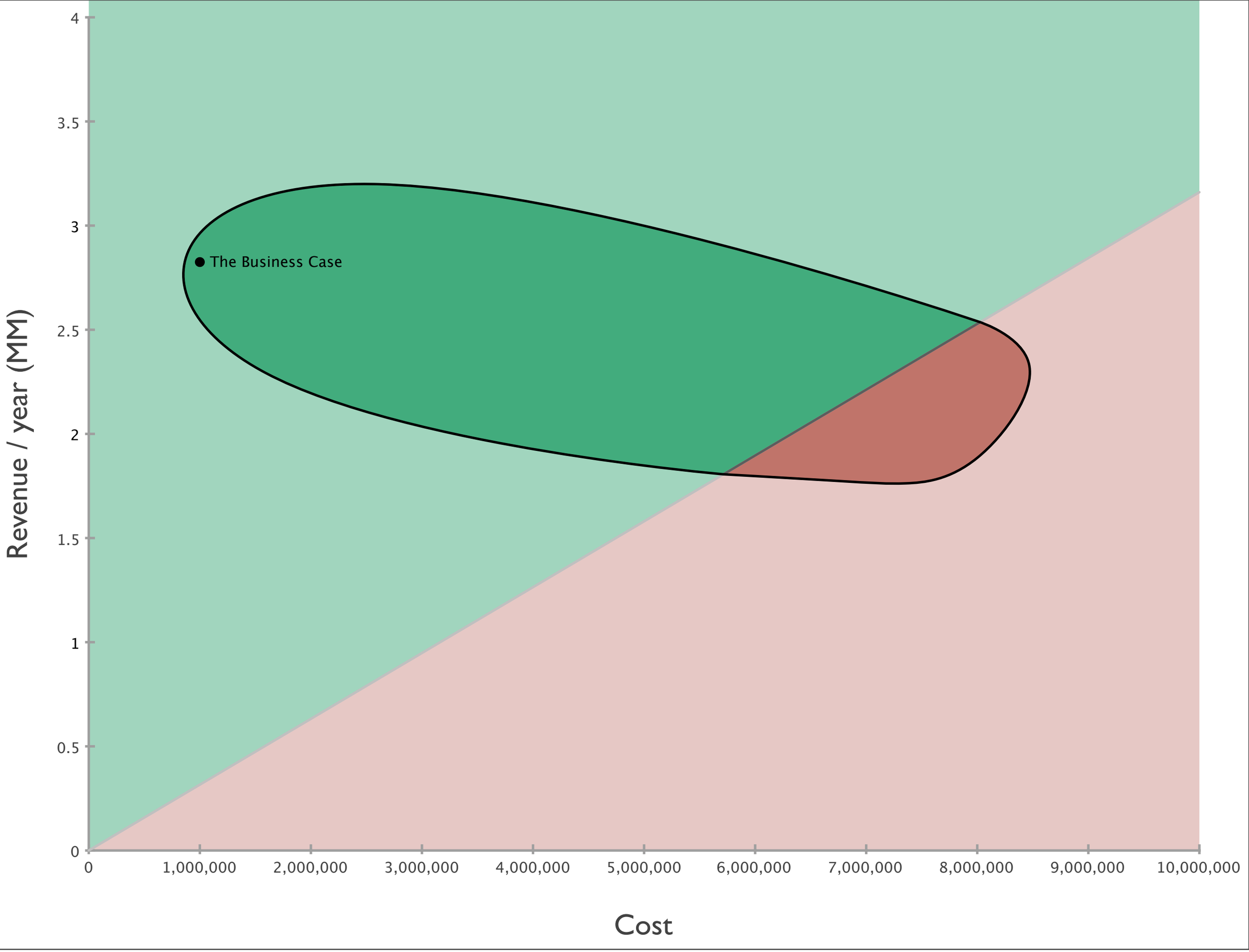
Typical Risk Management

		Likelihood	Mitigation
E	ium		Personal chef eloper
Data center hit by asteroid	High		laser e grid
Many se defec		Medium	Daily bug triage
Worldv zombie attack		Low	Stockpile food & ammo

Too specific

Too optimistic

Covers “movie plot scenarios”, ignores systemic risks


The Business Case
Revenue / year (MM)
4
3.5
3
2.5
2
1.5
1
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2,000,000
3,000,000
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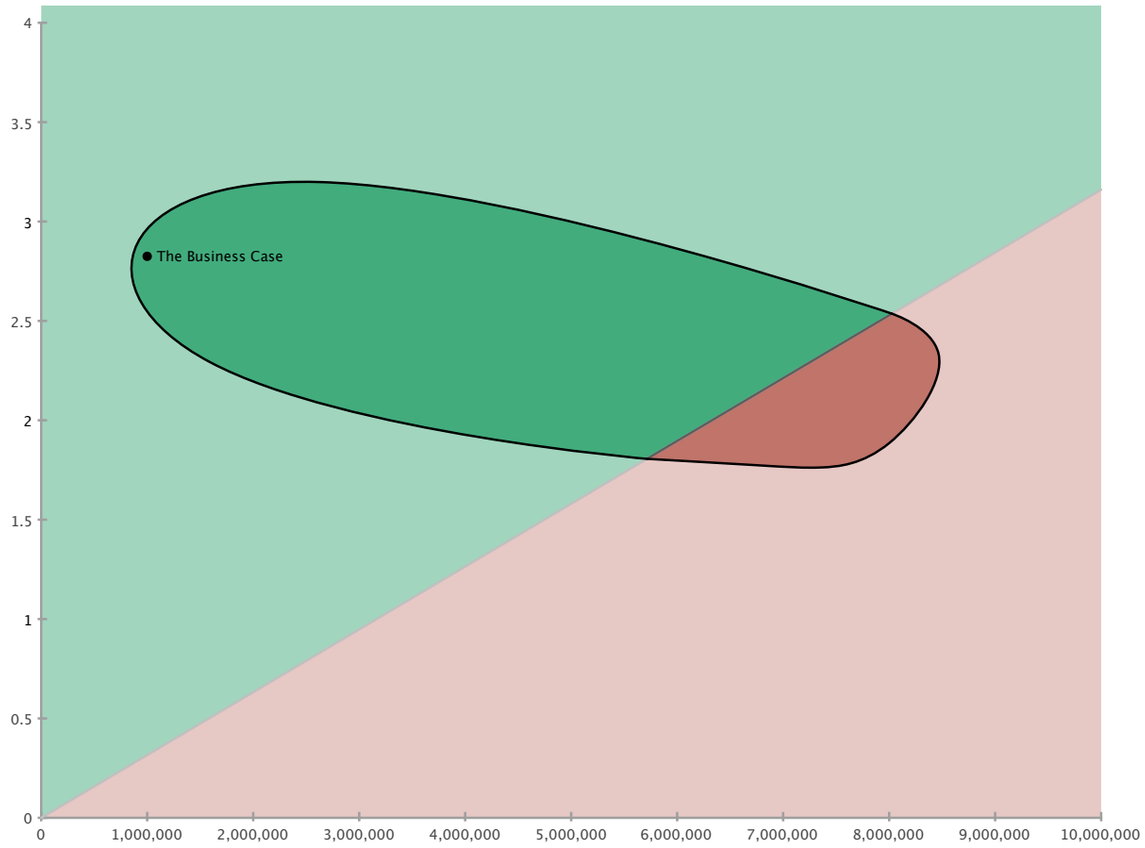
Cost

So, how do we find the risk?

We guess.

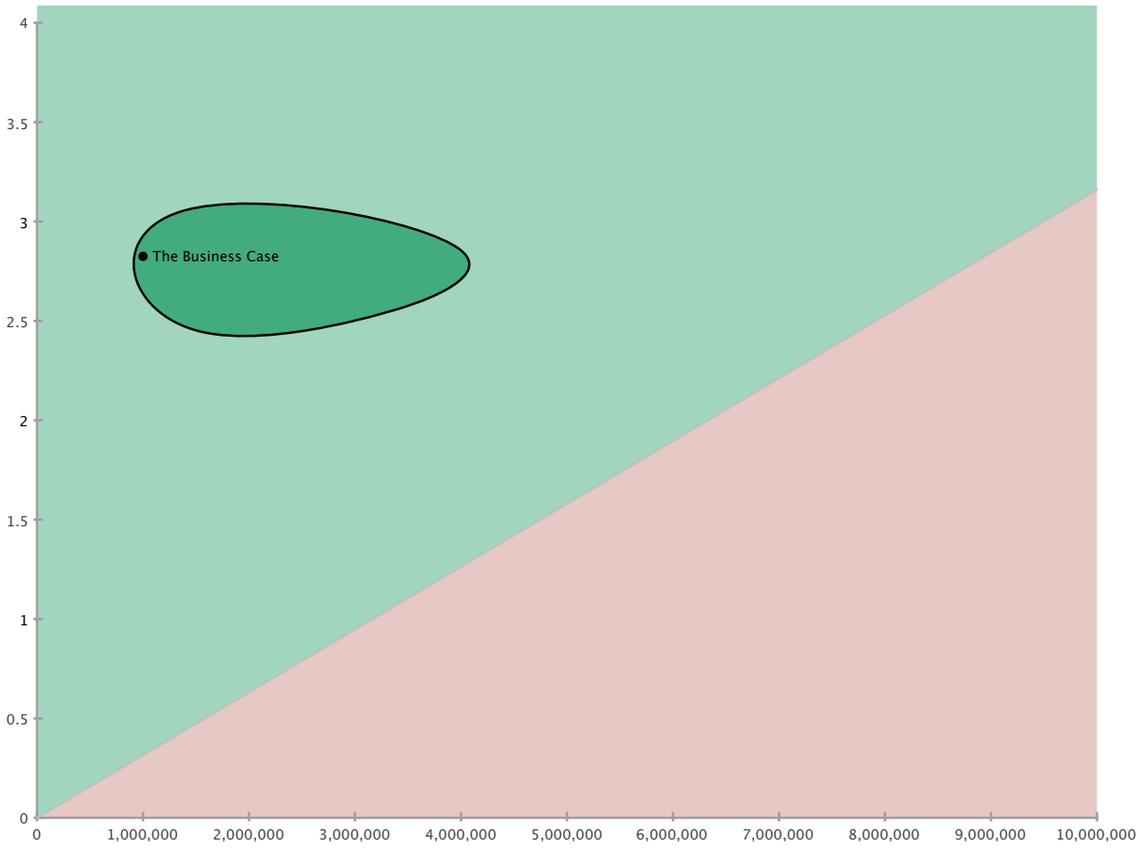
Projects are Experiments
Requirements are Ignorance
Guessing is Truth
Time is Space

Increasing certainty means reducing the area of possible outcomes.



