Junk Bonds Versus IT Projects

Risk Adjusted Performance Compared

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Summary

- Customary project evaluation ignores risk
- Risk adjustment shows junk bonks often better
- Key problem is ignoring "long tails"
- Time to address this explicitly
  - Include risk adjustment in project evaluation
  - Measure unpredictability
  - Select management practices that match

Outline

- Motivation and Goals
- Basics
- Detailed Example
- More Examples
- Models and Measures of Risk
- Conclusions & Recommendations

Projects Are Investments

Can We "Beat The Market" With Projects?

- Projects are business investments
- Investments
  - Compared to market benchmarks: e.g. S&P500
  - Corrected for the "risk free rate"
- Time to apply investment comparison techniques to project investments
  - Define credible benchmark
  - Compare Risk Adjusted Performance (RAP)

Basics

The Sharpe Ratio

- Perhaps the simplest risk assessment

$$Sharpe\,Ratio = S = \frac{excess\ return}{"measure\ of\ risk"} = \frac{r_i - r_f}{\sigma_i}$$

r_f	is the "risk free rate" [%/yr]
$r_i - r_f$	is "excess return" of the investment i
σ_i	quantifies the notion of risk [%/yr]

- Excess return is the additional benefit received for assuming risk exposure σ_i

Basics

Sharpe Ratio Examples

- Some example Sharpe calculations

Investment	Return	Risk	Sharpe Ratio
Treasury Bills	r_f = 1.0%		
S&P 500	r_i = 4.0%	σ_i = 4.0%	$\frac{4.0-1.0}{4.0}=0.75$
SNAFU Fund	r_i = 4.0%	σ_i = 6.0%	$\frac{4.0-1.0}{6.0}=0.50$
Foo Fighter Fund	r_i = 5.5%	σ_i = 6.0%	$\frac{5.5-1.0}{6.0}=0.75$

- Sharpe Ratio hard to interpret, one must develop intuition

Basics

Risk "Measured" By Volatility

- The fist risk measure was Standard Deviation
  - σ is the symbol Standard Deviation
  - Markowitz introduced in Modern Portfolio Theory
- Standard Deviation still a key measure of risk in financial services
  - Fundamental to Option Pricing (Black-Scholes)
- Not perfect
- Fancier approaches hard to justify

Basics

Risk Adjusted Performance (RAP)

- RAP expressed as adjusted return (CAGR)
- Still simple but more intuitive than Sharpe

$$\mathrm{RAP} = (r_i - r_f)\frac{\sigma_B}{\sigma_i} + r_f$$

σ_B is the volatility risk of a benchmark investment

- Note: RAP related to Sharpe Ratio

$$\mathrm{RAP} = \sigma_B \left(\frac{r_i - r_f}{\sigma_i} \right) + r_f$$

$$= \sigma_B S_i + r_f$$

Basics

Quick Example From RAP's Developers*

- Compare mutual funds to S&P 500 circa Sep 1996
- Recall $(r_i - r_f)$ is excess return, the benefit for risk exposure σ_i

$$\mathrm{RAP} = \sigma_B \left(\frac{r_i - r_f}{\sigma_i} \right) + r_f \qquad \Rightarrow \qquad \mathrm{RAP} = 14.4 \left(\frac{r_i - 5.5}{\sigma_i} \right) + 5.5$$

	Return %/yr	Excess Return %/yr	Volatility %/yr	Sharpe Ratio	RAP %/yr
S&P500 (Benchmark)	r_B = 14.1	$(r_B - r_f)$ = 8.6	σ_B = 14.4	0.60	14.10
AIM Constellation	r_i = 19.7	$(r_i - r_f)$ = 14.2	σ_i = 24.6	0.58	13.81
Fidelity Magellan	r_i = 15.4	$(r_i - r_f)$ = 9.9	σ_i = 17.2	0.58	13.79
Fidelity Puritan	r_i = 12.0	$(r_i - r_f)$ = 6.5	σ_i = 9.4	0.69	15.46

Risk free rate, r_f = 5.5%/yr (T-Bill)

*Modigliani and Modigliani (1997). Risk-Adjusted Performance. Journal of Portfolio Management., Winter 1997. 45—54.

Basics

How To Do RAP For Projects

1. Set up project model
2. Define benchmark portfolio
3. Obtain price and risk data
4. Don the green visor (and calculate)

Detailed Example

1 – Set Up Project Model

- Example Project
  - Project goal: create $8,000/yr perpetual cash flow
    - Four project milestones
    - Each establishes a cash stream of $1,000/6 months
  - $10,000 capital outlay, 10 yr recovery
- Perfect execution (at 0% inflation for 10 years)
  - NPV $54,000
  - CAGR 20.4%/yr

Detailed Example

2 – Define Benchmark Portfolio

- Identify a plausibly comparable investment for same amount of capital
  - Choose debt over equity
  - Challenged bonds resemble challenged projects
  - Choose high yield bond for best return
- Buy and hold a non-callable bond to maturity
  - 10yr Corporate B-Bond Yield=7.25%, CAGR=5.60%
  - 5yr Corporate B-Bond Yield=5.50%, CAGR=4.98%
  - Real bonds auctioned in May 2013
- Risk free rate in May 2013
  - 2% for 10 yr Treasury Note
  - 0.63% for a 5 yr Treasury Note

Detailed Example

3 – Obtain Price And Risk Data: Projects

- Project risk data is a mess
  - Arbitrary and inconsistent definitions
    - Criteria for "successful", "challenged", "canceled"
    - Canceled for what reason?
  - Project accounting often "very creative"
  - Bias suspected in non-academic reports
    - No transparency or peer review
    - Intended for support more than illumination
    - NO CHAOS REPORTS! (see Appendix)
  - Qualitative data especially problematic
    - Attribution errors likely
    - Inconsistent design of interviews and surveys

