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Project Portfolio Management Planning:
A Method for Prioritizing Projects

Presented by:
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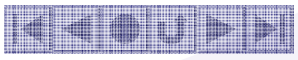
Summary

- Software Project Management ⇐ Software Project Planning, Software Project Tracking and Oversight
- Portfolio Management ⇐ Portfolio Planning, Portfolio Tracking and Oversight
- Measurement objectifies management
- Size, Technology ⇒ Time, Effort, Defects
- Size and Technology are Uncertain
- Uncertainty ⇒ Confidence
- Effort, Confidence ⇒ Risk-Adjusted Investment
- Pairwise Comparison Process ⇒ Relative Return
- Risk-Adjusted Investment, Relative Return ⇒ RARROI
- Portfolio Sorted by RARROI ⇒ Project Priority, Budget Cut Line



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SEI CMM
Software Project Management KPAs

- Software Project Planning
- Software Project Tracking and Oversight

Portfolio Management
Key Elements

- **Portfolio Planning**
- **Portfolio Tracking and Oversight**

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Fundamental Measures

Size

Effective Technology

Time

Effort, Cost, Staffing

Defects

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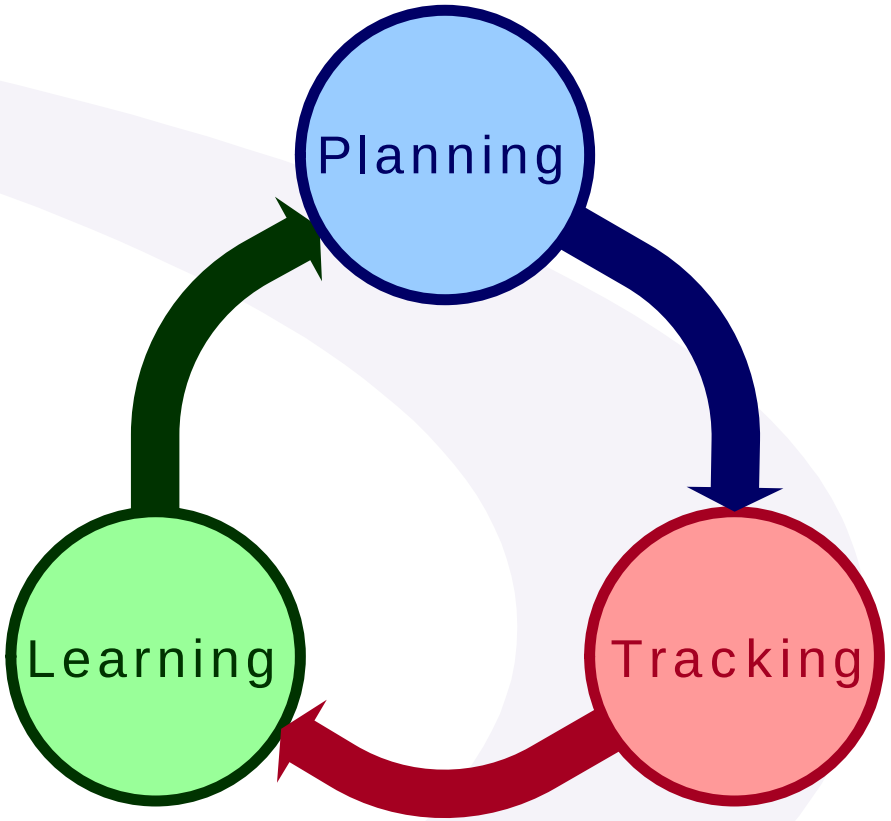
Software Project Management Measurement Process

- **Planning**
  - *PROJECT PLANNING*
  - Predict future performance
- **Tracking**
  - *PROJECT TRACKING AND OVERSIGHT*
  - Control current performance
- **Learning**
  - *PROCESS MANAGEMENT*
  - Learn from past performance
- ***Facilitates communication that is:***
  - Objective (fact-based)
  - Repeatable



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Estimate Defined

es·ti·mate (es′ti mit), *n.*

an approximate *judgment* or *calculation*, as of the value or amount of something

a prediction that is equally likely to be above or below the actual result (Tom DeMarco)

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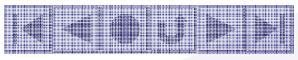
Brooks' Law

- **Quote:** ***Adding people to a late project makes it later.***
- **Interpretation:** ***Productivity is inversely proportional to some function of the project's average staffing rate.***
- **Assumptions (based on regression analysis of historical data):**
  - The function is a ***power function***.
  - The exponent (beta) represents process entropy and is approximately ***0.5***.
  - The constant of proportionality represents ***effective technology***.

$$\frac{Size}{Effort} \propto \left(\frac{Effort}{Time^2}\right)^{-a}$$

$$\frac{Size}{Effort} = Technology \times \left(\frac{Effort}{Time^2}\right)^{-0.5}$$



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Software Equation
Conceptually Simplified

$$Effort^{0.5} \times Time = \frac{Size}{Technology}$$

- **The family of project time-effort solutions depends on the software's size and the project's effective technology**
- ***As the size goes up, the effort and/or time goes up***
- ***As the effective technology goes up, the effort and/or time goes down***
- ***As the time goes up, the effort goes down***

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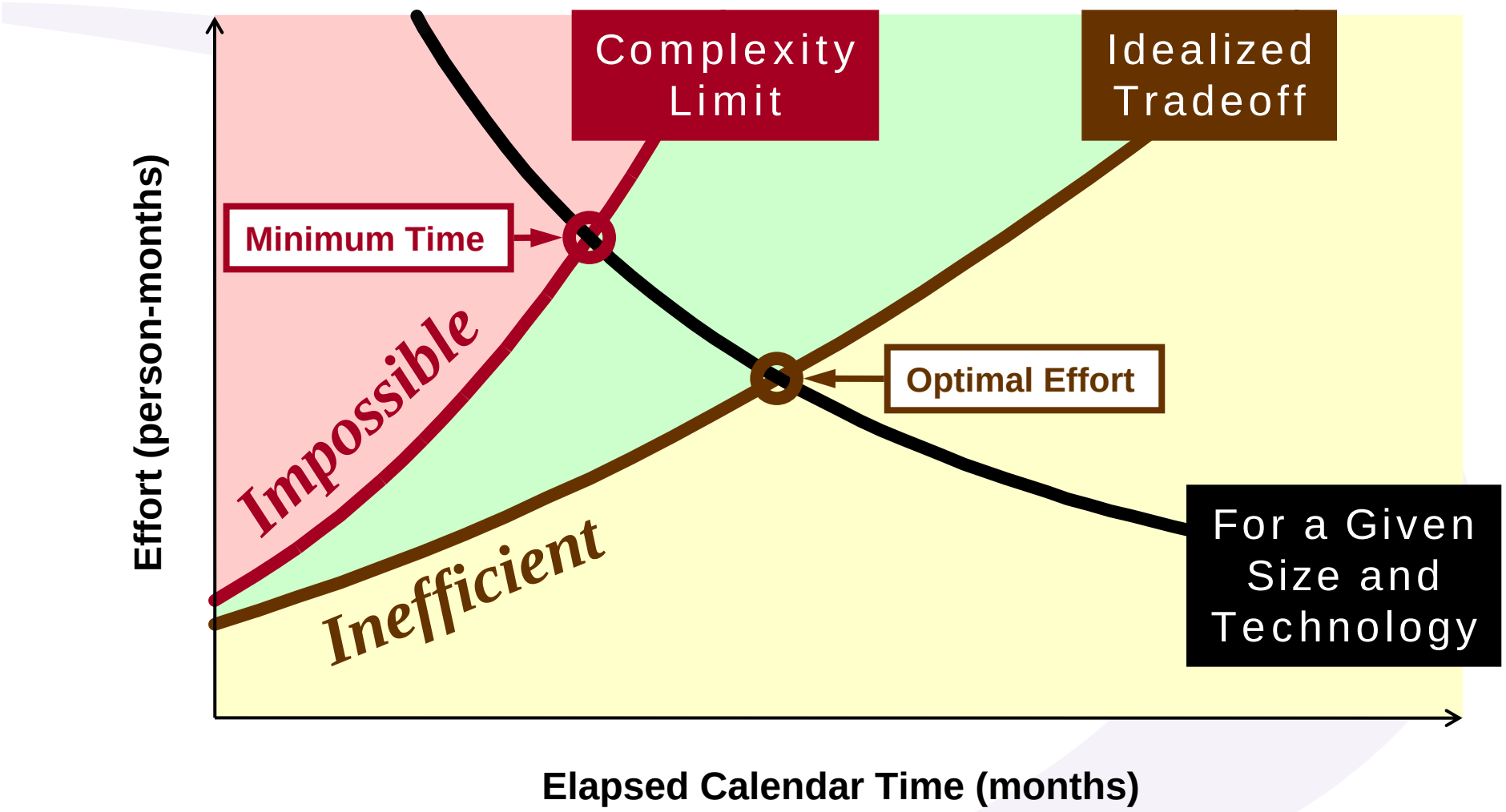
Software Development Dynamics