Less certain

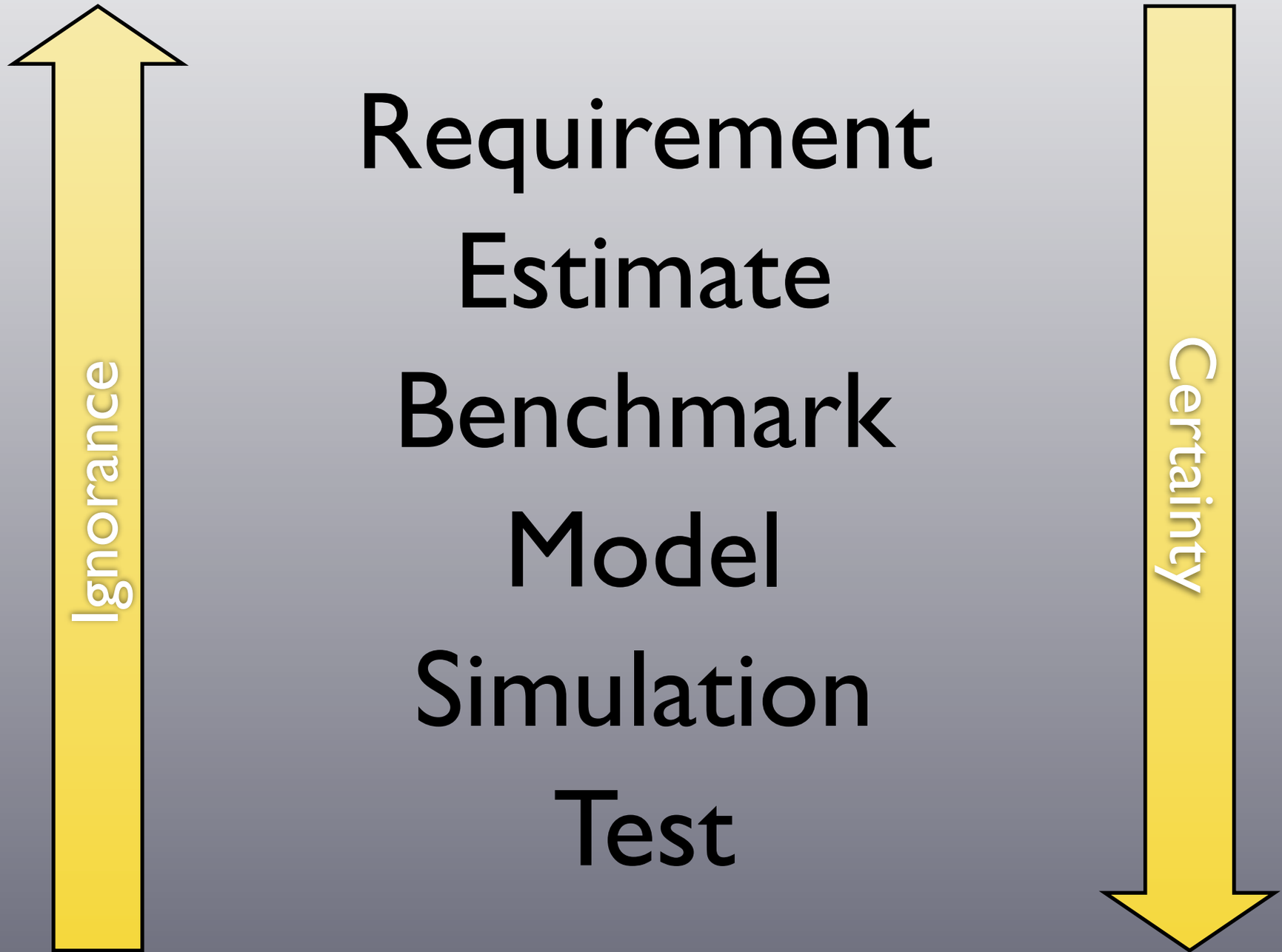
Higher level of ignorance



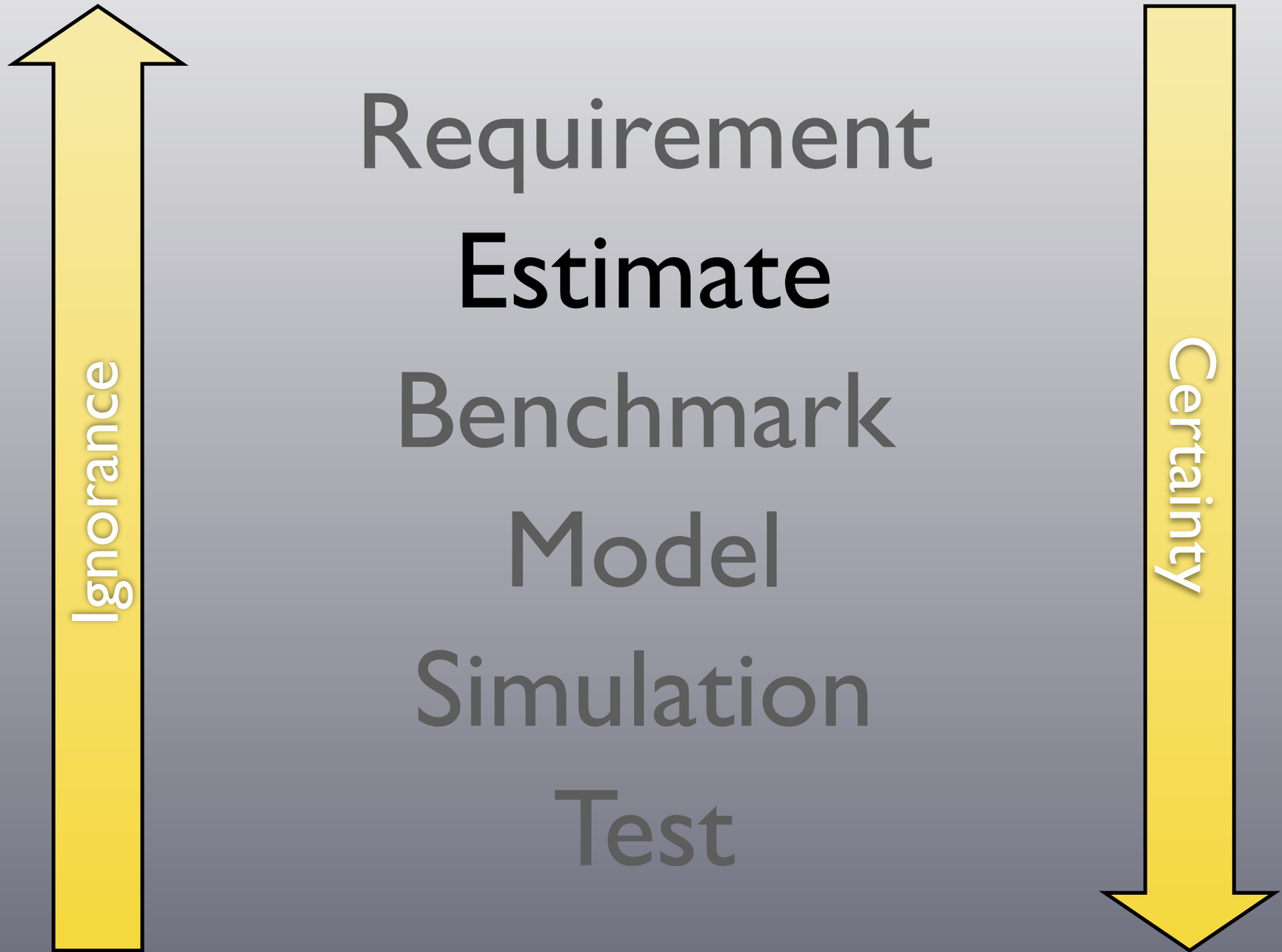
More certain

Reduced level of ignorance

Hierarchy of Knowledge



Hierarchy of Knowledge



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90% Confidence Interval

Interval where the true value will be between the lower and upper bounds 90% of the time.

With just 5 samples, the population median will be between the smallest and largest samples **93.8% of the time**.

Rule of Five

Ask Some Experts

Average of 3 experts' lower & upper bounds will reach correct 90% CI about 90% of the time.