Detailed Example

3 – Obtain Price And Risk Data: Project Default Rates

Source	Good	Challenged	Failed
Jones 2000	69%	18%	13%
Computer Weekly, et. al. 2003	27%	68%	5%
Hubber (Sauer & Cuthbertson) 2003	16%	75%	9%
Molokken-Ostvold, et. Al. 2004	11%	84%	5%
GAO 2004	45%	55%	
GAO 2005	48%	52%	
GAO 2006	69%	31%	
GAO 2007	69%	31%	
GAO 2008	59%	41%	
GAO 2009	28%	72%	
Jones 2007	62%	14%	24%
Sauer, et. al. 2007	68%	23%	9%
Miller, et. al. IPMA paper, 2008	58%		42%
Ambler DDJ 2011 Survey, Not Agile	50%	36%	14%
Ambler DDJ 2011 Survey, Agile	68%	6%	26%
Average	45%	40%	15%
Standard Deviation	20%	25%	12%

Ave Failure Rate = 15%

σ_{fail} = 12%

Ave Failure rate is equivalent to the Default Rate for bonds

Ave Challenge Rate = 40%

σ_{proj} = 25%

The standard deviation of the Challenge Rate will be our estimate for project volatility

Detailed Example

4 – Calculate!

- Expected return versus raw return
  - Roll a die 10 time, 5 or 6 pays \$10, else 0, what's the expected return?
    - 1/3 x \$10 x 10 + 2/3 x 0 x 10 = \$33
  - For 10 bonds that pay \$1000 ea, default rate is 33%
    - 1/3 x \$1000 x 10 + 2/3 x 0 x 10 = \$3,333
  - But wait! As a creditor, you can recover some money

    $E(r_{bond})$ = yield (1-[default rate(1-recovery rate)])

    $E(r_{bond})$ = yield (1-loss rate)

Source	Ave Loss Rate	σ_B
Fitch (1990-2012)	2.88%	3.44%
Moody's (1982-2010)	2.78%	2.18%

  - We'll use the Fitch values because σ_B larger

Detailed Example

4 – Calculate!

- Given Uncertainties, let's calculate 3 things
  - Project RAP given estimate of risk

$$RAP_{proj} = \frac{r_{proj} - r_f}{\sigma_{proj}} \sigma_B + r_f$$

  - Project Parity Return, r^*_{proj} given fixed σ_{proj}

$$r^*_{proj} = \frac{r_B - r_f}{\sigma_{proj}} \sigma_B + r_f$$

  - Project Parity Risk, σ^*_{proj} given fixed r_{proj}

$$\sigma^*_{proj} = \frac{r_{proj} - r_f}{r_B - r_f} \sigma_B$$

Example 1

4 – Calculate!

Project Investment					
Capital Outlay	$10,000	Project Duration	2 yr	Recovery Schedule	10 yr
Junk Bond Benchmark					
Risk Free Rate	2.00%	Inflation	0.00%	10yr B-Bond Yield	7.25%
Ave Loss Rate	2.88%	Risk σ_B	3.44%	Bond E(CAGR), r_B	5.44%
Project Performance					
Raw Project CAGR	20.4%	Project Loss Rate	15.00%	Project Risk, σ_p	25%

Risk Adjusted Returns and Sensitivity Analysis

Scenario	Expected Return	RAP
Junk Bond	5.44%	5.44%
Successful Project	17.34%	4.11%
Cash flow 2 delayed by 6 months	16.85%	4.04%
75% of scope achieved	14.23%	3.36%
50% more capital at month 18	16.51%	3.99%

Bond RAPs better than Project's!

Risk equivalent project return, r^*_{proj} = 27.1% Equivalent execution risk given project return, σ^*_{proj} = 15.3%

Example 2

Same Project, But 5Yr Capital Recovery

Project Investment					
Capital Outlay	$10,000	Project Duration	2 yr	Recovery Schedule	5 yr
Junk Bond Benchmark					
Risk Free Rate	0.63%	Inflation	0.00%	5yr B-Bond Yield	5.50%
Ave Loss Rate	2.88%	Risk σ_B	3.44%	Bond E(CAGR), r_B	4.48%
Project Performance					
Raw Project CAGR	24.57%	Project Loss Rate	15.00%	Project Risk, σ_p	25%

Risk Adjusted Returns and Sensitivity Analysis

Scenario	Expected Return	RAP
Junk Bond	4.84%	4.84%
Successful Project	20.89%	3.41%
Cash flow 2 delayed by 6 months	14.08%	2.41%
75% of scope achieved	9.52%	1.85%
50% more capital at month 18	17.10%	2.89%

Bond RAPs better than Project's!

Risk equivalent project return, r^*_{proj} = 31.3% Equivalent execution risk given project return, σ^*_{proj} = 16.6%

Example 3

Same Project, But Half The Capital Outlay Recovered in 5 Yrs

Project Investment					
Capital Outlay	$5,000	Project Duration	2 yr	Recovery Schedule	5 yr
Junk Bond Benchmark					
Risk Free Rate	0.63%	Inflation	0.00%	5yr B-Bond Yield	5.50%
Ave Loss Rate	2.88%	Risk σ_B	3.44%	Bond E(CAGR), r_B	4.84%
Project Performance					
Raw Project CAGR	47.58%	Project Loss Rate	15.00%	Project Risk, σ_p	25%

Risk Adjusted Returns and Sensitivity Analysis

Scenario	Expected Return	RAP
Junk Bond	4.84%	4.84%
Successful Project	40.44%	6.10%
Cash flow 2 delayed by 6 months	33.20%	5.10%
75% of scope achieved	29.32%	4.57%
50% more capital at month 18	38.60%	5.84%

Project RAPs better than Bond's (as long as it makes sense to finish)!