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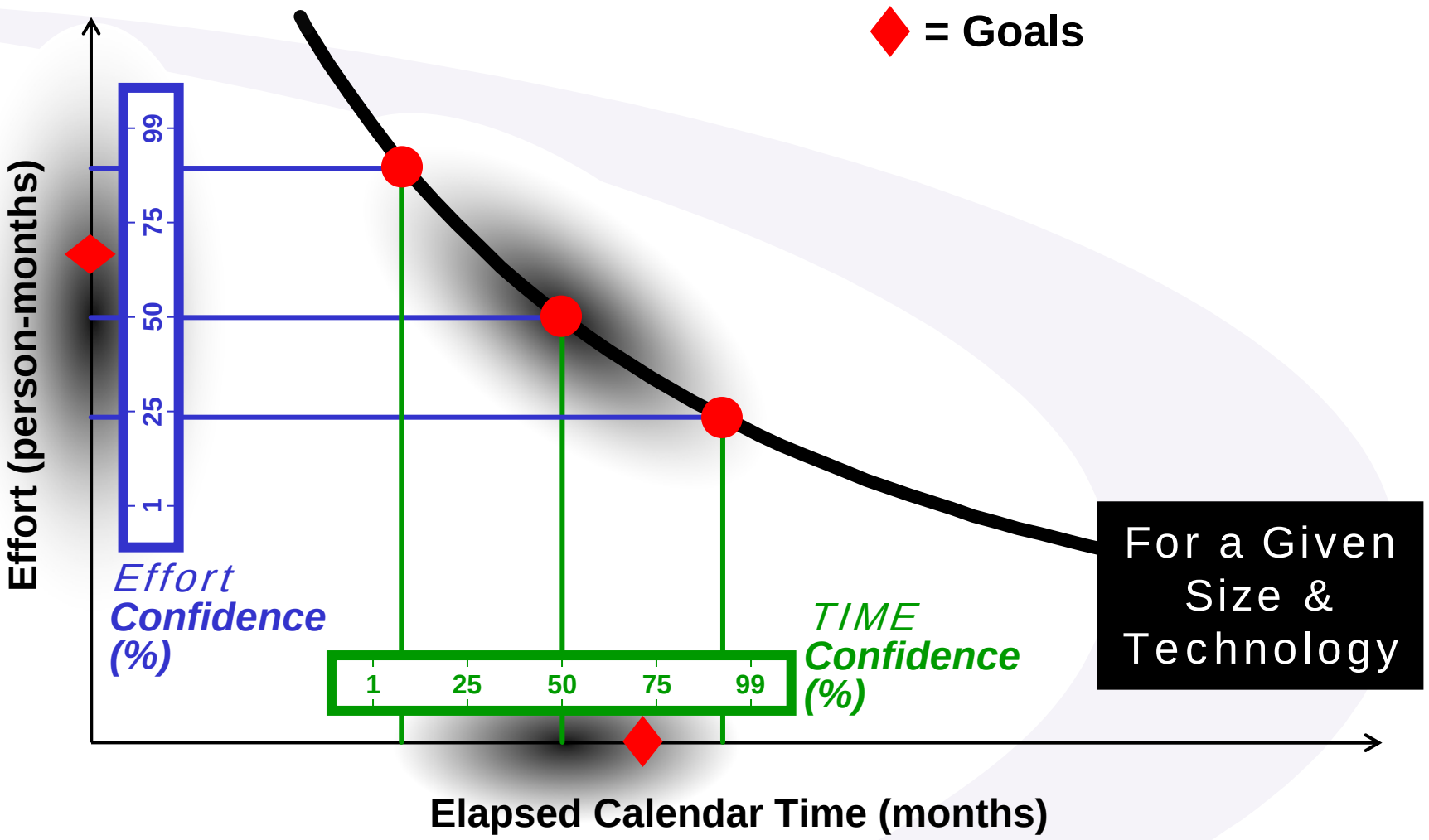
Uncertainty and Confidence



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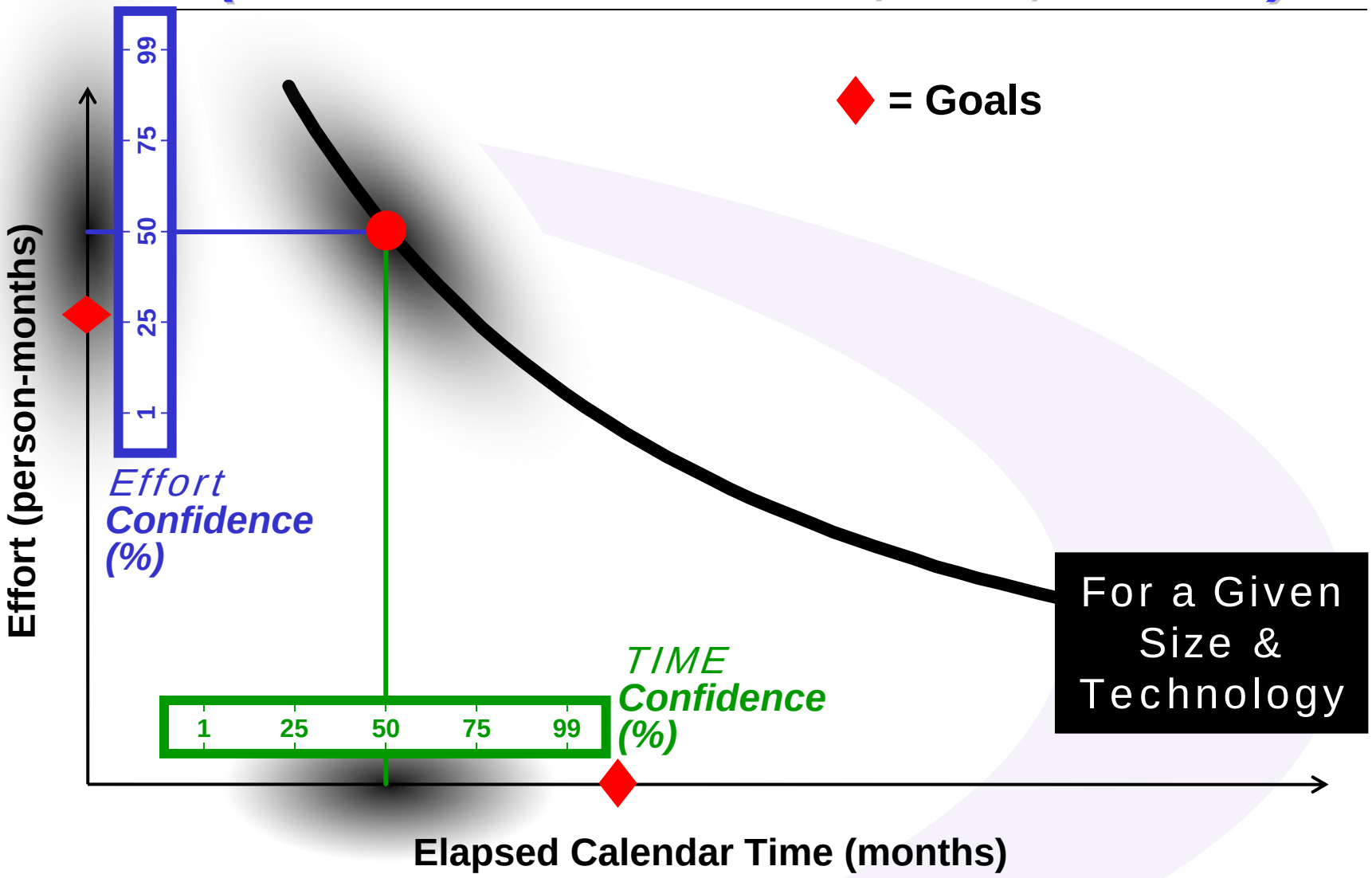
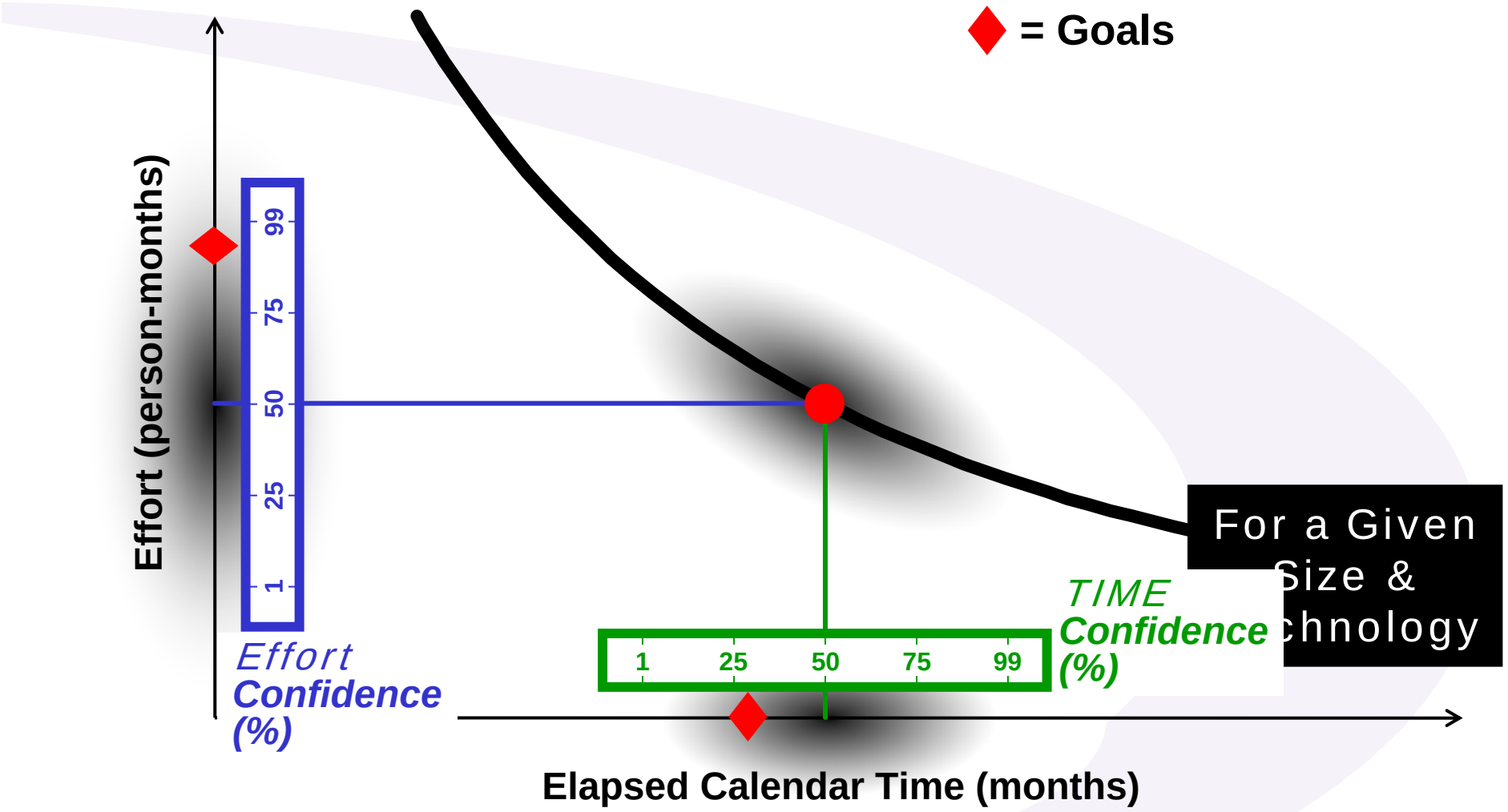
Low Confidence (Risky) Effort
(less time – more effort, cost, defects)