Common Issues

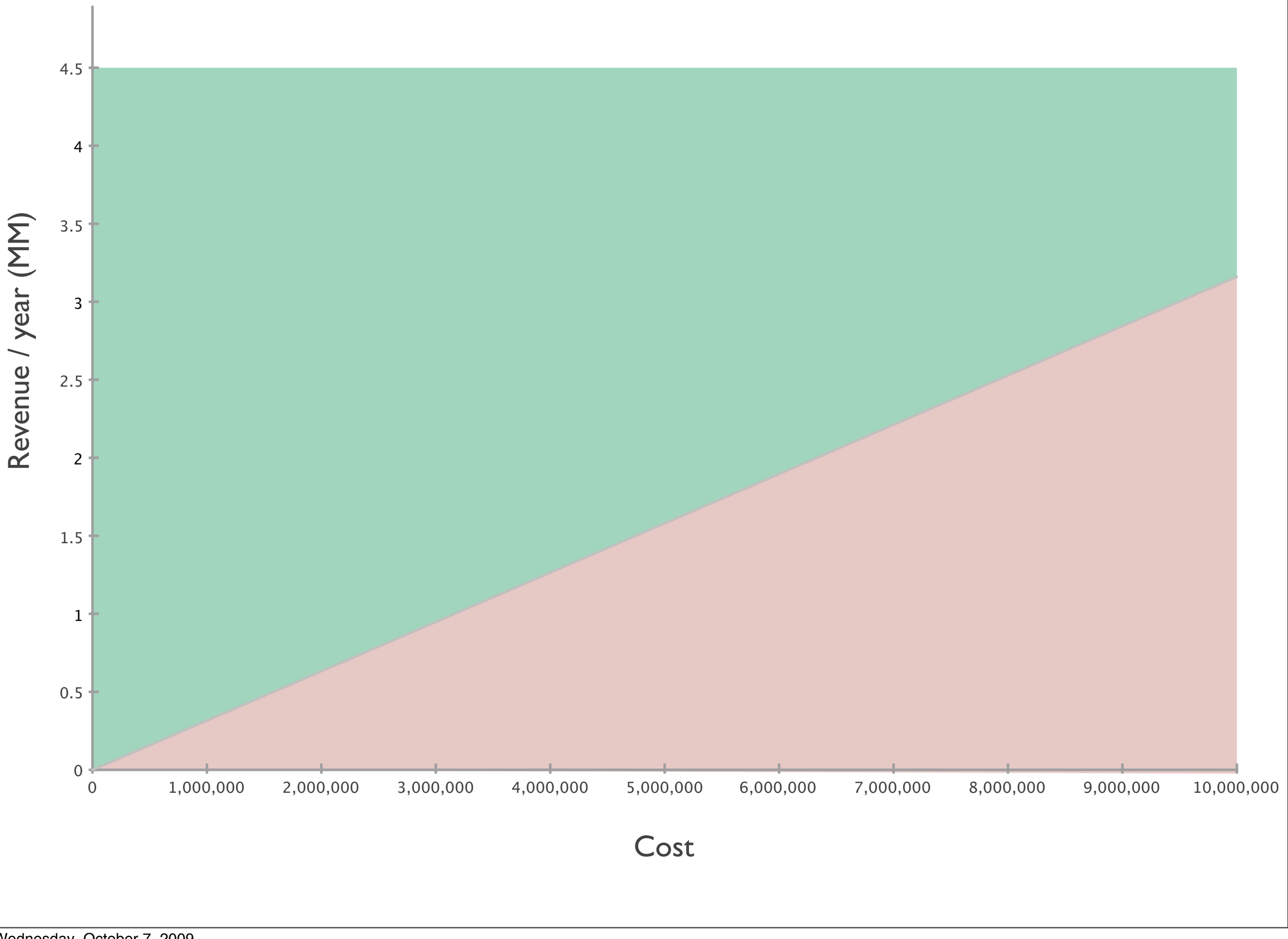
"But I have no idea!"

Guessing, then adding "error bars"

"If it's not perfect, it's worthless."