Risk equivalent project return, r^*_{proj} = 31.3%   Equivalent execution risk given project return, σ^*_{proj} = 32.5%

Models and Measures of Risk

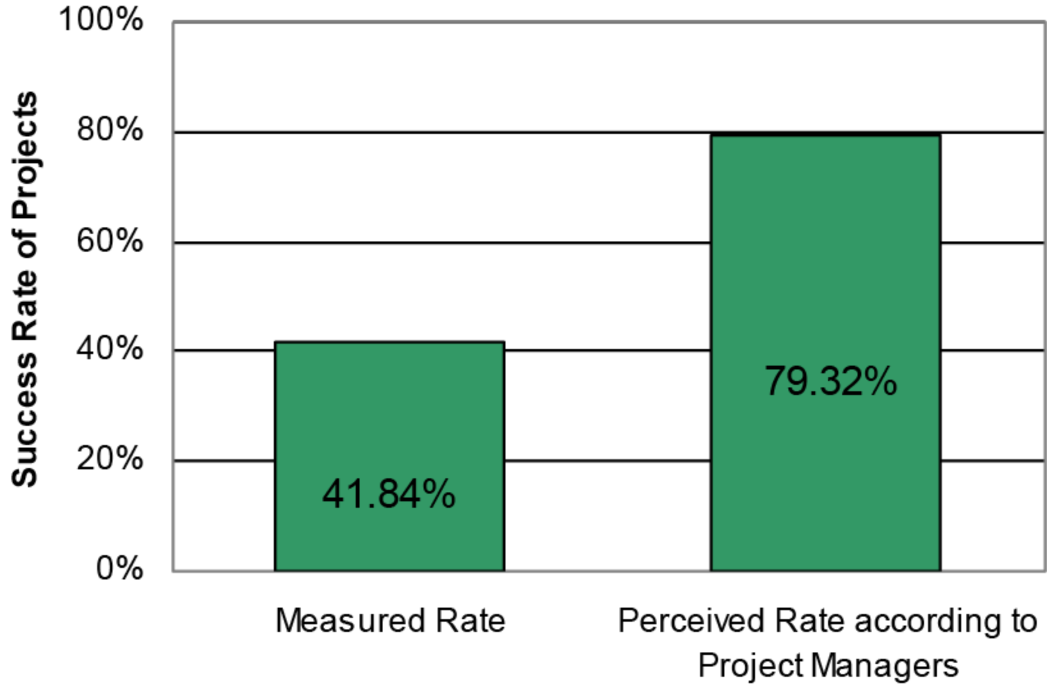
How Accurate And Useful Are The Models?

- Issue is ***unpredictability***, of which ***risk*** is part
  - Risk: known unknowns, can estimate probability
  - Uncertainty: unknown unknowns, estimate what?
  - Bias: systematic errors in thinking or measurements

- Model difficulties are significant and pervasive
  - Always simplifications of real world
  - Premised on scores of assumptions, estimates and guesses
  - Only can model what one can think of

Models and Measures of Risk

Attribution Bias In Data Reporting?



The measured success rate (10% allowances) compared
to how the project managers perceived their projects.

Matthew G. Miller, Ray J. Dawson, Kieran B. Miller, Malcolm Bradley (2008). *New Insights into IT Project Failure & How to Avoid It*. Presented at 22nd IPMA World Congress - Rome (Italy) November 9-11, 2008, in Stream 6. As of May 2013, self published at http://www.mgmiller.co.uk/files/paper.pdf.

Models and Measures of Risk

Risk Models Especially Challenging

- Categorically, σ is a very poor *measure* of risk
  - Widely accepted doesn't mean it's right
  - It's really a ***heuristic*** introduced by Markowitz*

  "… that the investor does (or should) consider expected return a desirable thing and variance of return an undesirable thing. (p 77)"

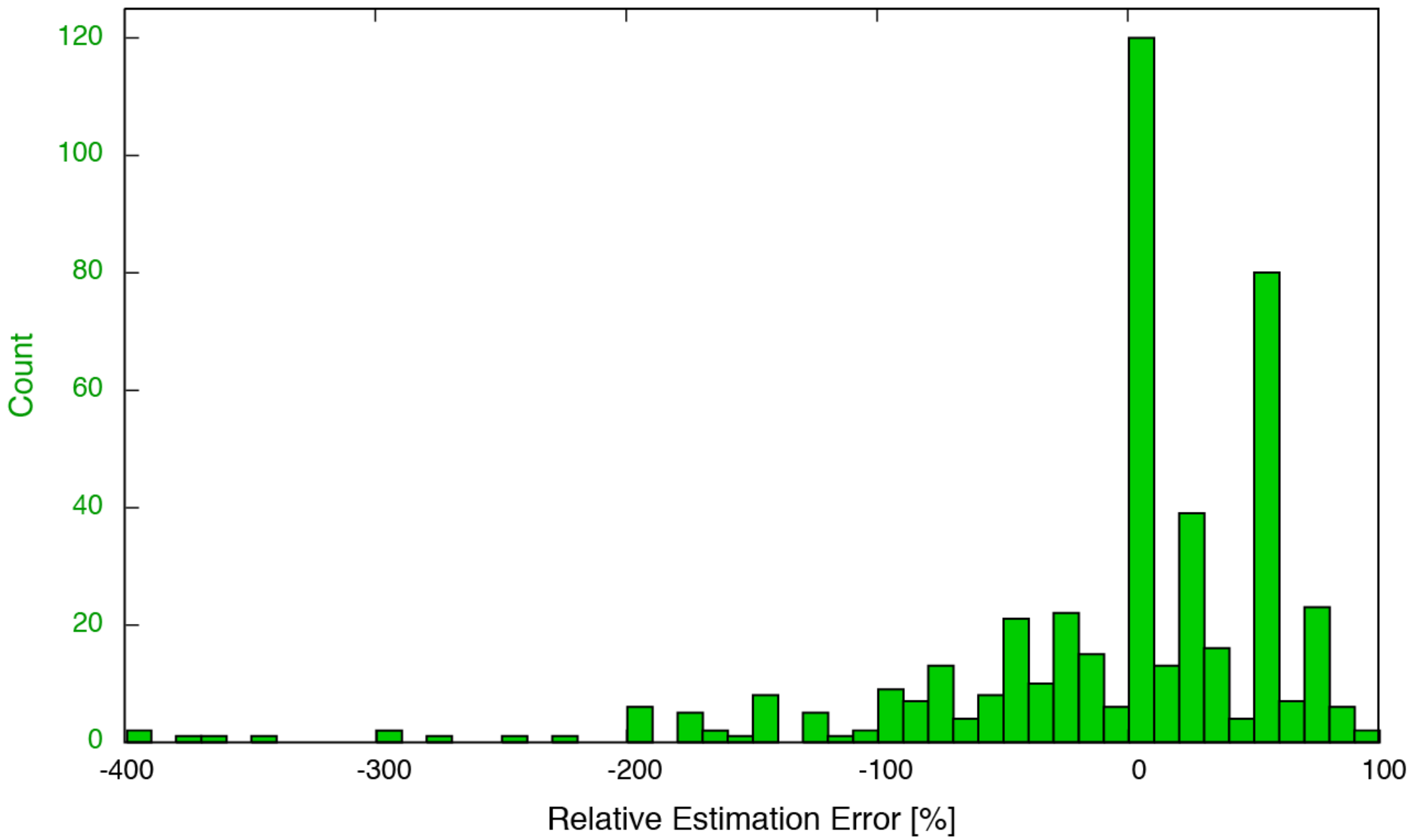
- Using σ assumes an underlying distribution
- Project and bond risk is asymmetric, σ isn't