Low Confidence (Risky) Schedule
(more time – less effort, cost, defects)



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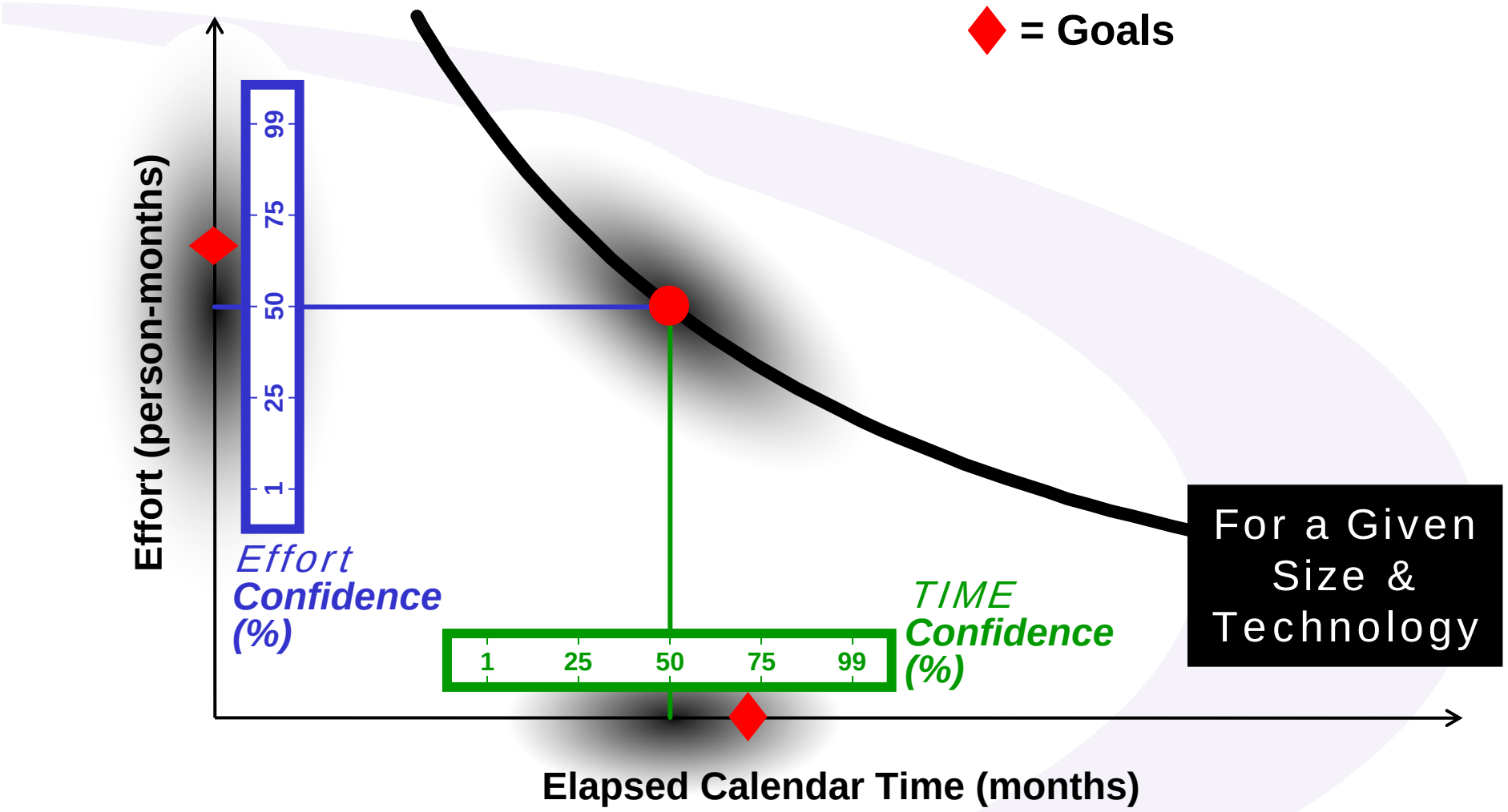
Balanced Risk



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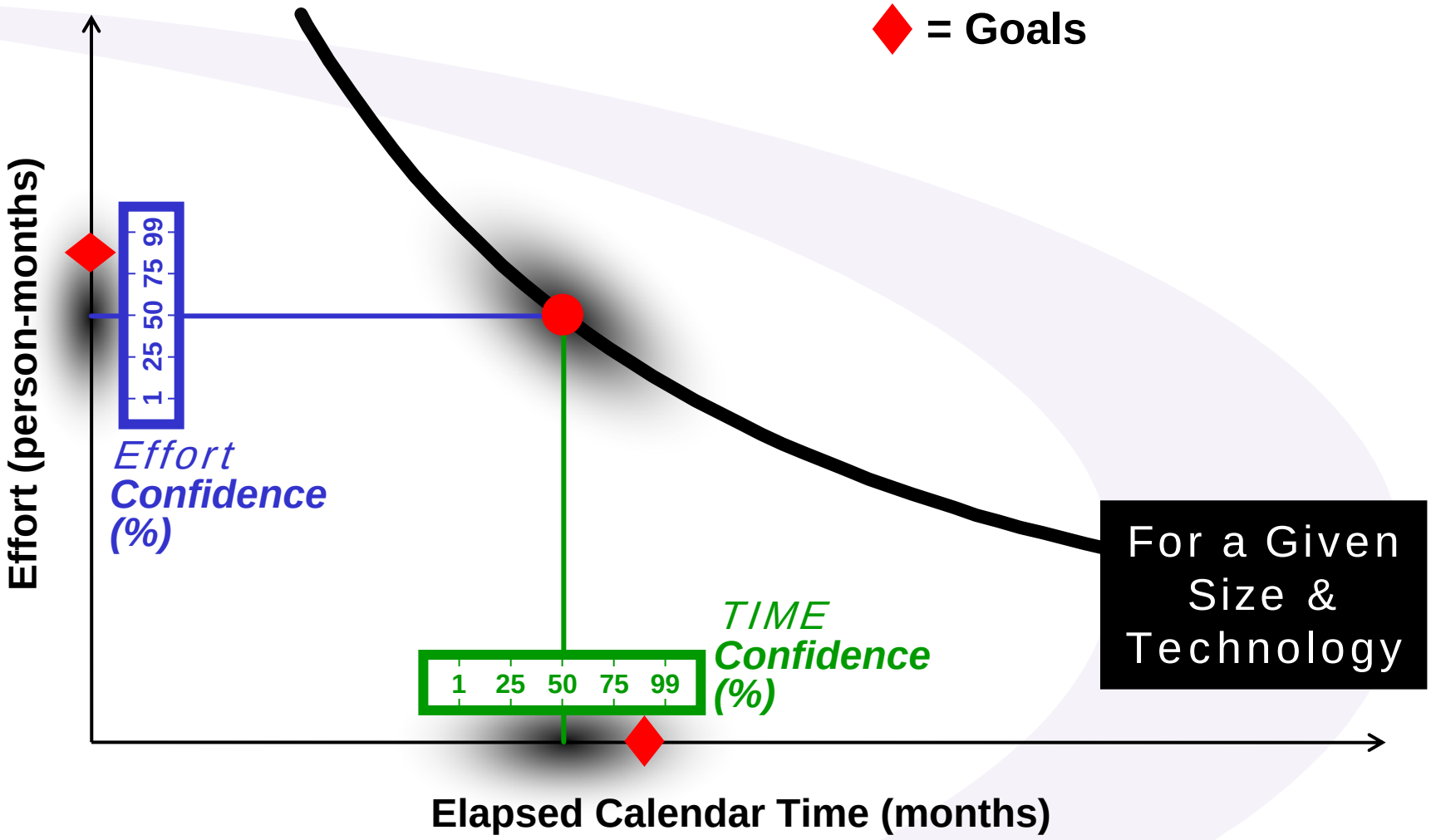
Reduced Uncertainty