Improving Estimates

- Equivalent Bets
- 2 & 2
- Two Single-Ended Questions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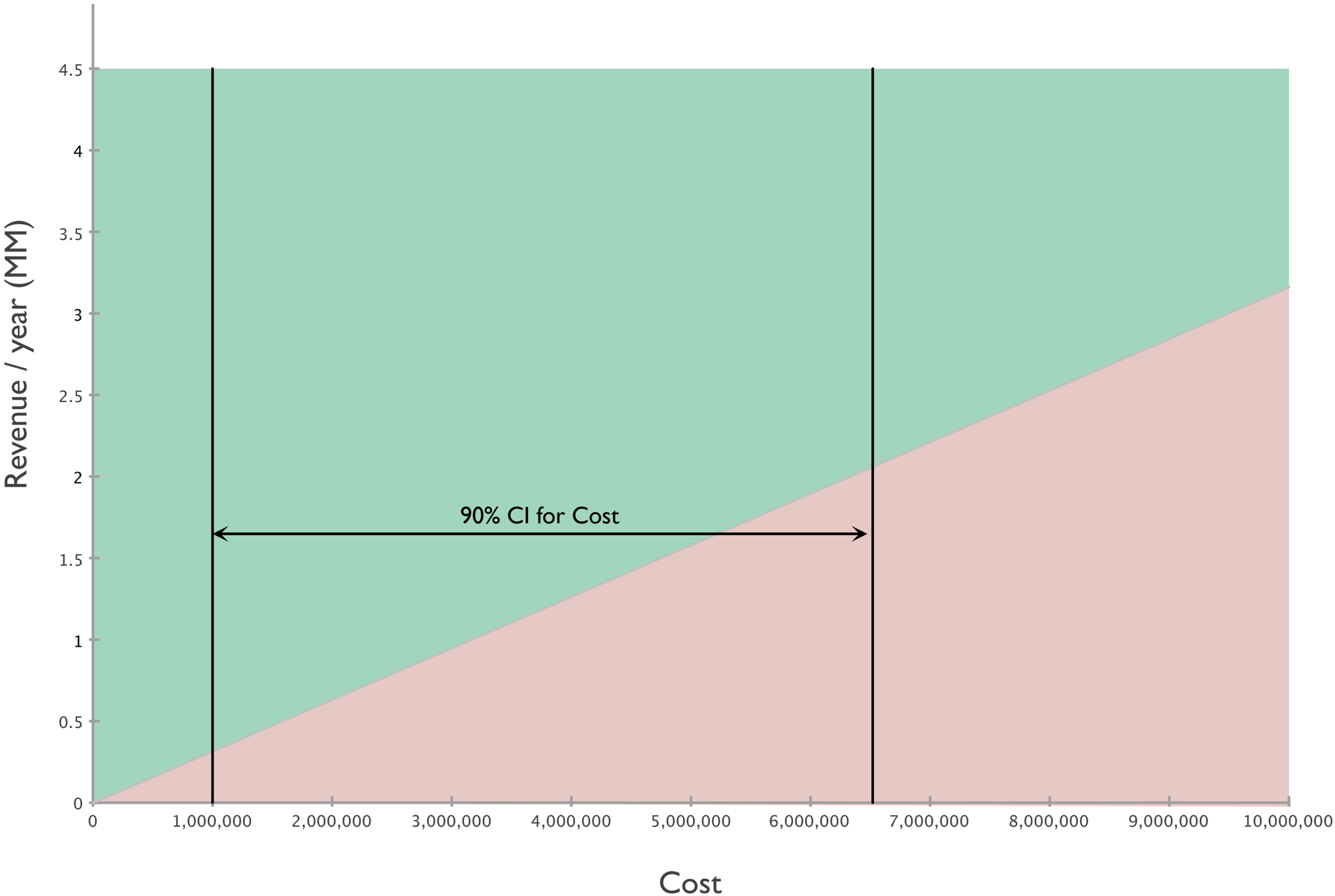
Revenue / year (MM)
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90% CI for Cost
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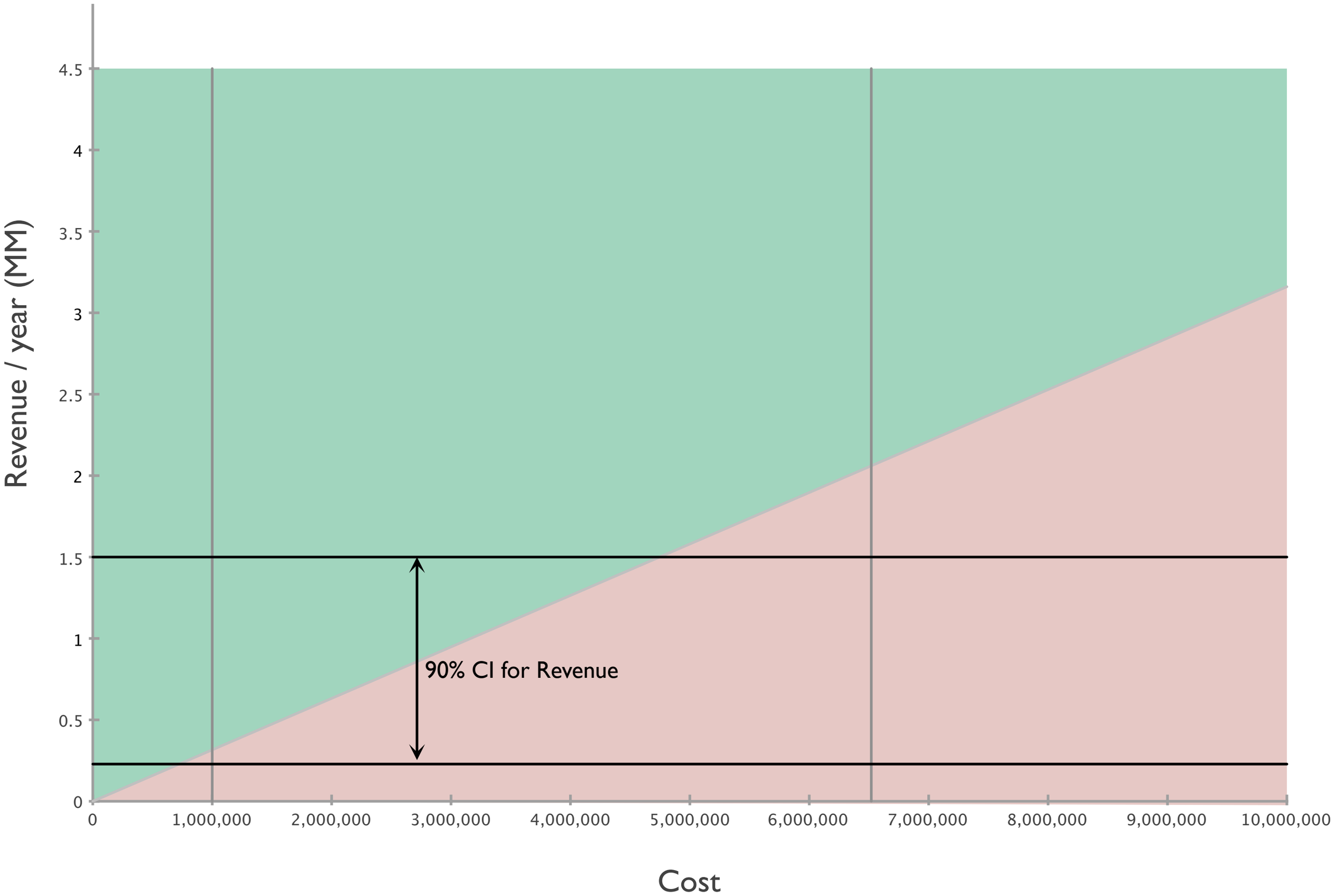
Cost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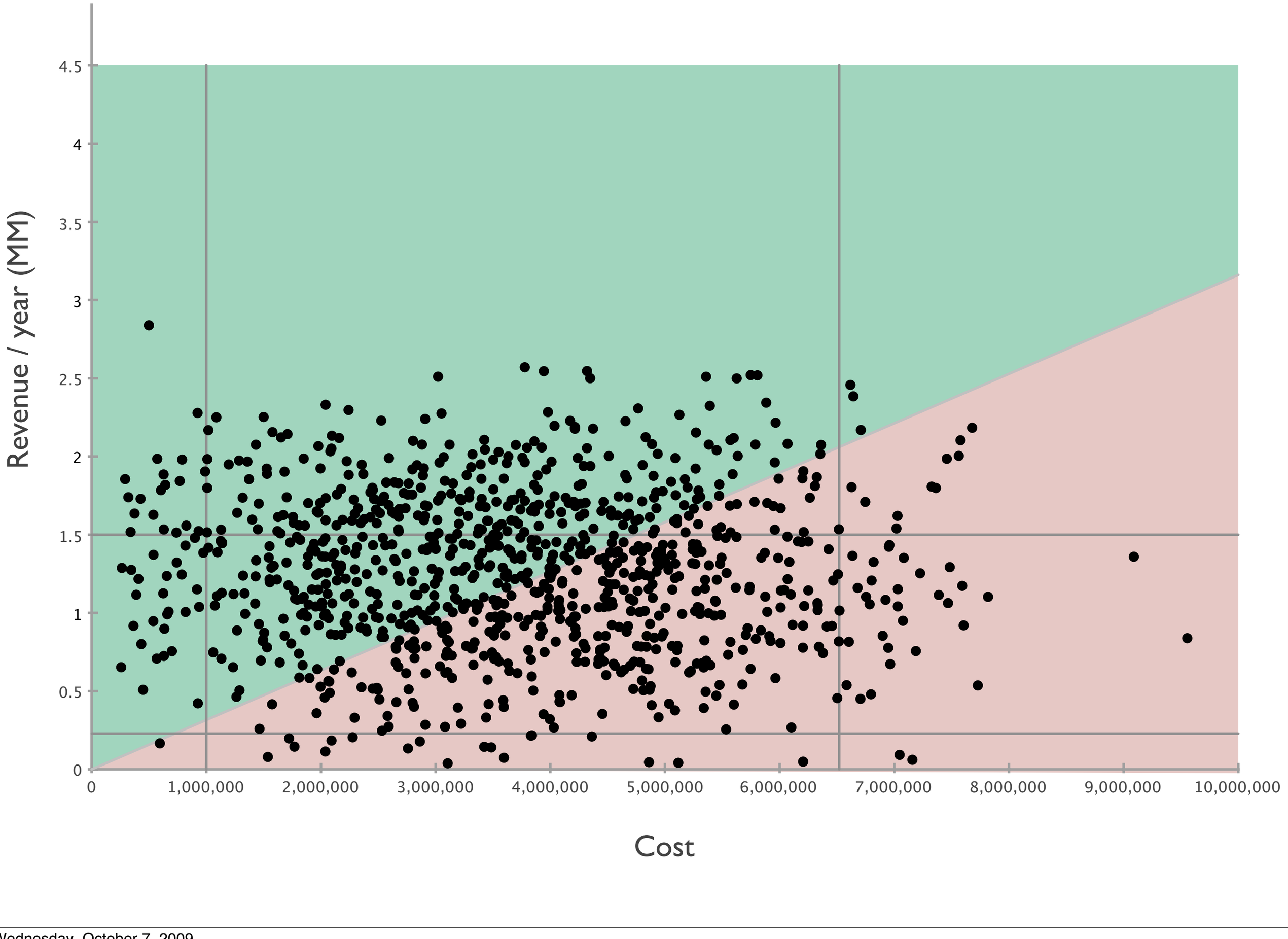
90% CI for Revenue
Cost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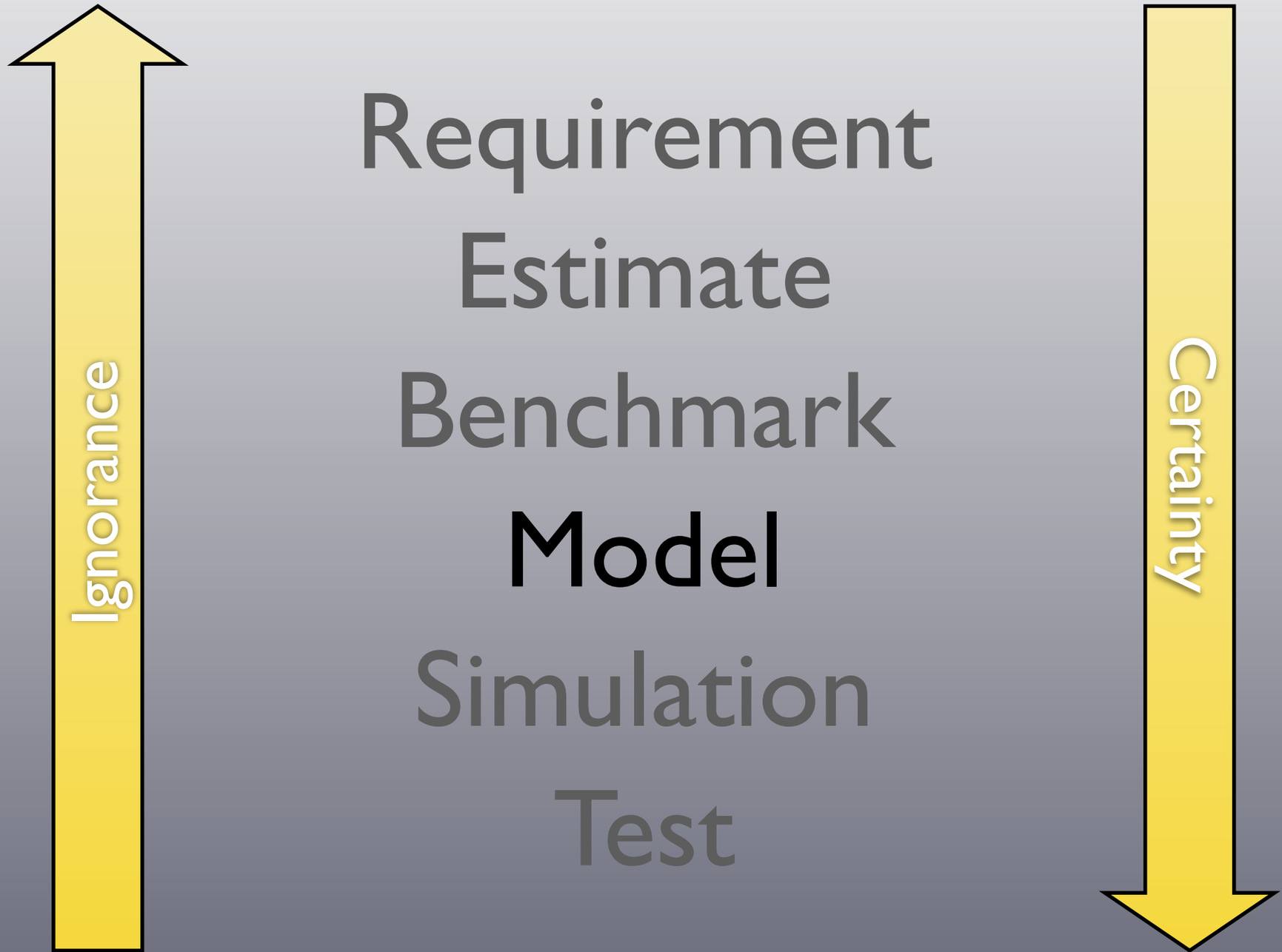
Hierarchy of Knowledge