* Markowitz, H.M. (1952). "Portfolio Selection". *Journal of Finance*, 7(1) (March), 77-91.

Models and Measures of Risk

σ Underrepresents Long-Tail Risks

Example Estimation Accuracy "Distribution"



Notes: 465 User Stories; Single Scrum Team; 39 sprints in 2 yrs

Models and Measures of Risk

σ Underrepresents Long-Tail Risks

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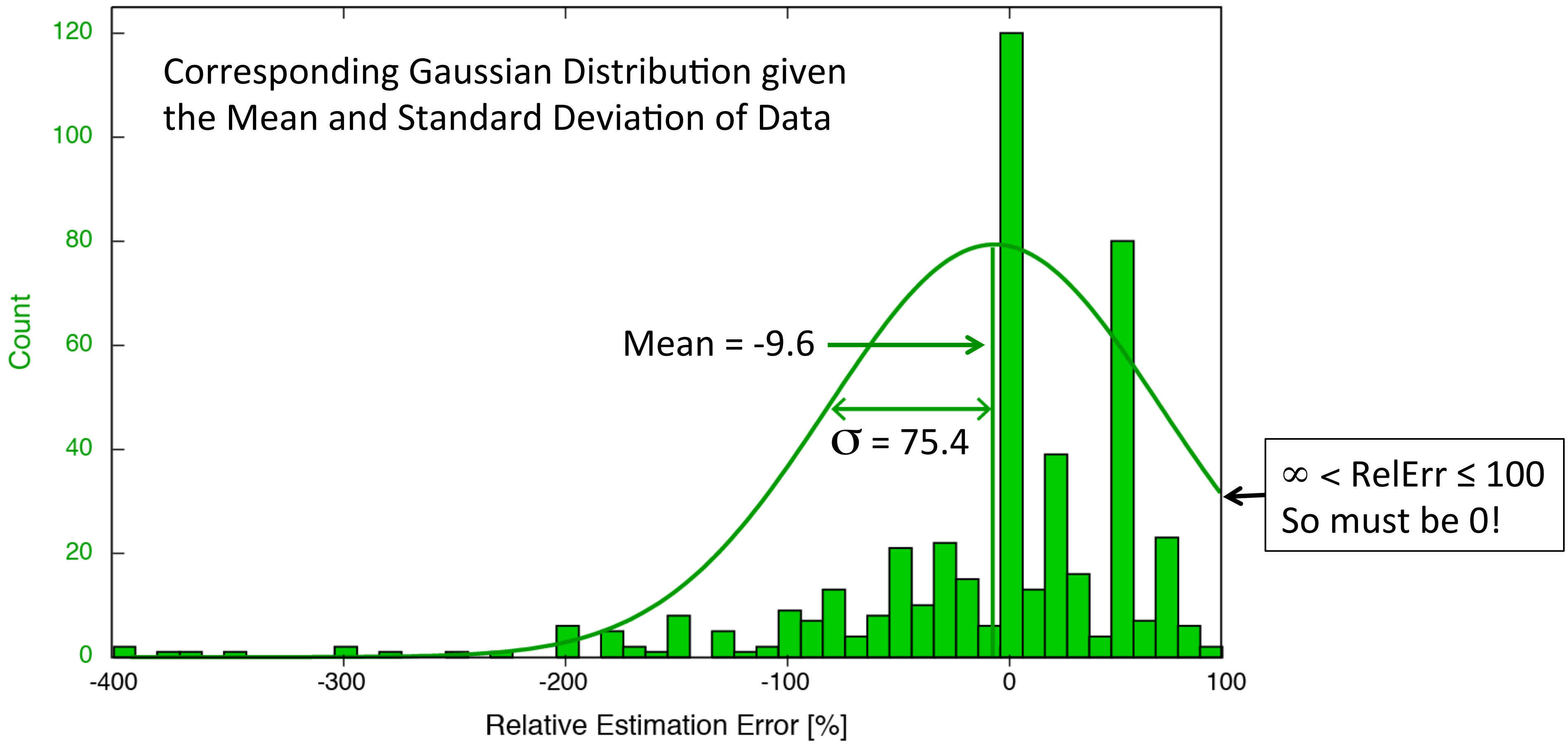