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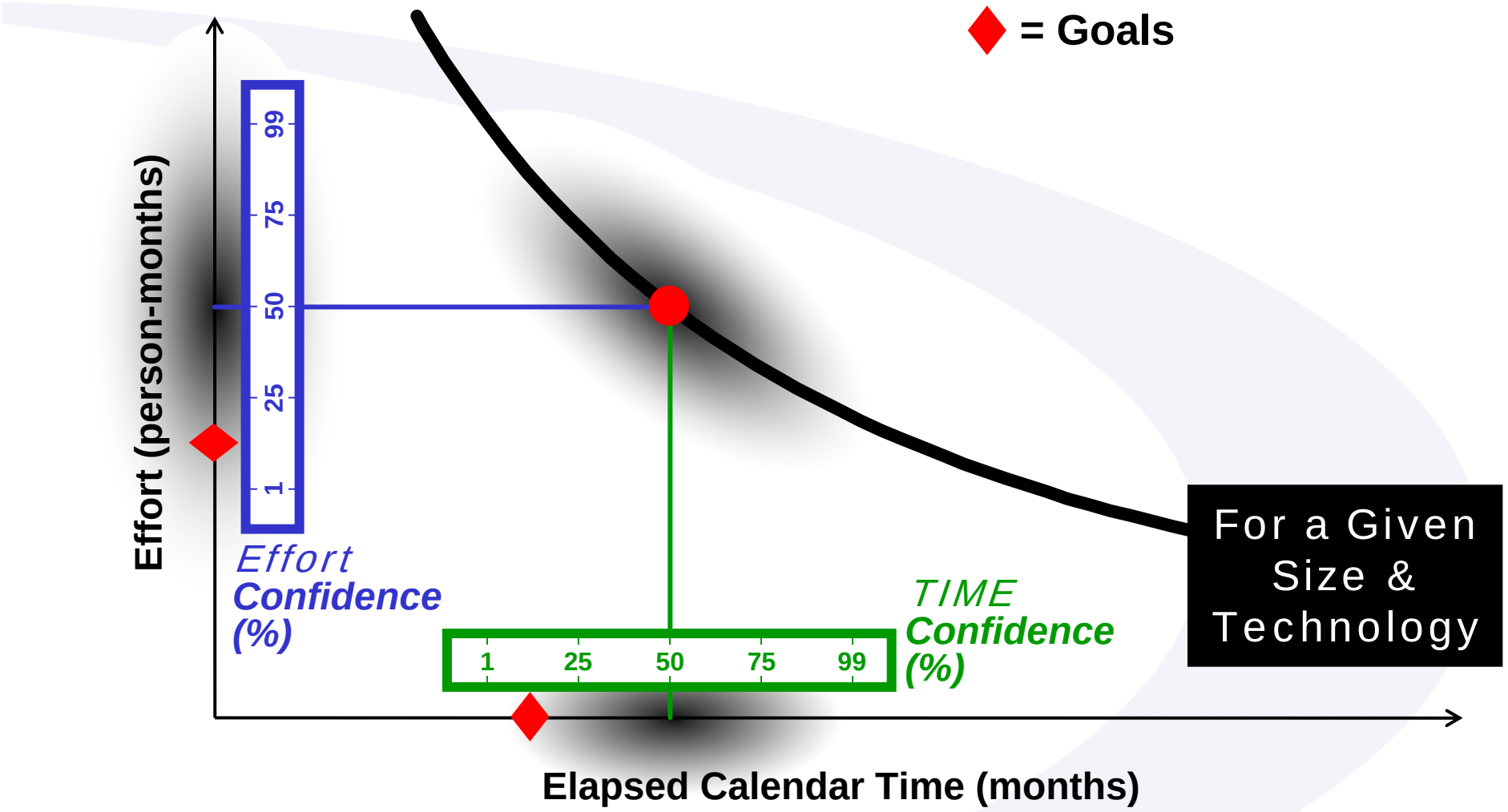
What About This One?



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Expressing Uncertainty

- **Estimates of Size and Technology expressed as single point values don't tell the *whole* story:**
  - How ***confident*** am I in this value; i.e., what is the probability of not exceeding this value?
  - How ***certain*** am I in this value; i.e., how wide is the probability distribution?
- **Three-point estimates are better:**
  - *LEAST:* 1% Probability; ***"I can't imagine the result being any smaller than this."***
  - *LIKELY:* Best Guess; ***"If I were forced to pick one value, this would be it."***
  - *MOST:* 99% Probability; ***"I can't imagine the result being any larger than this."***