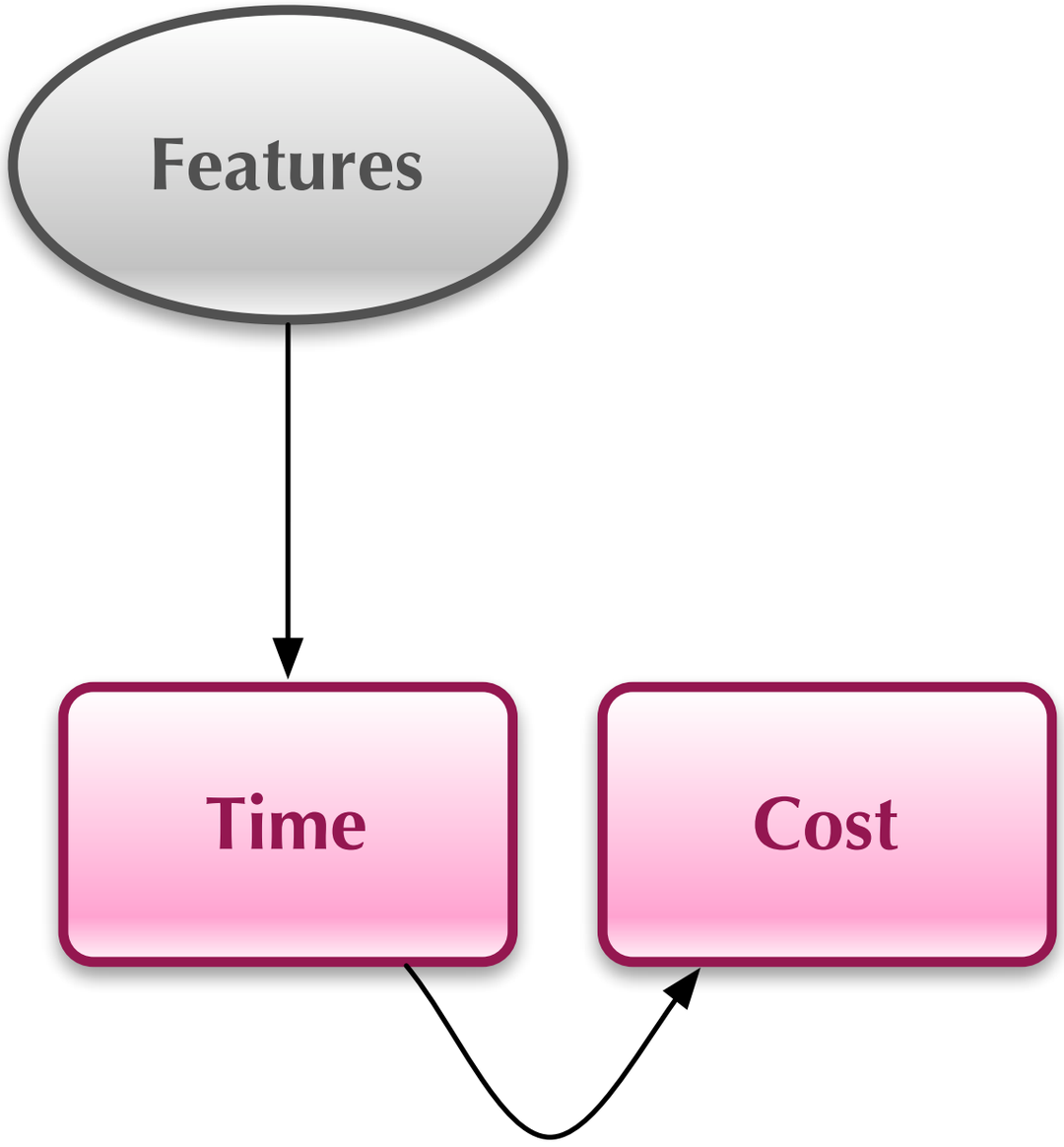
Tradeoffs

Tradeoff	Example	Indirect Effect
Dev cost vs. Ops cost	Optimize or buy boxes?	Optimizing: ↗ rev Buy boxes: ↗ cap
Features vs. Availability	New UI or bug hunt?	New UI: ↗ rev Bug hunt: ↗ rev
Time vs. Features	Third party feature via JavaScript or built-in?	Third party: ↘ time Built-in: ↗ capacity, ↗ features

Tradeoffs

Evaluating these tradeoffs requires modeling.

Cost



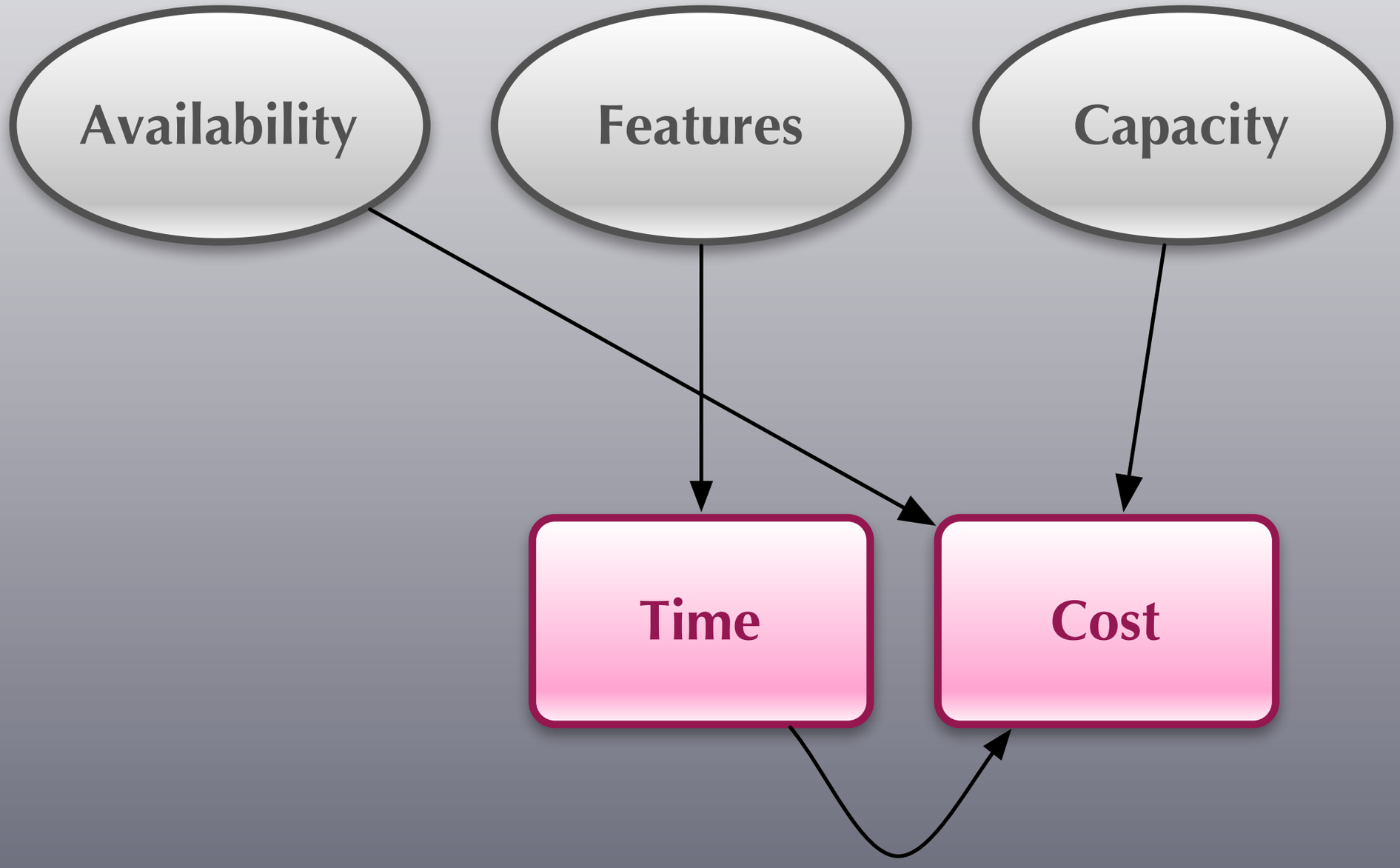
Cost

Labor
Facilities
Hardware Purchase
Software Licenses

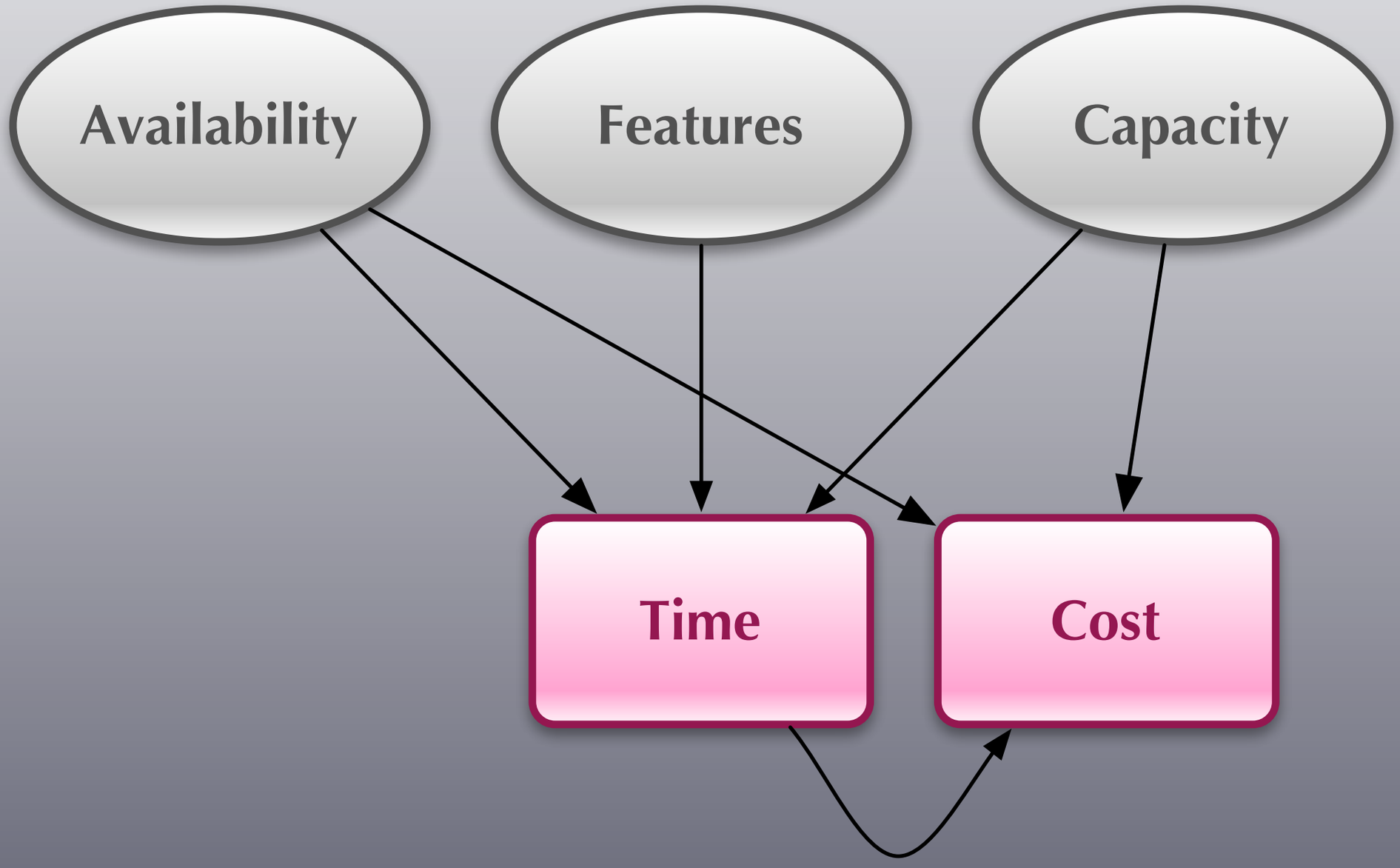
Time

Quality Driven	Scope Driven	Scale Driven
Functional Testing Load Testing Performance Tuning Optimization Failover Testing	UX Design Development Functional Testing Training Documentation Integration Integration Testing Process Change	Procurement Physical Installation Software Installation Configuration Validation Documentation Dev Support Test Support