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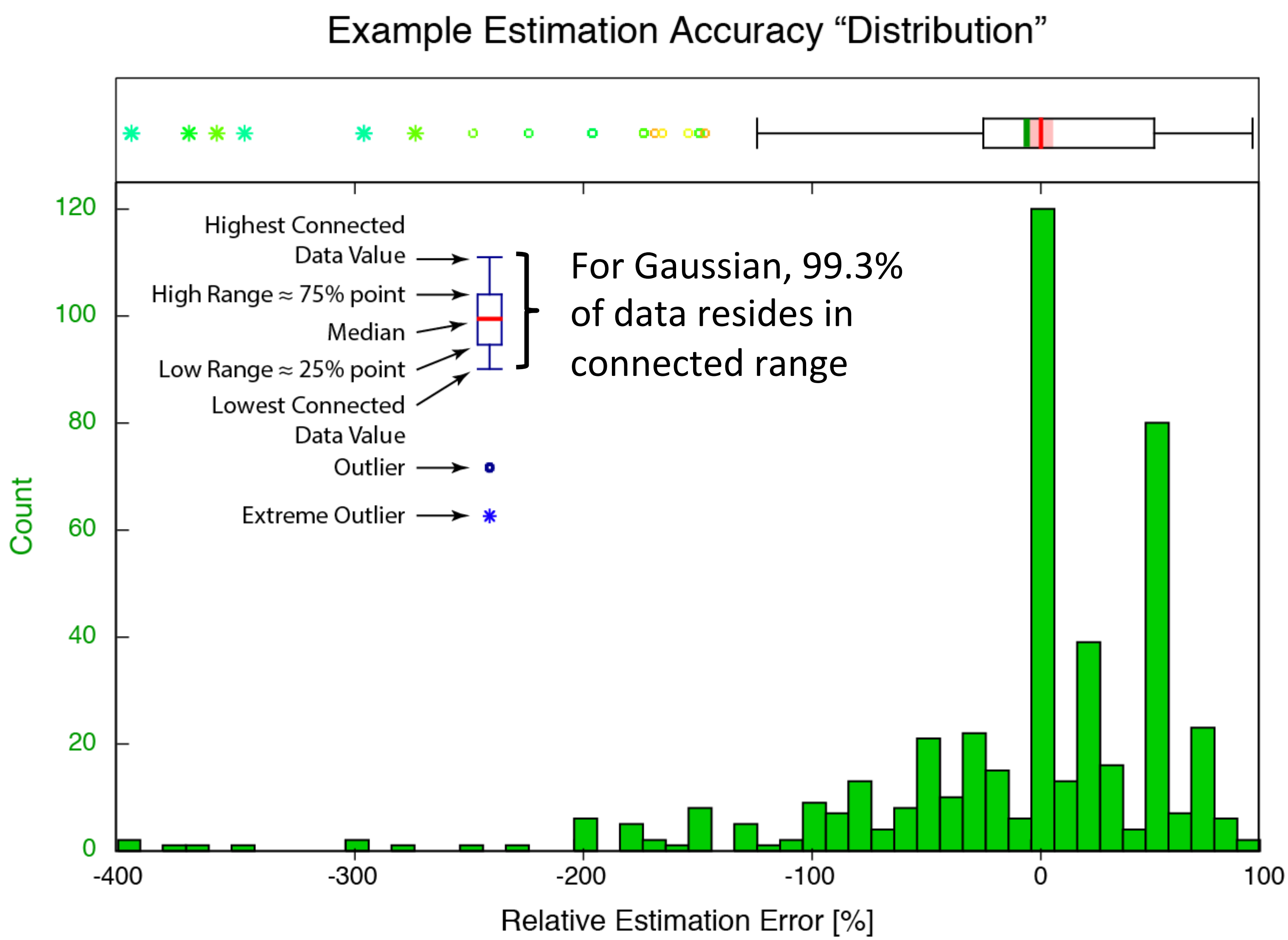

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Models and Measures of Risk

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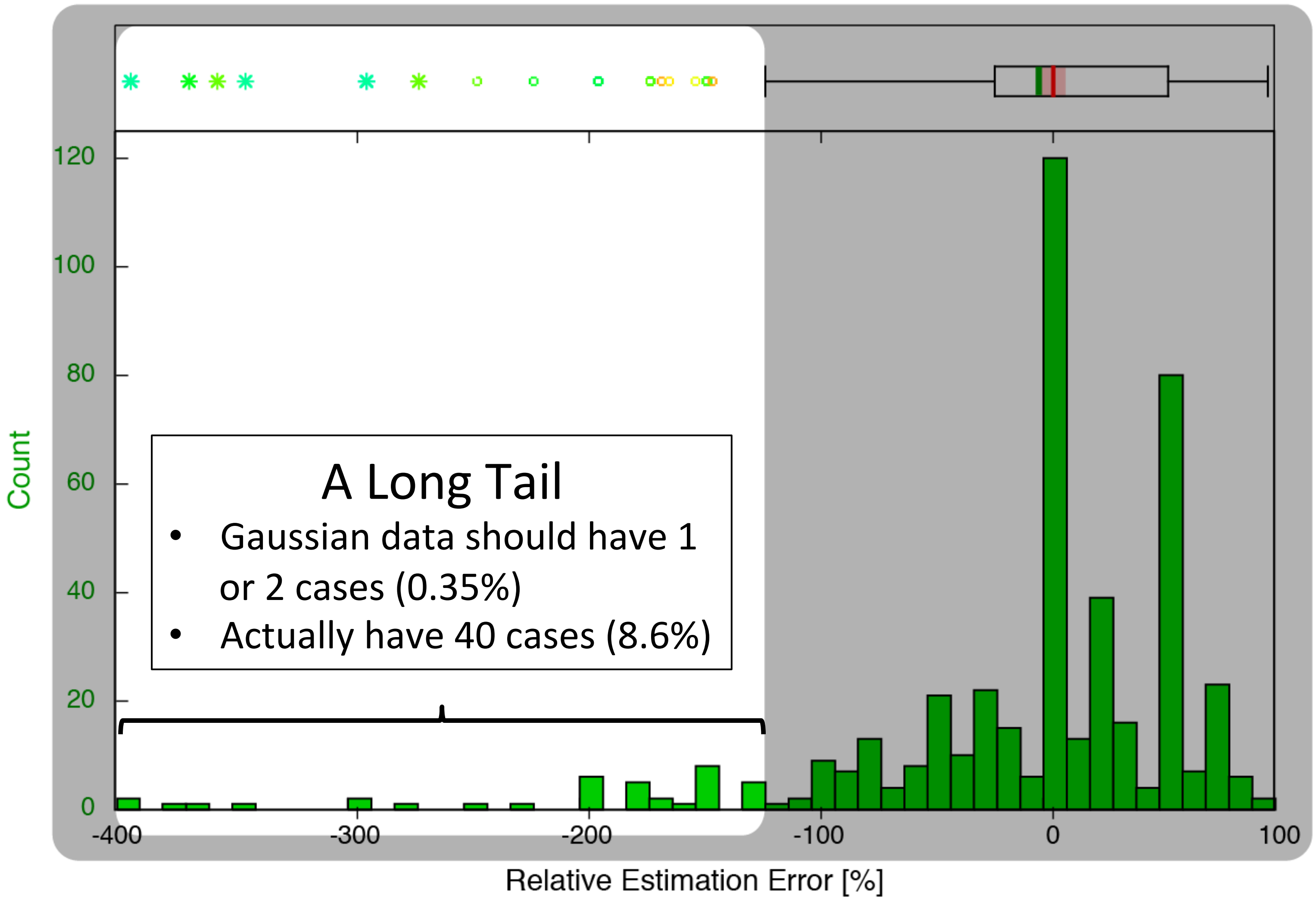