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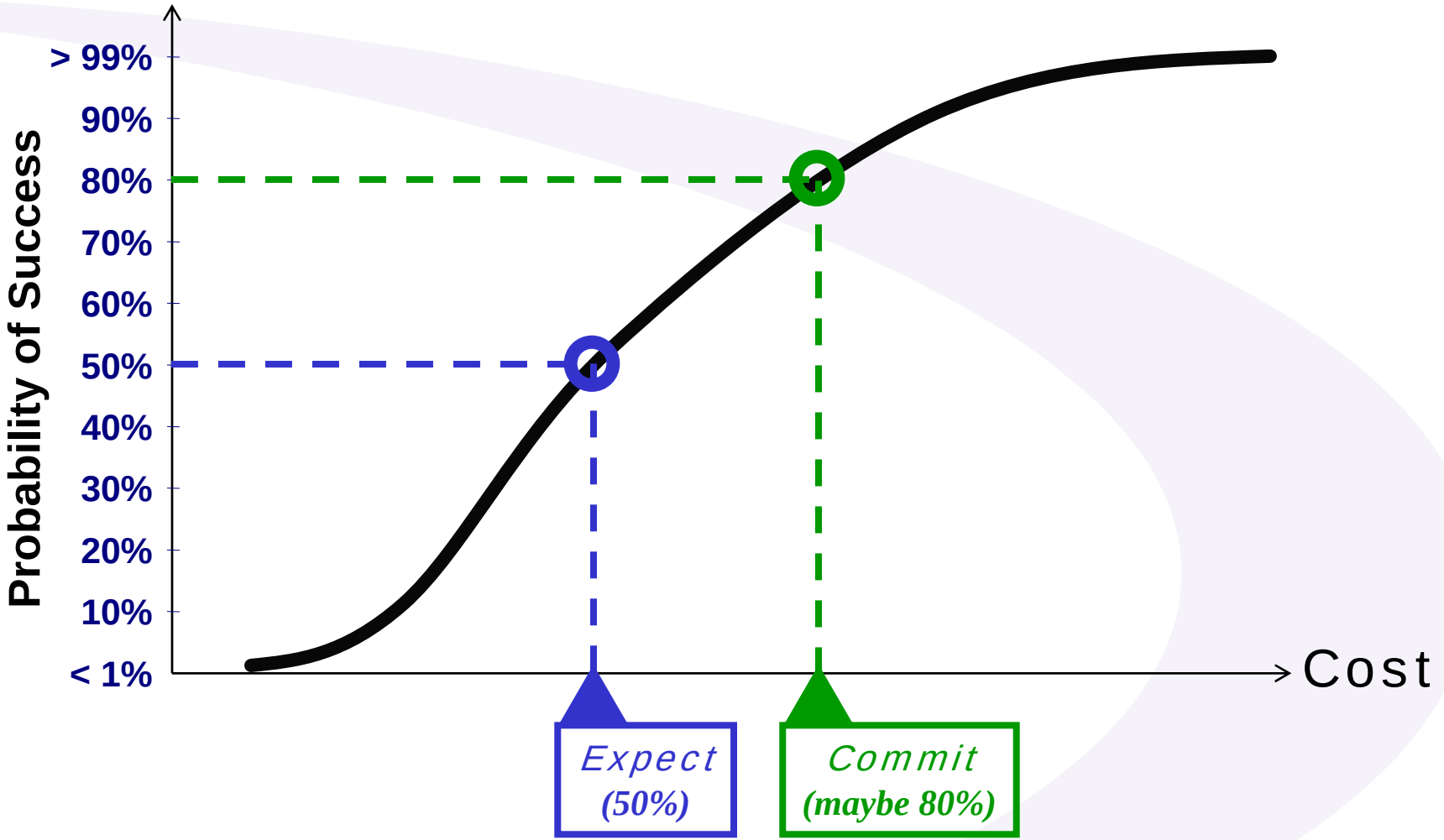
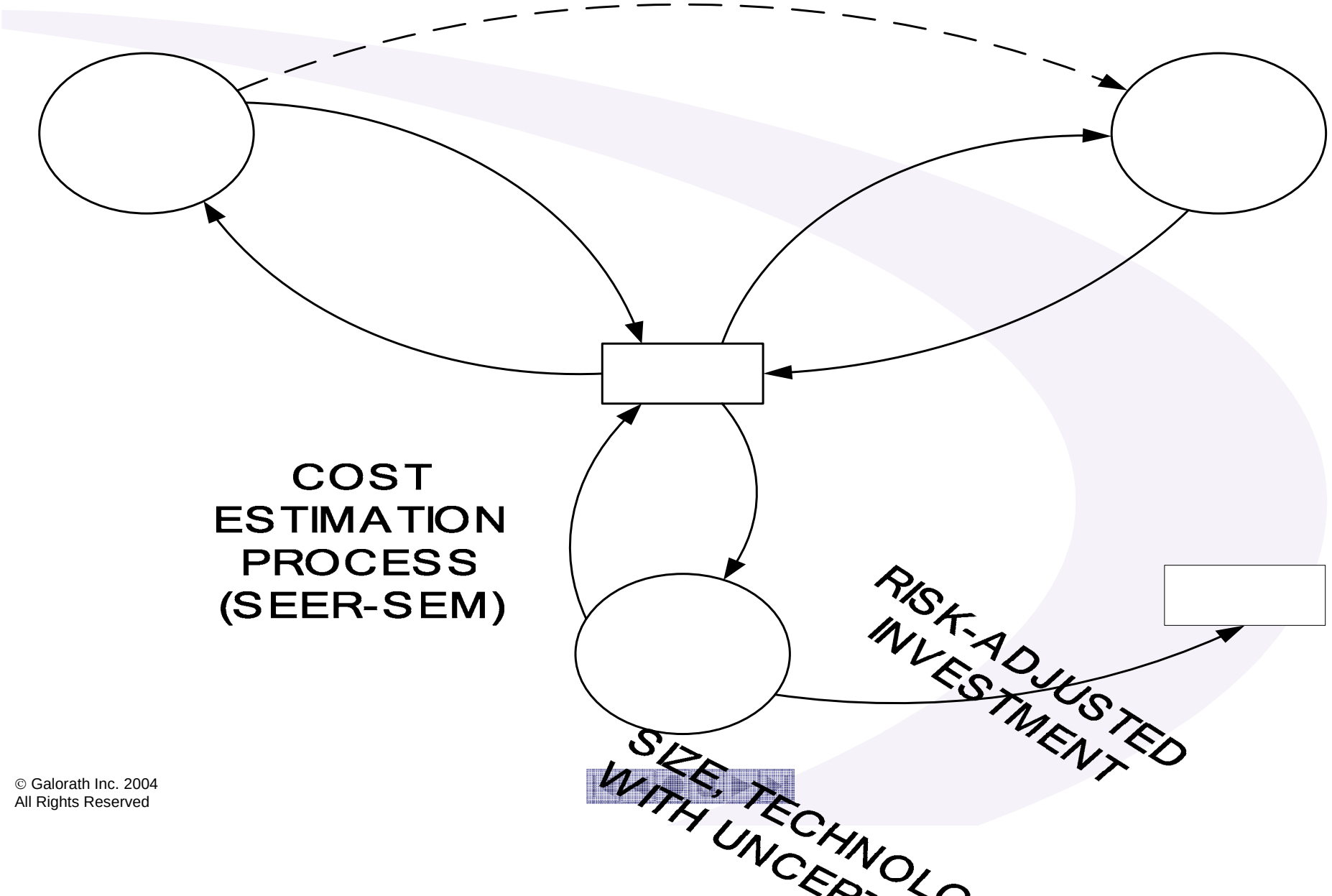
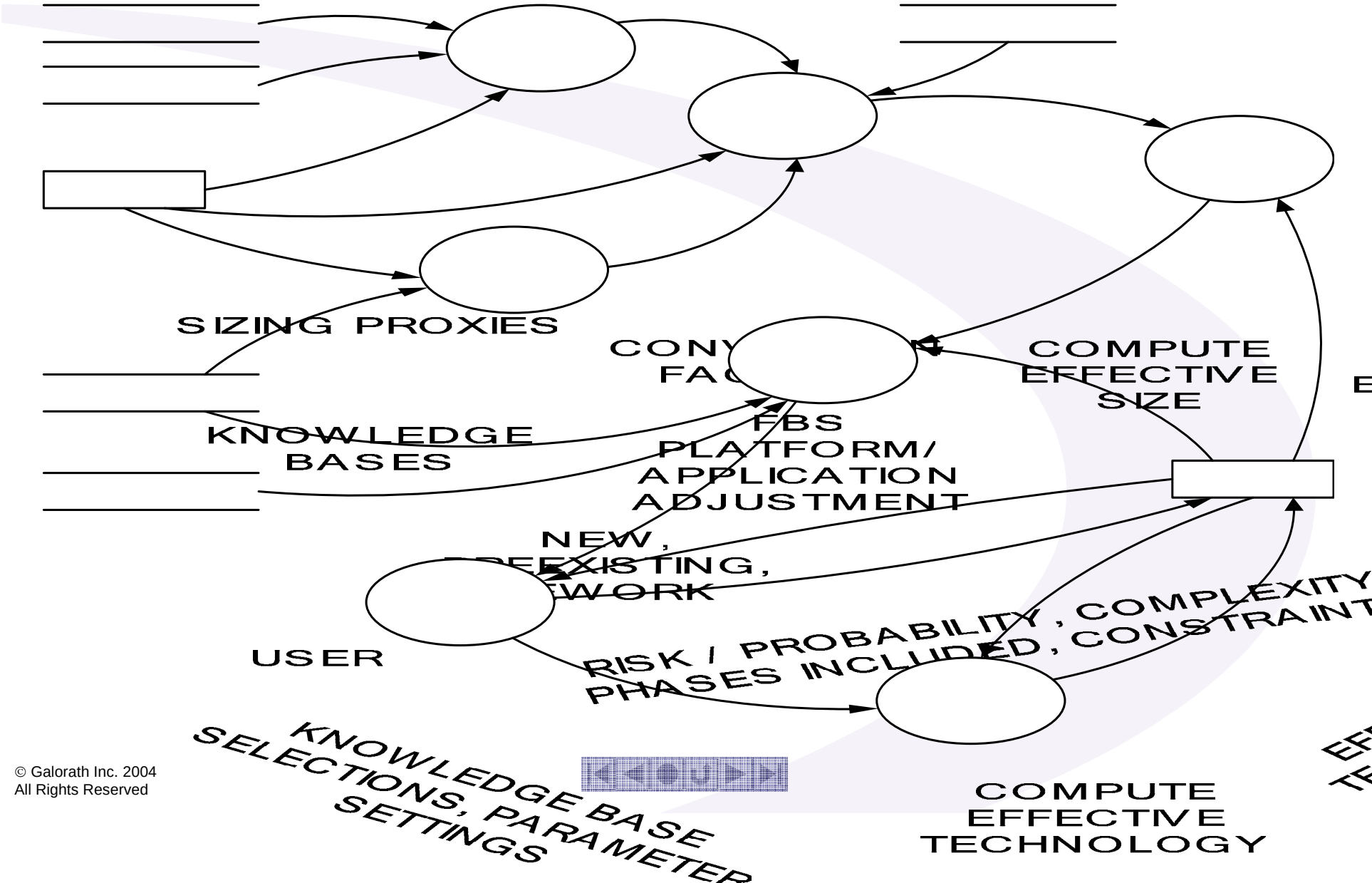
Managing Risk