Cost and Time

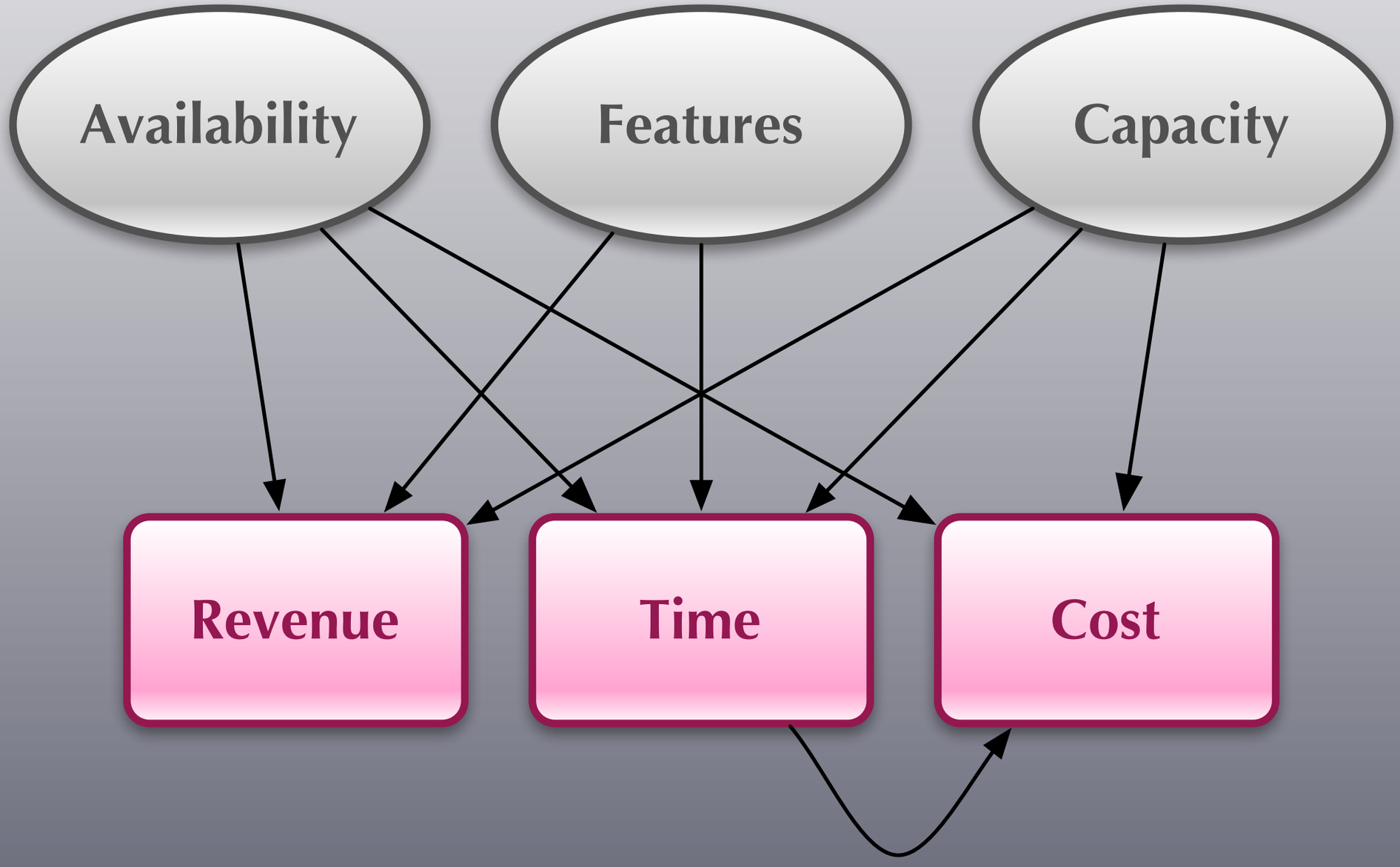


Cost and Time

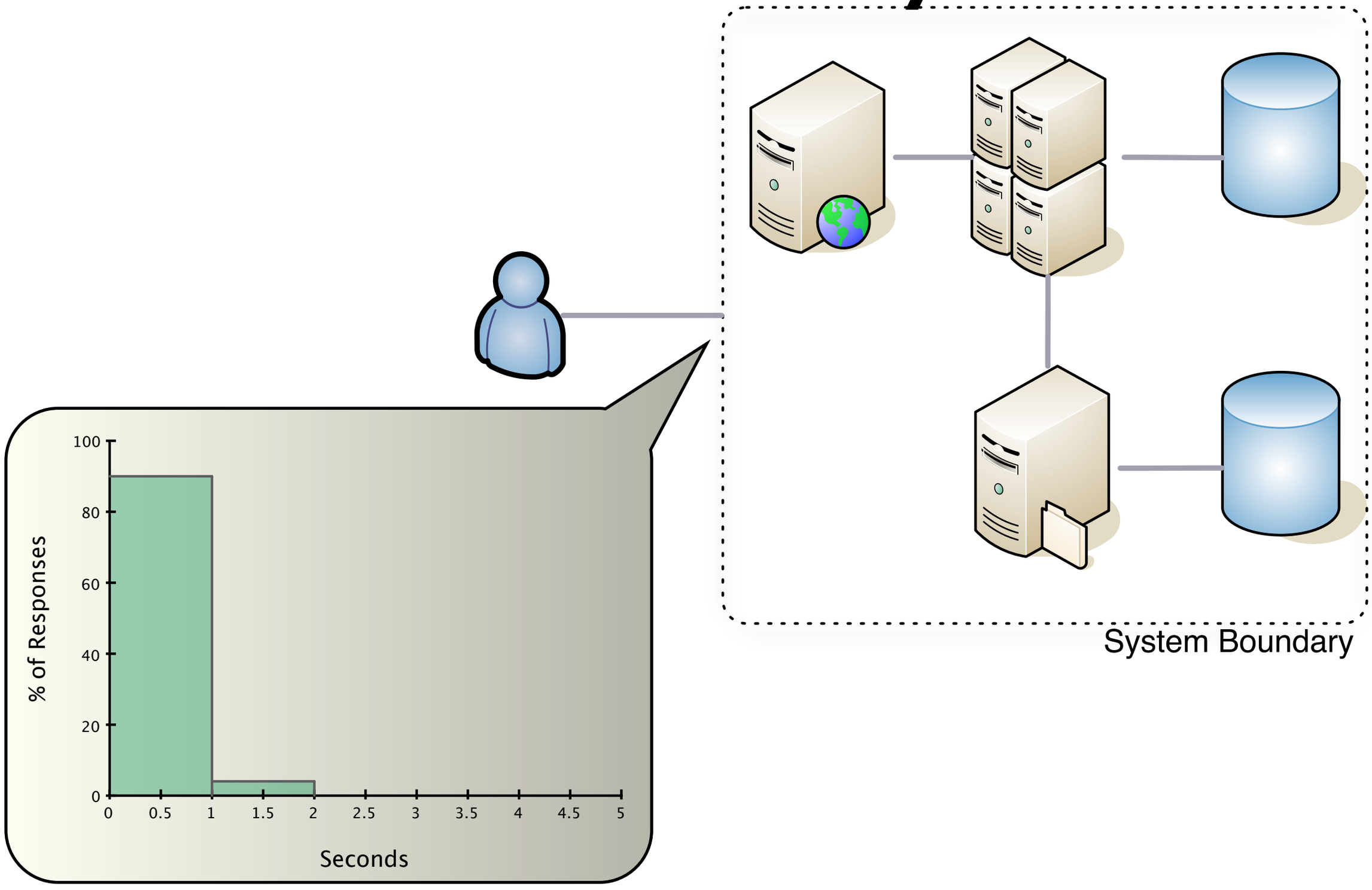


Many tradeoffs available; implications not fully understood.