Notes: 465 User Stories; Single Scrum Team; 39 sprints in 2 yrs

Models and Measures of Risk

The Gaussian Distribution Is An Incomplete Truth

Notes: B-Bond data only, data from 1982-2010

Conclusions and Recommendations

Conclusions

- σ almost always UNDERESTIMATES risk
- Especially dangerous with long tails
- Clearly risk assessment is very approximate
  - Absolute unpredictability is unquantifiable
  - Risk metrics are specific aspects of *perceived risk*
  - Experience from Wall St. shows they work well enough—except when they don't work at all…

Conclusions and Recommendations

Conclusions

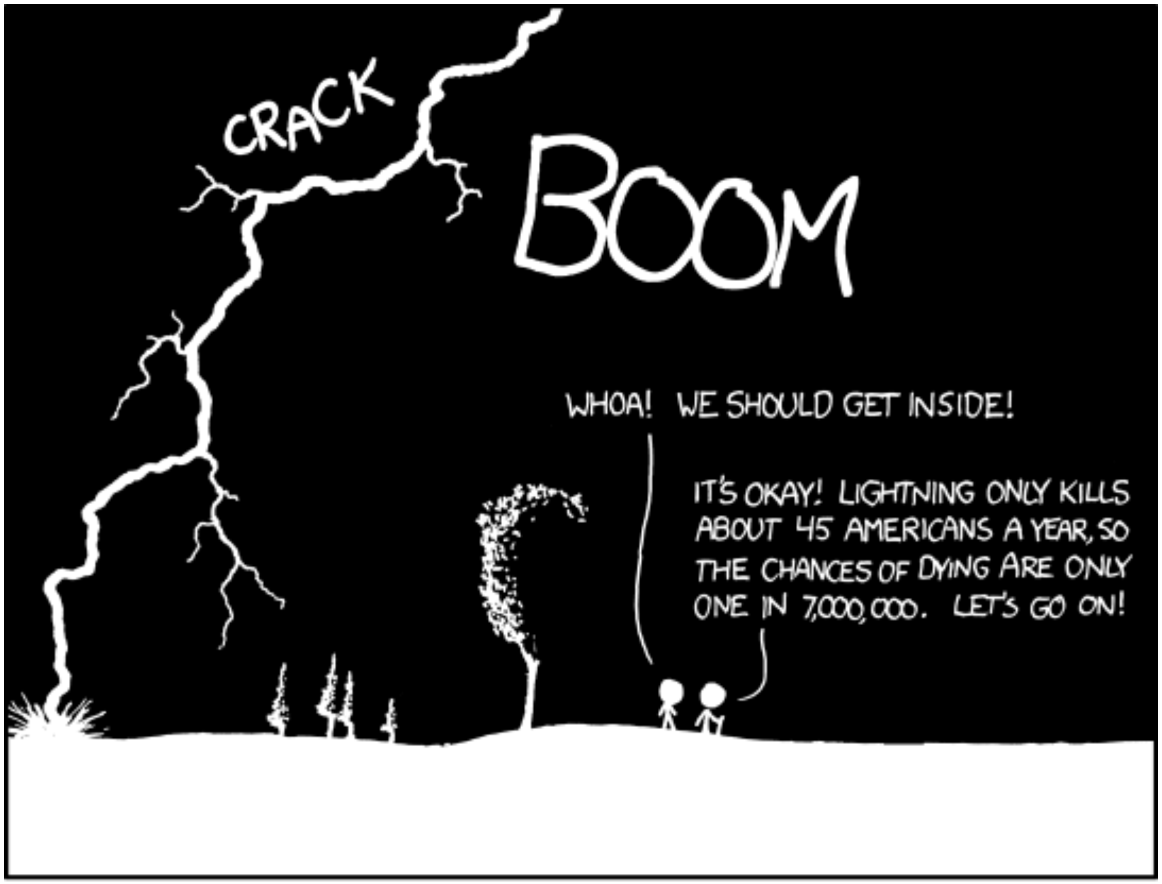
- Project Management *IS* risk management

Thus , the practical question is

Conclusions and Recommendations

Conclusions

Will Project RAPs promote desirable behavior?



THE ANNUAL DEATH RATE AMONG PEOPLE WHO KNOW THAT STATISTIC IS ONE IN SIX.