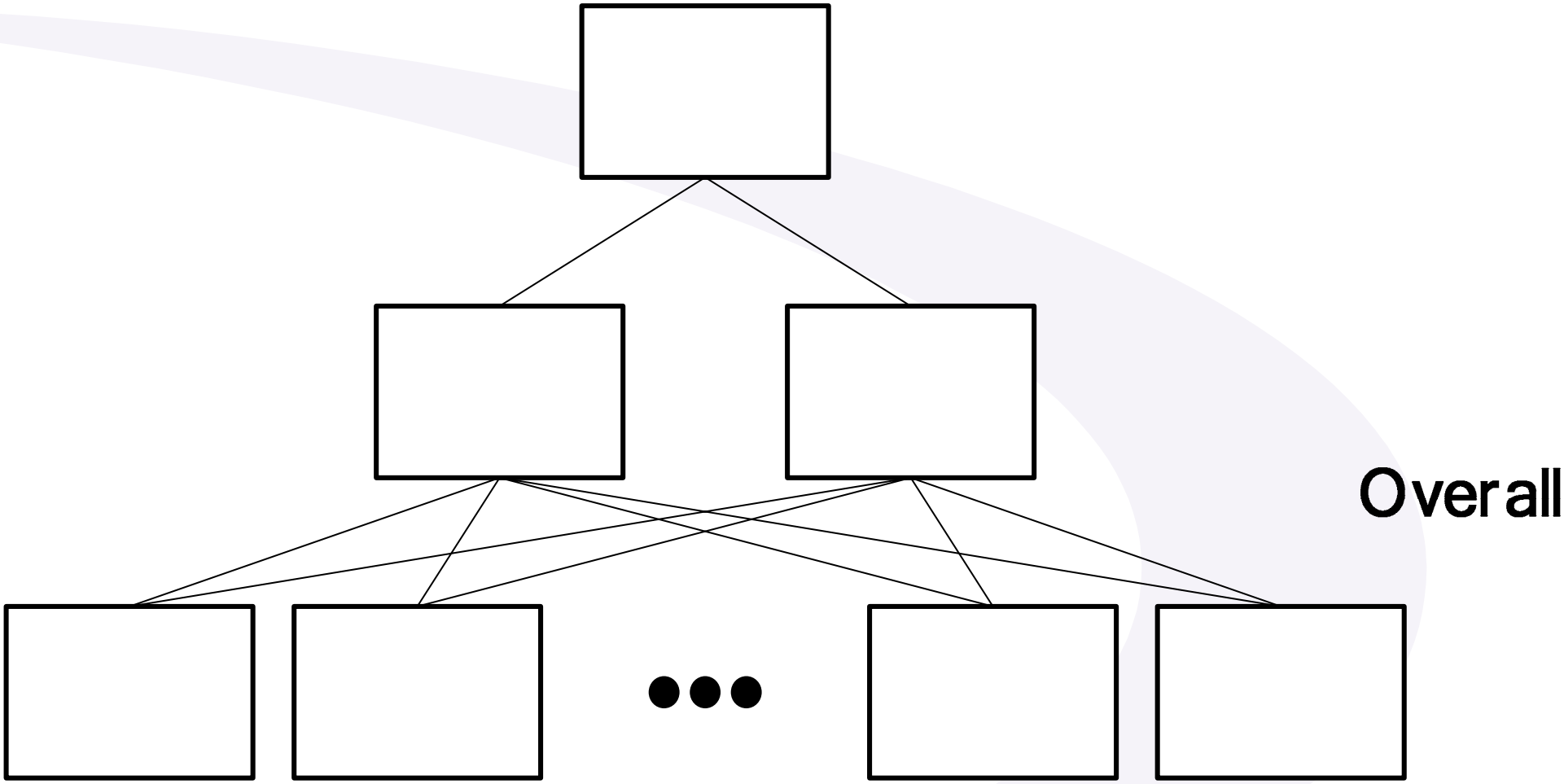
Portfolio Planning Process Data Flow



Structured Estimating Process Data Flow



Example Decision Hierarchy for Return Parameters



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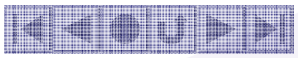
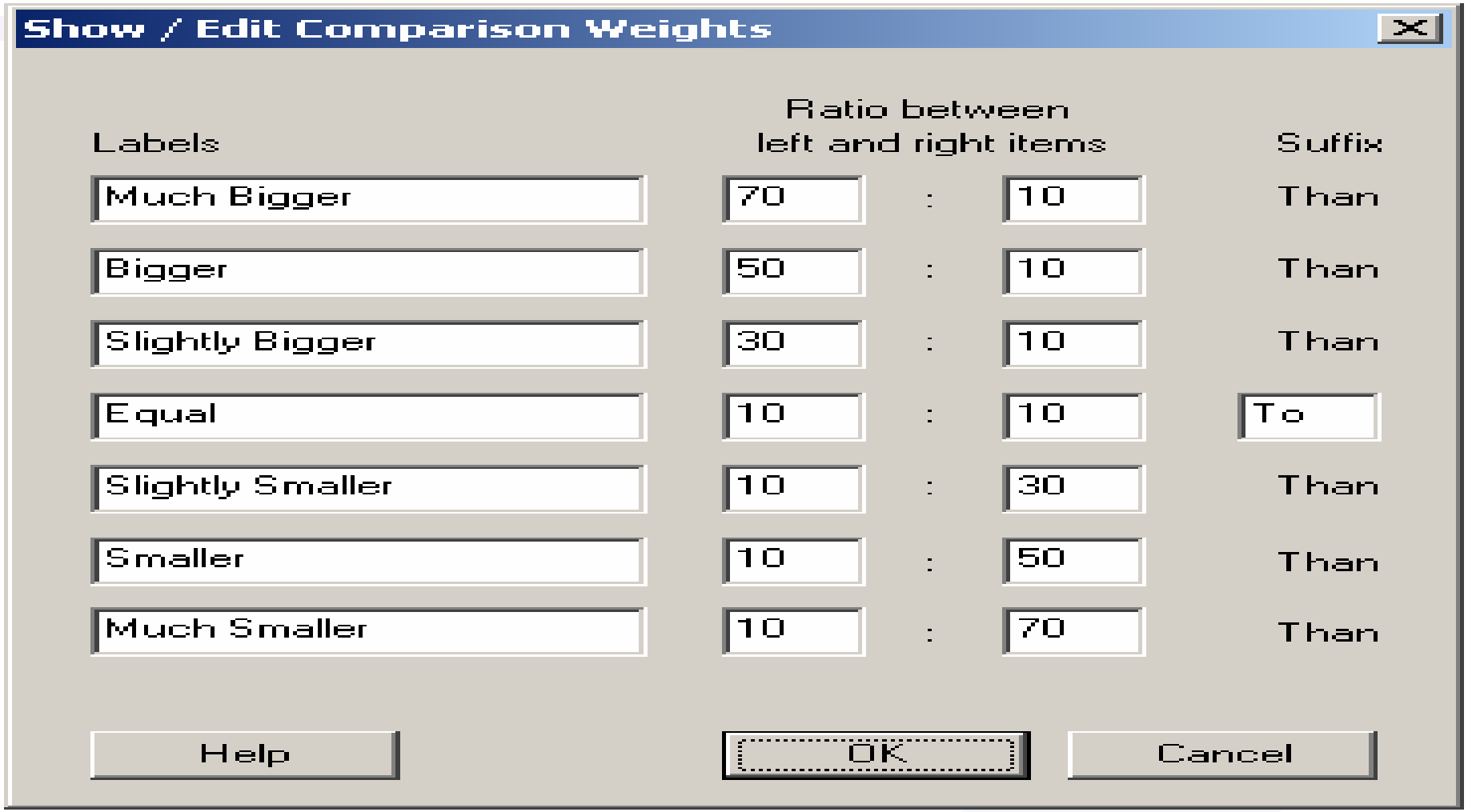
AccuScope Comparison Options