Revenue



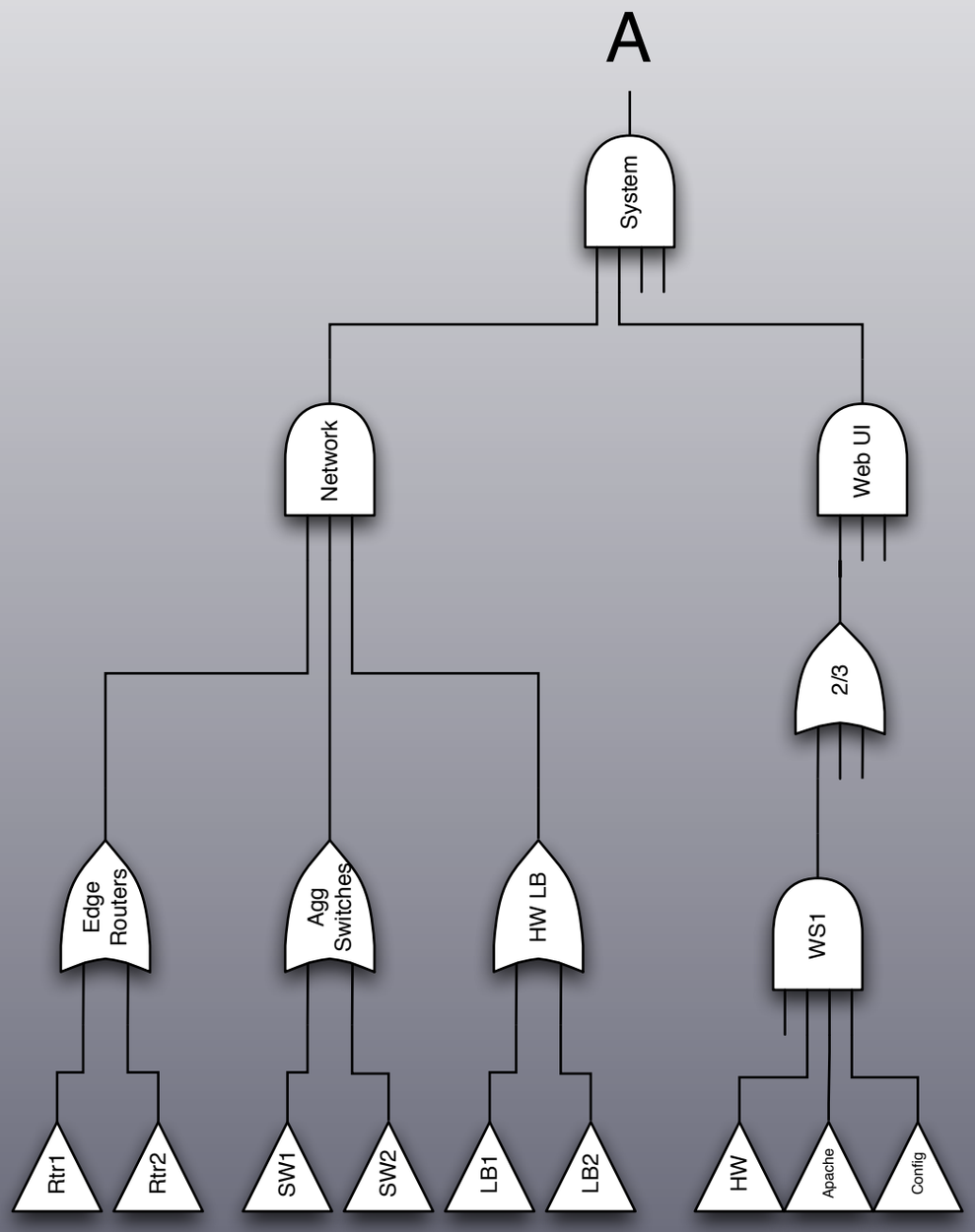
Availability



System Model

- Software components
- Hardware components
- Physical locations
- Plus dependencies
- Expressed as a DSL or diagram

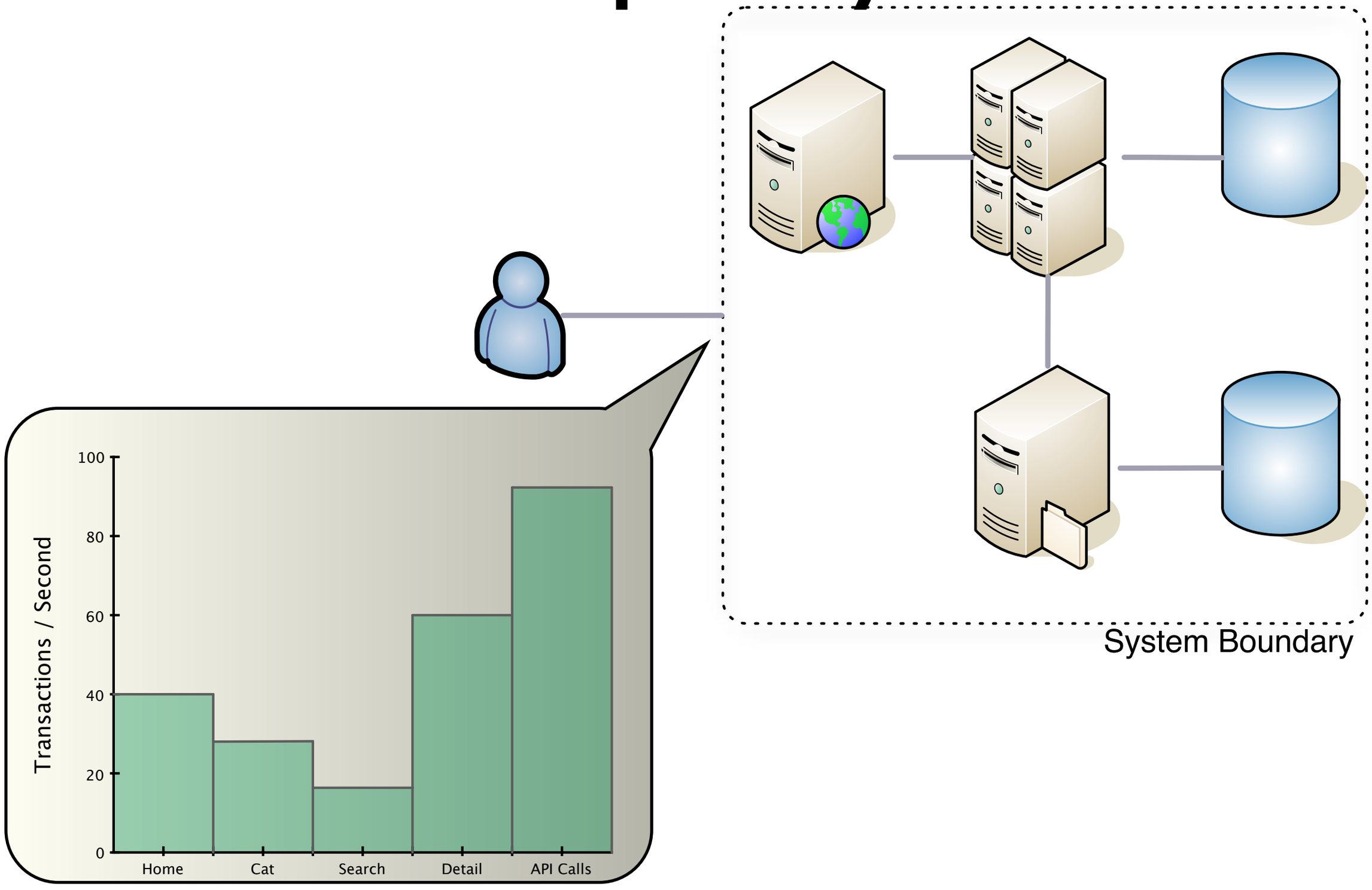
Availability Analysis



Fault Tree Simulation
or
Reliability Block Diagram

MTBF / MTTR ?

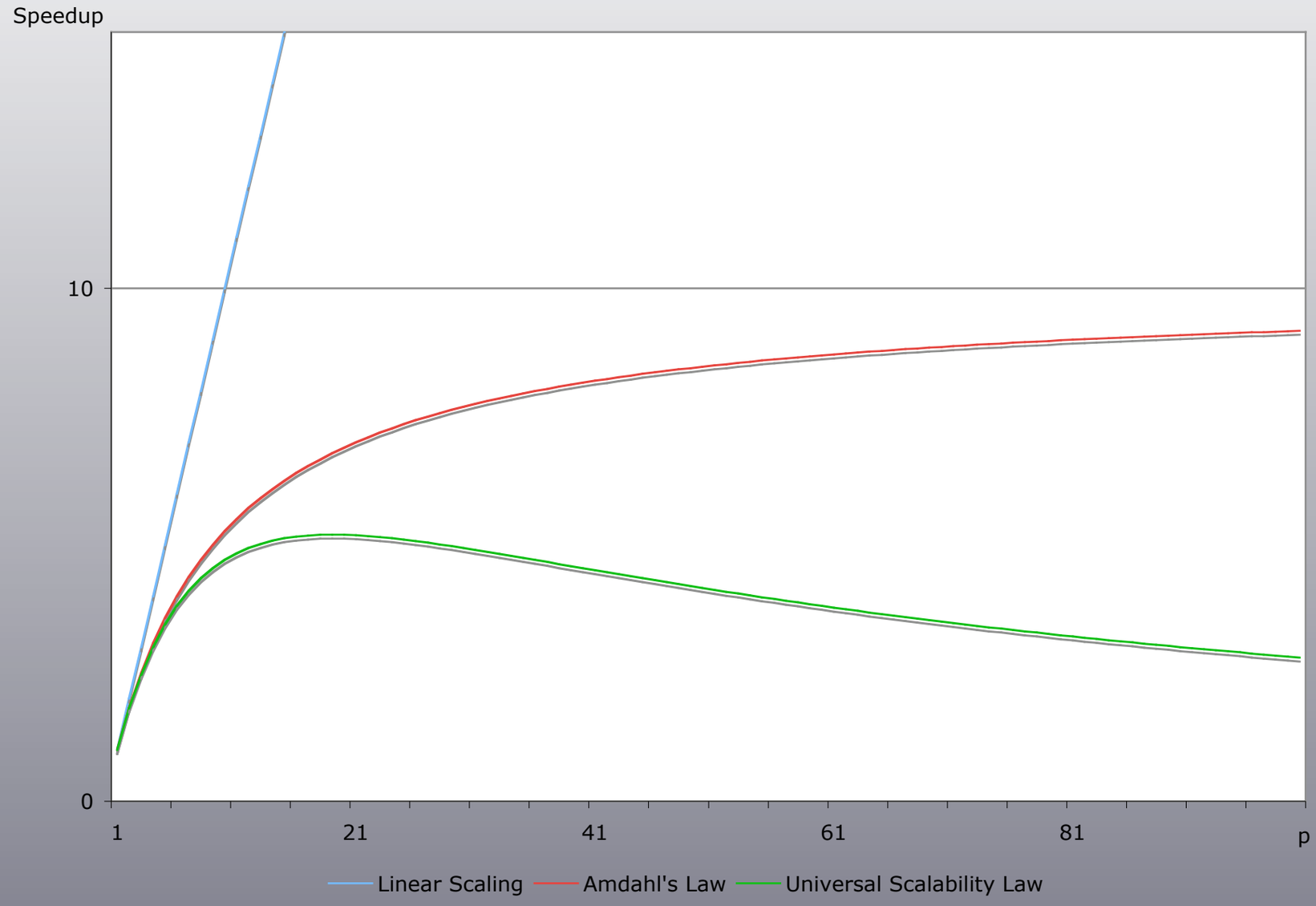
Capacity


System Boundary
Transactions / Second
100
80
60
40
20
0
Home
Cat
Search
Detail
API Calls

Benchmarking Helps Estimates

Benchmark Data?