Conclusions and Recommendations

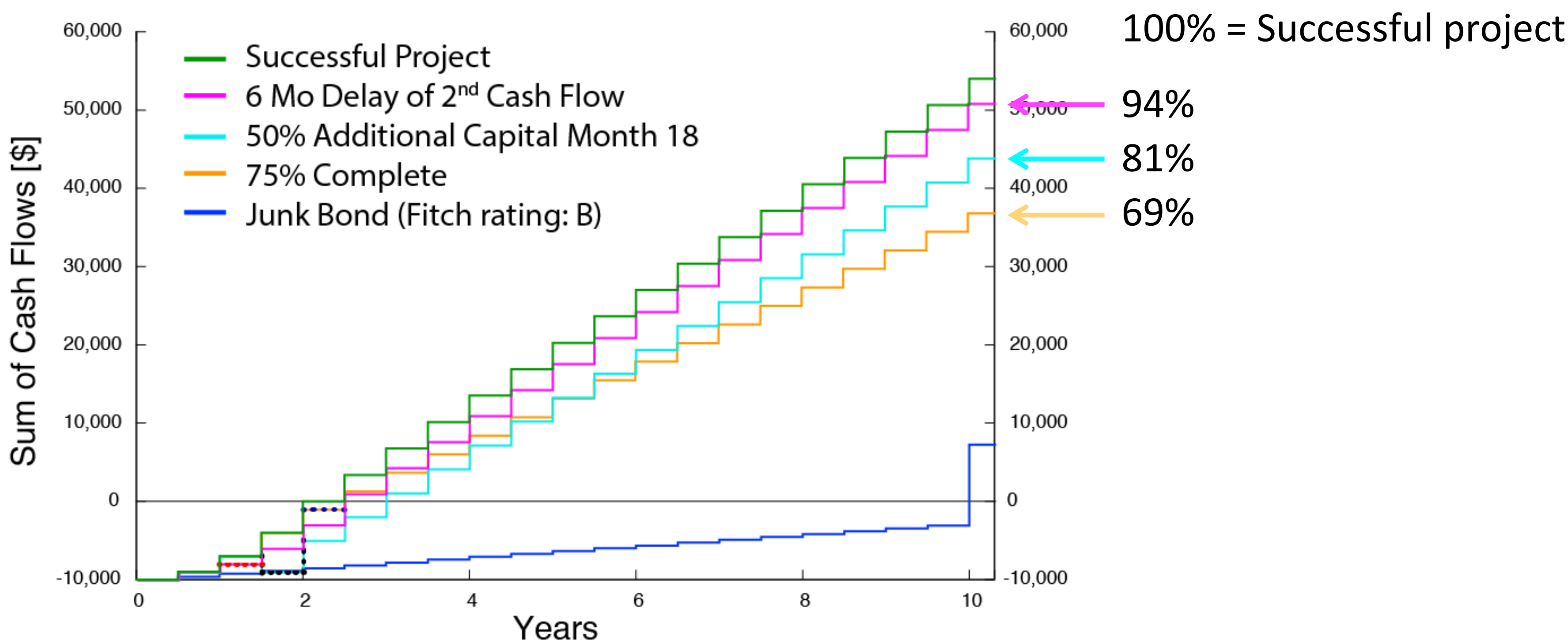
Conclusions

- Evaluate projects against a financial benchmark
  - Enriches understanding of business consequences
  - Offers more informative basis for comparison
- Risk assessment
  - Forces explicit acknowledgement of unpredictability
  - More informative basis for expectation setting
- RAP results *ARE* directionally useful despite analytical limitations
  - Comparisons much more valid than absolute RAPs
  - Failure rate gap is "bigger than statistics"
- Perform sensitivity analysis