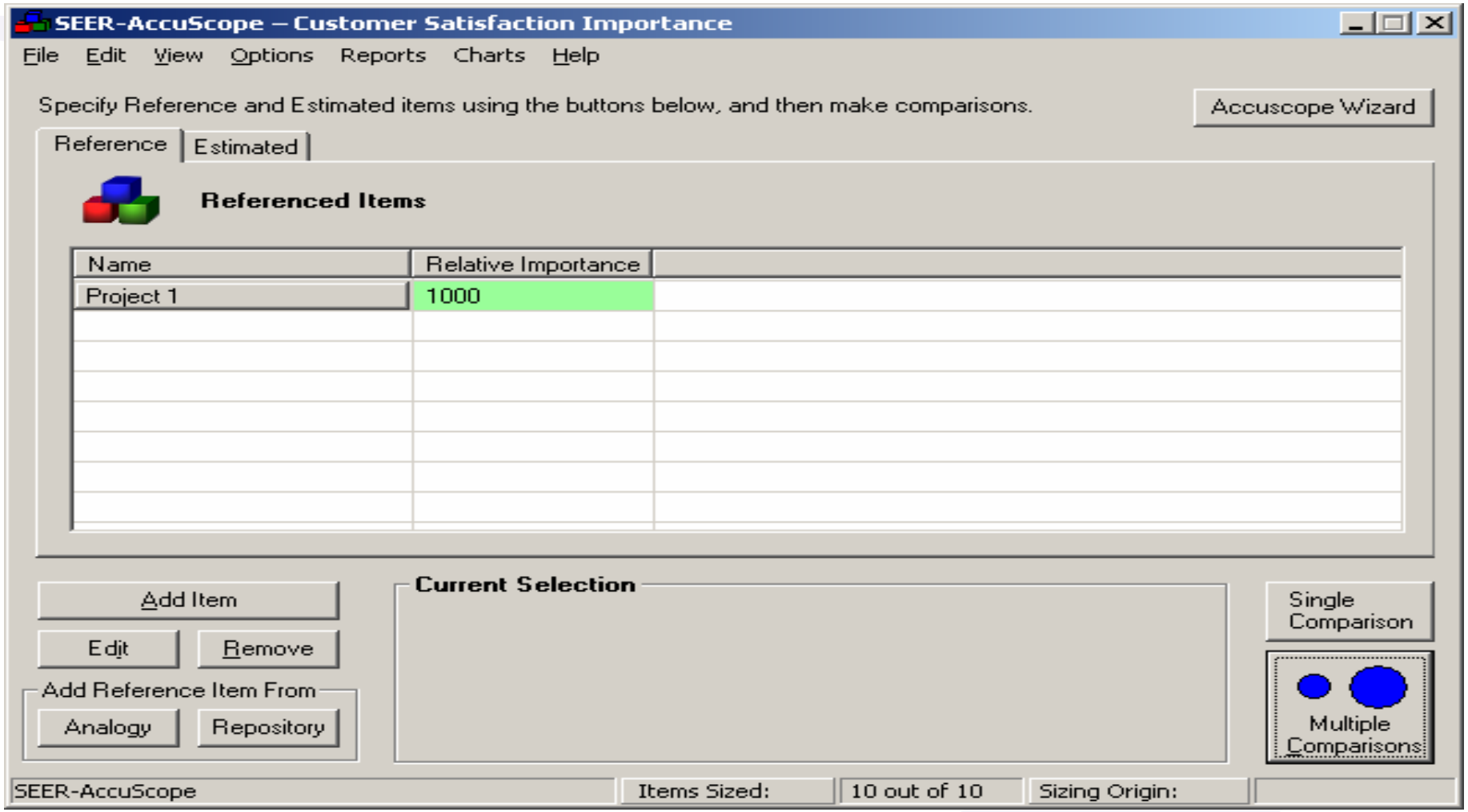
- ***i*** **having** ***much smaller*** **impact than** ***j*****.**
- ***i*** **having** ***smaller*** **impact than** ***j*****.**
- ***i*** **having a** ***slightly smaller*** **impact as** ***j*****.**
- ***i*** **having** ***equal*** **impact as** ***j*****.**
- ***i*** **having** ***slightly bigger*** **impact than** ***j*****.**
- ***i*** **having** ***bigger*** **impact than** ***j*****.**
- ***i*** **having a** ***much bigger*** **impact than** ***j*****.**



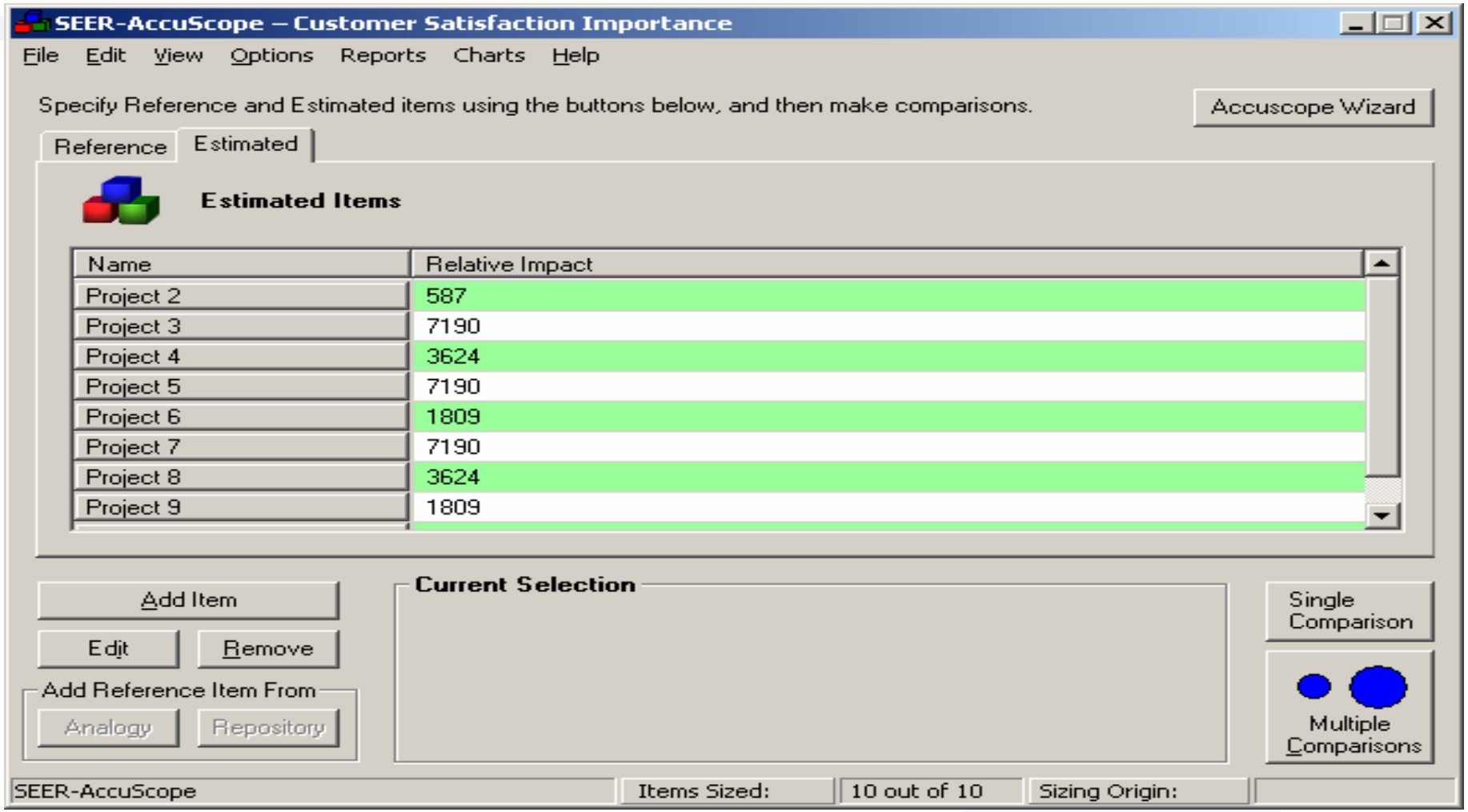
Analytic Hierarchy Process
Relative Importance Ratio Mapping



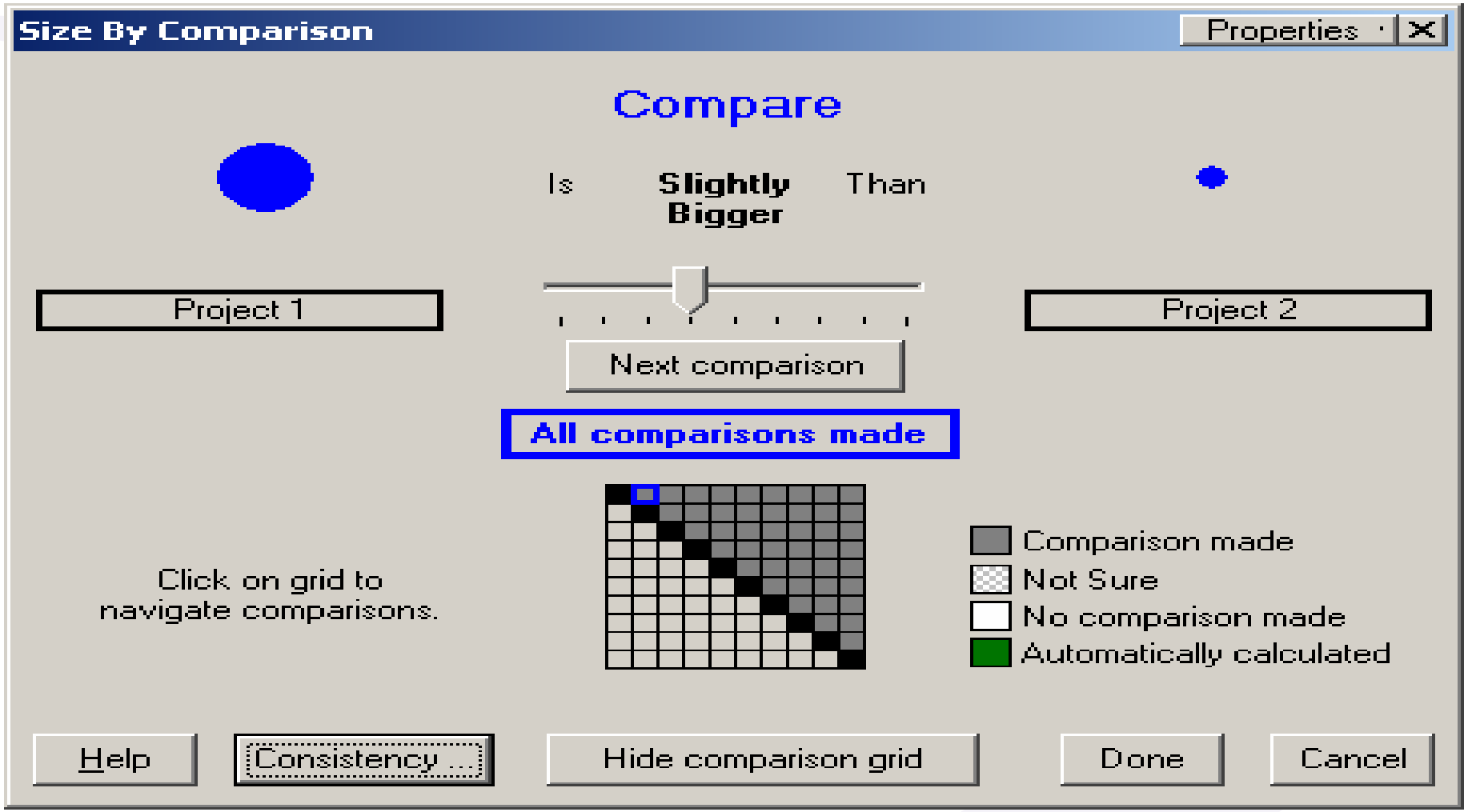
Arbitrarily-Selected Relative Baseline Project