Universal Scalability Law



$$C(p) = \frac{p}{1 + \sigma(p-1) + \kappa p(p-1)}$$

σ = Contention

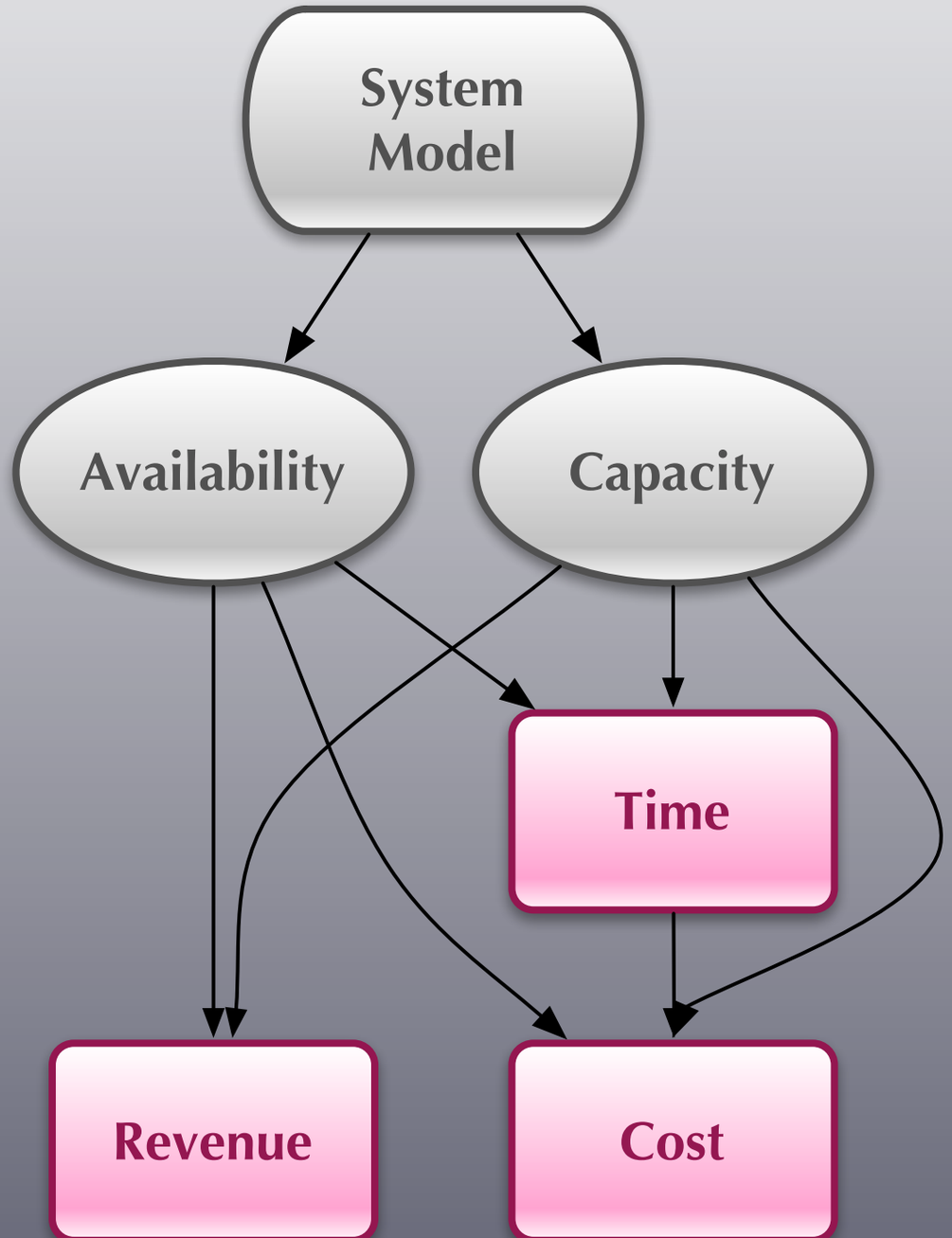
κ = Coherency

From “Guerilla Capacity Planning”, by Dr. Neil Gunther.

Ideal Concurrency $\sigma = 0, \kappa = 0$ Shared-nothing platform Google search Read-only queries	**Contention Only** $\sigma > 0, \kappa = 0$ Message-based queuing Peer-to-peer Polling service
Incoherent Only $\sigma = 0, \kappa > 0$ HPC/Grid computations OLAP Data mining	**Worst Case** $\sigma > 0, \kappa > 0$ Shared writable data OLTP

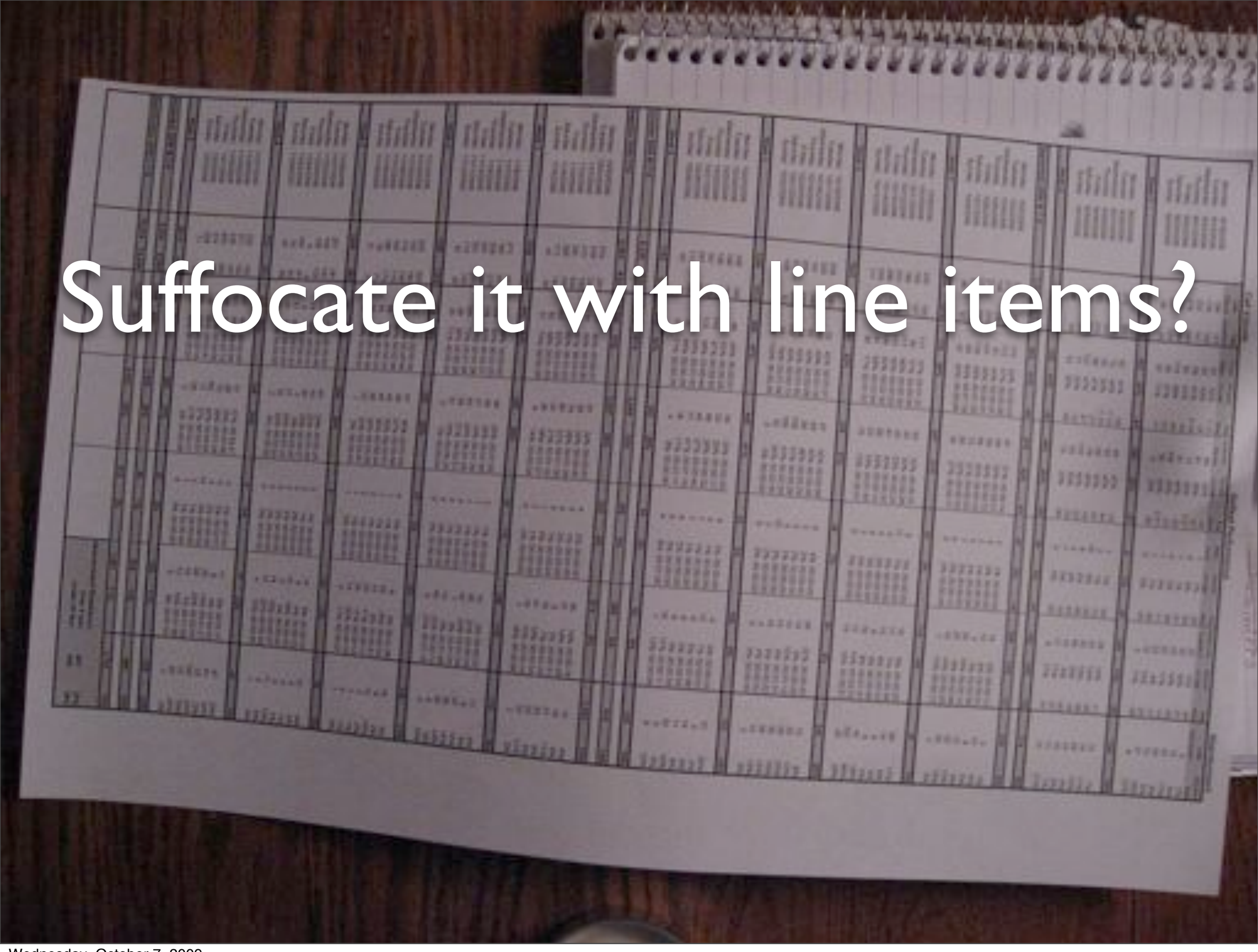
Revenue Modeling?

Relating the Dimensions



What to do about the risk?

Take the leap?


Suffocate it with line items?

Take a Measurement!

Measurement

- Anything that reduces uncertainty.
- Reducing uncertainty has value.
- Taking the measurement has cost.

Next Steps

- Improve formalism of models.
- Refine relationships between dimensions.
- Build knowledge base for benchmarks.

Seeking Collaborators!

Michael T. Nygard
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Resources

"How to Measure Anything," Douglas Hubbard, Wiley

"Scheduling in the Age of Complexity," Patrick Weaver, Mosaic Project Services
http://www.mosaicprojects.com.au/Planning.html

"Guerilla Capacity Planning," Dr. Neil Gunther, Springer

"The Logic of Failure," Dietrich Dörner, Basic Books

"The Black Swan," Nassim Nicholas Taleb, Random House

Photo Credits

Old Workbench
http://www.flickr.com/photos/kogakure/

Sun rises over the new airport
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angel
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interior construction
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Spreadsheet
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Reach.
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