Conclusions and Recommendations

Recommendations

- Use project models for RAPs and sensitivity analysis

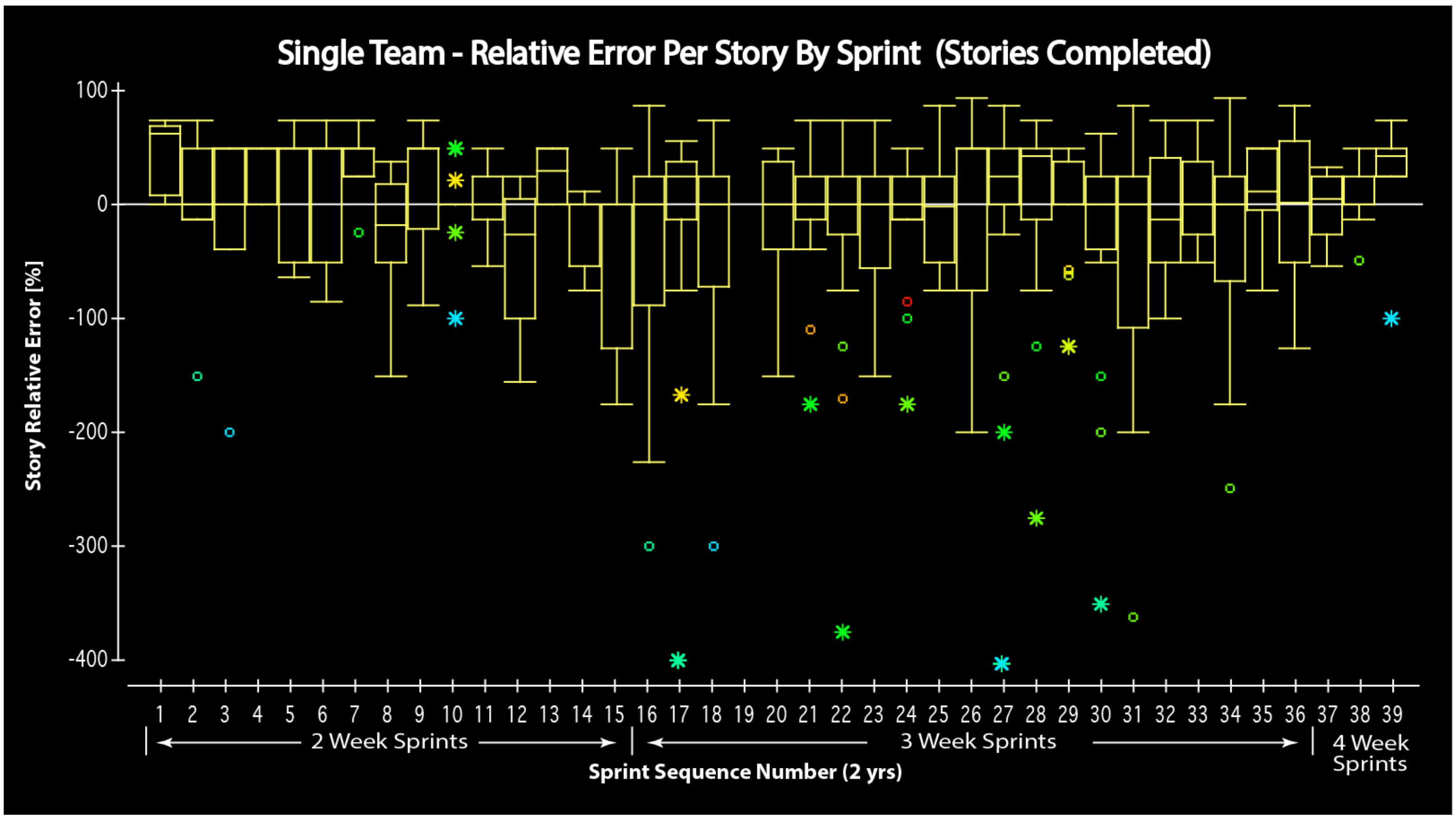


Notes: No inflation, no risk, benchmark data obtained on 2 May 2013

Conclusions and Recommendations

Recommendations

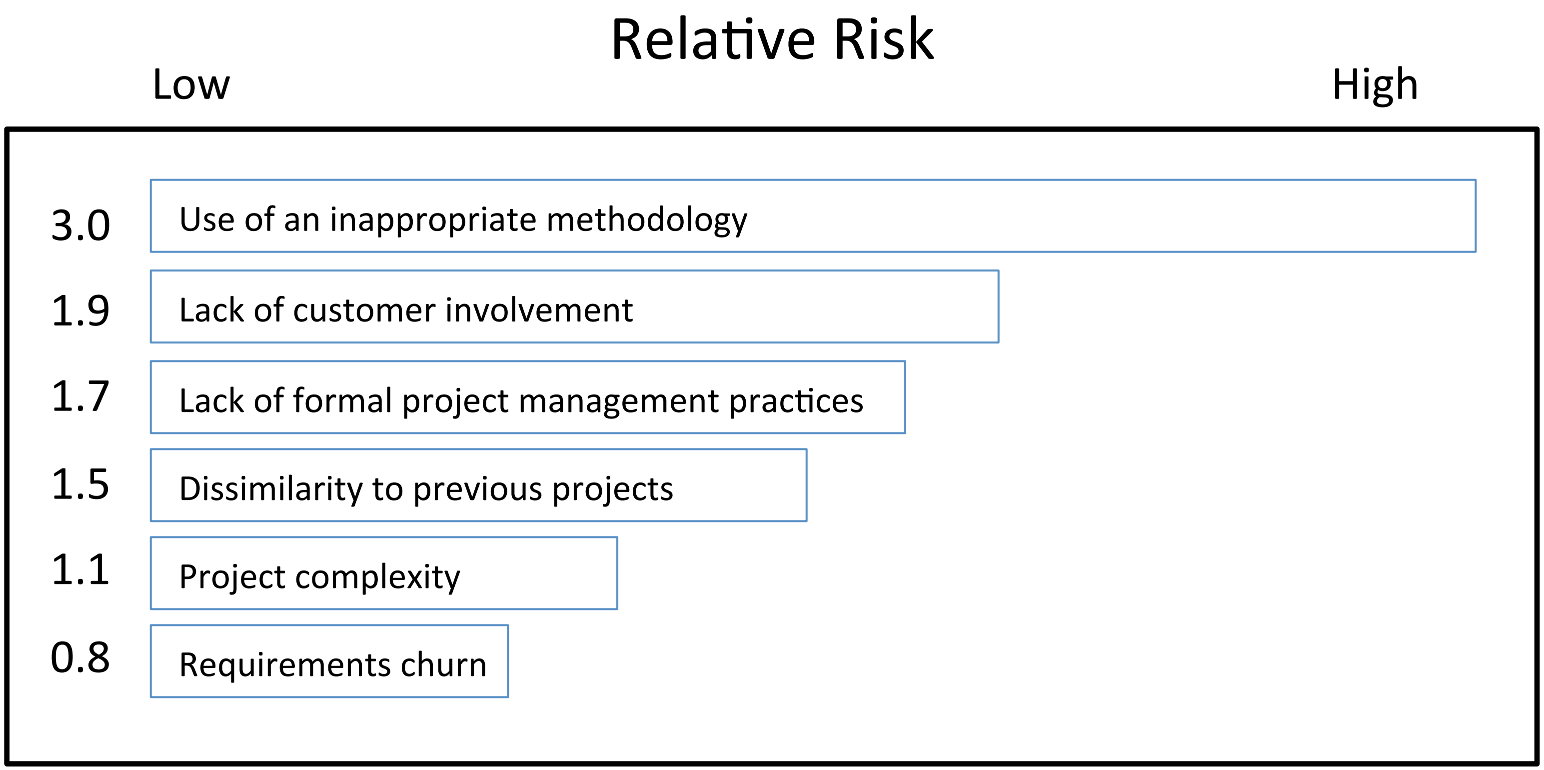
- Measure and track unpredictability
  - You can't manage what you don't measure
  - Best way is to accurately track estimation error



Conclusions and Recommendations

Recommendations

- Mismatched management approach: #1 risk
- Use quantified unpredictability with Cynefin Framework to select appropriate project management approach



Tiwana and Keil (2004). "The One-Minute Risk Assessment Tool". *Communications of the ACM,* 47(11) 73-77.

Do More Than "Embrace Change"

Embrace Unpredictability!

Questions?

This presentation can be downloaded from jhelmassociates.com/resources.html?item=junkProj

Appendix

Concerns Raised About The Chaos Reports

- Review of Chaos reports by Moløkken-Østvold and Jørgensen (2006)
  - Cost overruns were not well-defined and could have included costs on canceled projects
  - The method of calculating the overruns was not specified
    - Authors estimate overruns should have been about 89%, not 189%.
  - The Standish Group appeared to have deliberately solicited failure stories
  - There was no category for under-budget projects
- Additional concerns raised by Eveleens and Verhoef (2008).
  - In this paper we showed that Standish's successful and challenged project results are indeed meaningless for benchmarking. Our research on 12,187 forecasts of 1741 real-world projects of in total 1059 million Euro showed that IT forecasts have political biases

Jørgensen, M., and K. Moløkken-Østvold. 2006. How large are software cost overruns? A review of the 1994 CHAOS report. *Information and Software Technology* 48: 297–301.

J.L. Eveleens and C. Verhoef (2009). The rise and fall of the Chaos report figures. IEEE Software. 27(1) Jan-Feb 2010, 30—36.

Appendix

Boxplot Ranges Over The Gaussian Distribution