Other Projects Relative to Baseline



Individual Pairwise Comparison



Example Parameter Importance to the Overall Return

Pairwise Comparison Matrix

Return Parameters

		j			
		Customer Satisfaction	***Productivity Improvement***	***Relative Weight***	***Normalized Weight***
i	***Customer Satisfaction***		Slightly Bigger	**1000**	**0.75**
	Productivity Improvement			**333**	**0.25**

Example Project Importance to Customer Satisfaction

Pairwise Comparison Matrix

Customer Satisfaction

		j											
		Project 1	***Project 2***	***Project 3***	***Project 4***	***Project 5***	***Project 6***	***Project 7***	***Project 8***	***Project 9***	***Project 10***	***Relative Weight (AccuScope)***	***Normalized Weight***
i	***Project 1***		Slightly Bigger	Smaller	Smaller	Smaller	Slightly Smaller	Smaller	Smaller	Slightly Smaller	Equal	**1000**	**0.03**
	Project 2			Much Smaller	Smaller	Much Smaller	Smaller	Much Smaller	Smaller	Smaller	Slightly Smaller	**587**	**0.02**
	Project 3				Slightly Bigger	Equal	Bigger	Equal	Slightly Bigger	Bigger	Bigger	**7190**	**0.21**
	Project 4					Slightly Smaller	Slightly Bigger	Slightly Smaller	Equal	Slightly Bigger	Bigger	**3624**	**0.10**
	Project 5						Bigger	Equal	Slightly Bigger	Bigger	Bigger	**7190**	**0.21**
	Project 6							Smaller	Slightly Smaller	Equal	Slightly Bigger	**1809**	**0.05**
	Project 7								Slightly Bigger	Bigger	Bigger	**7190**	**0.21**
	Project 8									Slightly Bigger	Bigger	**3624**	**0.10**
	Project 9										Slightly Bigger	**1809**	**0.05**
	Project 10											**1000**	**0.03**

Example Project Importance to Productivity Improvement

Pairwise Comparison Matrix

Productivity Improvement

		j											
		Project 1	***Project 2***	***Project 3***	***Project 4***	***Project 5***	***Project 6***	***Project 7***	***Project 8***	***Project 9***	***Project 10***	***Relative Weight (AccuScope)***	***Normalized Weight***
i	***Project 1***		Slightly Bigger	Equal	Slightly Smaller	Slightly Smaller	Bigger	Slightly Smaller	Bigger	Slightly Bigger	Bigger	**1000**	**0.10**
	Project 2			Slightly Smaller	Smaller	Smaller	Bigger	Smaller	Slightly Bigger	Equal	Slightly Bigger	**499**	**0.05**
	Project 3				Slightly Smaller	Slightly Smaller	Bigger	Slightly Smaller	Bigger	Slightly Bigger	Bigger	**1000**	**0.10**
	Project 4					Equal	Much Bigger	Equal	Bigger	Bigger	Bigger	**1984**	**0.21**
	Project 5						Much Bigger	Equal	Bigger	Bigger	Bigger	**1984**	**0.21**
	Project 6							Much Smaller	Slightly Smaller	Smaller	Slightly Smaller	**162**	**0.02**
	Project 7								Bigger	Bigger	Bigger	**1984**	**0.21**
	Project 8									Slightly Smaller	Equal	**276**	**0.03**
	Project 9										Slightly Bigger	**499**	**0.05**
	Project 10											**276**	**0.03**

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Risk-Adjusted Relative Return on Investment Calculation

$$RARROI_P = \frac{\sum_{i=1}^{n} R_i W_i}{I_C}$$

- $RARROI_P$ is the Risk Adjusted Relative Return on Investment for project P.
- R_i is the normalized project relative importance for the i^{th} return parameter.
- W_i is normalized relative parameter importance (weight) for the i^{th} return parameter.
- I_C is normalized relative investment (cost of ownership) with confidence percentage C where C represents the enterprise standard risk tolerance (desired probability of success).

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Example Project RARROI Calculations

RARROI Computations

Before Sorting

Project Name	Investment		Return				RARROI	Cumulative Investment
			Customer Satisfaction		Productivity Improvement			
	80% Confidence Estimated Cost of Ownership	Relative Weight	Relative Parameter Value	Relative Parameter Weight	Relative Parameter Value	Relative Parameter Weight		
Project 1	$ 28,500.00	0.01	0.03	0.75	0.10	0.25	**3.60**	$ 28,500.00
Project 2	$ 237,000.00	0.11	0.02	0.75	0.05	0.25	**0.23**	$ 265,500.00
Project 3	$ 304,500.00	0.14	0.21	0.75	0.10	0.25	**1.28**	$ 570,000.00
Project 4	$ 173,500.00	0.08	0.10	0.75	0.21	0.25	**1.61**	$ 743,500.00
Project 5	$ 283,000.00	0.13	0.21	0.75	0.21	0.25	**1.57**	$ 1,026,500.00
Project 6	$ 680,000.00	0.31	0.05	0.75	0.02	0.25	**0.14**	$ 1,706,500.00
Project 7	$ 68,000.00	0.03	0.21	0.75	0.21	0.25	**6.55**	$ 1,774,500.00
Project 8	$ 108,500.00	0.05	0.10	0.75	0.03	0.25	**1.70**	$ 1,883,000.00
Project 9	$ 200,000.00	0.09	0.05	0.75	0.05	0.25	**0.56**	$ 2,083,000.00
Project 10	$ 87,000.00	0.04	0.03	0.75	0.03	0.25	**0.71**	$ 2,170,000.00

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Example Project Ranking with Budget Cut Line

RARROI Computations

Sorted by Descending RARROI with Budget Cut Line Shown

Project Name	Investment		Return				RARROI	Cumulative Investment
			Customer Satisfaction		Productivity Improvement			
	80% Confidence Estimated Cost of Ownership	Relative Weight	Relative Parameter Value	Relative Parameter Weight	Relative Parameter Value	Relative Parameter Weight		
Project 7	$ 68,000.00	0.03	0.21	0.75	0.21	0.25	**6.55**	$ 68,000.00
Project 1	$ 28,500.00	0.01	0.03	0.75	0.10	0.25	**3.60**	$ 96,500.00
Project 8	$ 108,500.00	0.05	0.10	0.75	0.03	0.25	**1.70**	$ 205,000.00
Project 4	$ 173,500.00	0.08	0.10	0.75	0.21	0.25	**1.61**	$ 378,500.00
Project 5	$ 283,000.00	0.13	0.21	0.75	0.21	0.25	**1.57**	$ 661,500.00
Project 3	$ 304,500.00	0.14	0.21	0.75	0.10	0.25	**1.28**	$ 966,000.00
Project 10	$ 87,000.00	0.04	0.03	0.75	0.03	0.25	**0.71**	$ 1,053,000.00
Project 9	$ 200,000.00	0.09	0.05	0.75	0.05	0.25	**0.56**	$ 1,253,000.00
Project 2	$ 237,000.00	0.11	0.02	0.75	0.05	0.25	**0.23**	$ 1,490,000.00
Project 6	$ 680,000.00	0.31	0.05	0.75	0.02	0.25	**0.14**	$ 2,170,000.00

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Summary Revisited

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- Pairwise Comparison Process ⇒ Relative Return
- Risk-Adjusted Investment, Relative Return ⇒ RARROI
- Portfolio Sorted by RARROI ⇒ Project Priority, Budget Cut Line