What Have we Learned: Return-on-Investment from the SW-CMM

Khaled El Emam

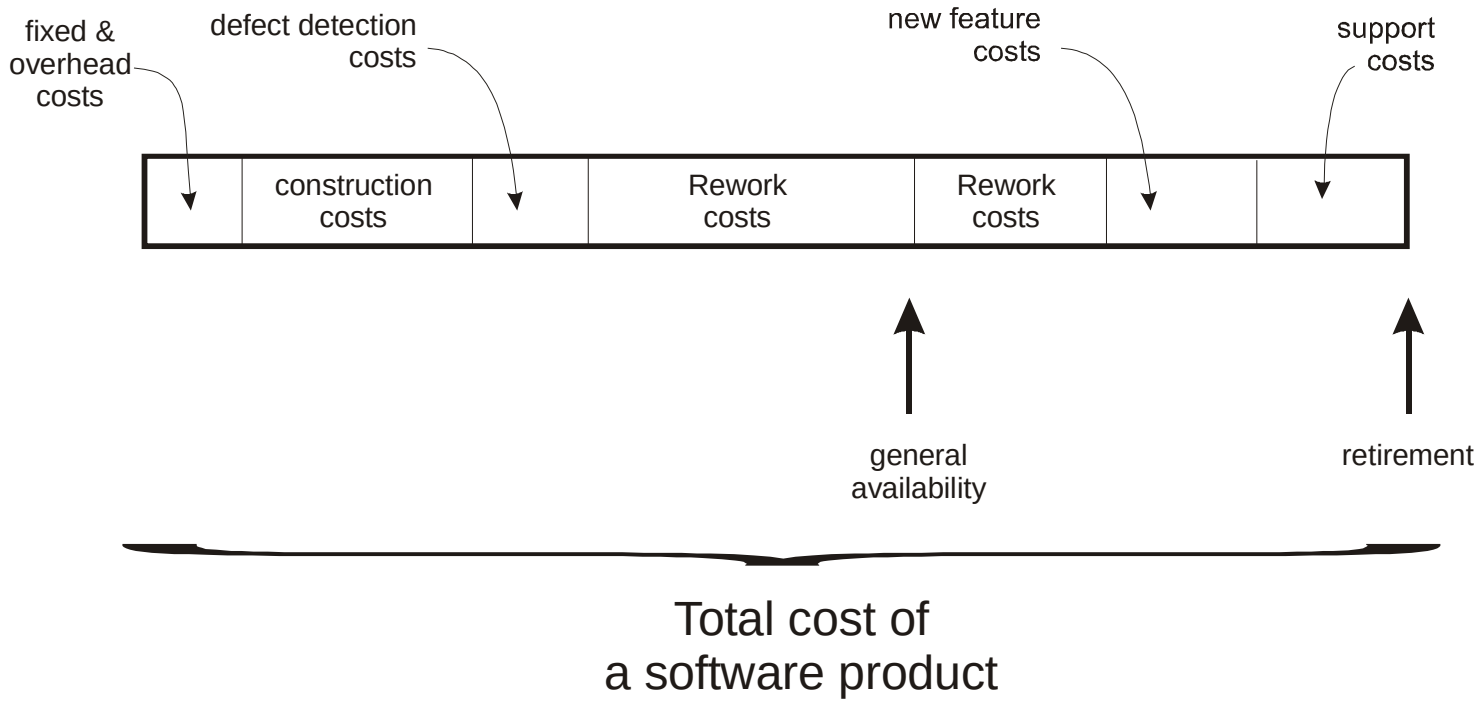
What is ROI

Contents
ROI
TCO
Evidence
Benchmarks
ROI 2
End

- Cost / benefit ratio
  - Benefit typically measured in terms of savings rather than new business
- Savings on projects
  - Mostly through reduction in rework
- We do not really look at variation

Breakdown of Project Costs

Contents
- ROI
- TCO
- Evidence
- Benchmarks
- ROI 2
- End



- Pre-release rework 50% - 80% of effort
- Post-release rework 18% - 50% of effort
- 8% of revenues typically spent on support

The Cost of Low Quality

Contents

- ROI
- TCO
- Evidence
- Benchmarks
- ROI 2
- End

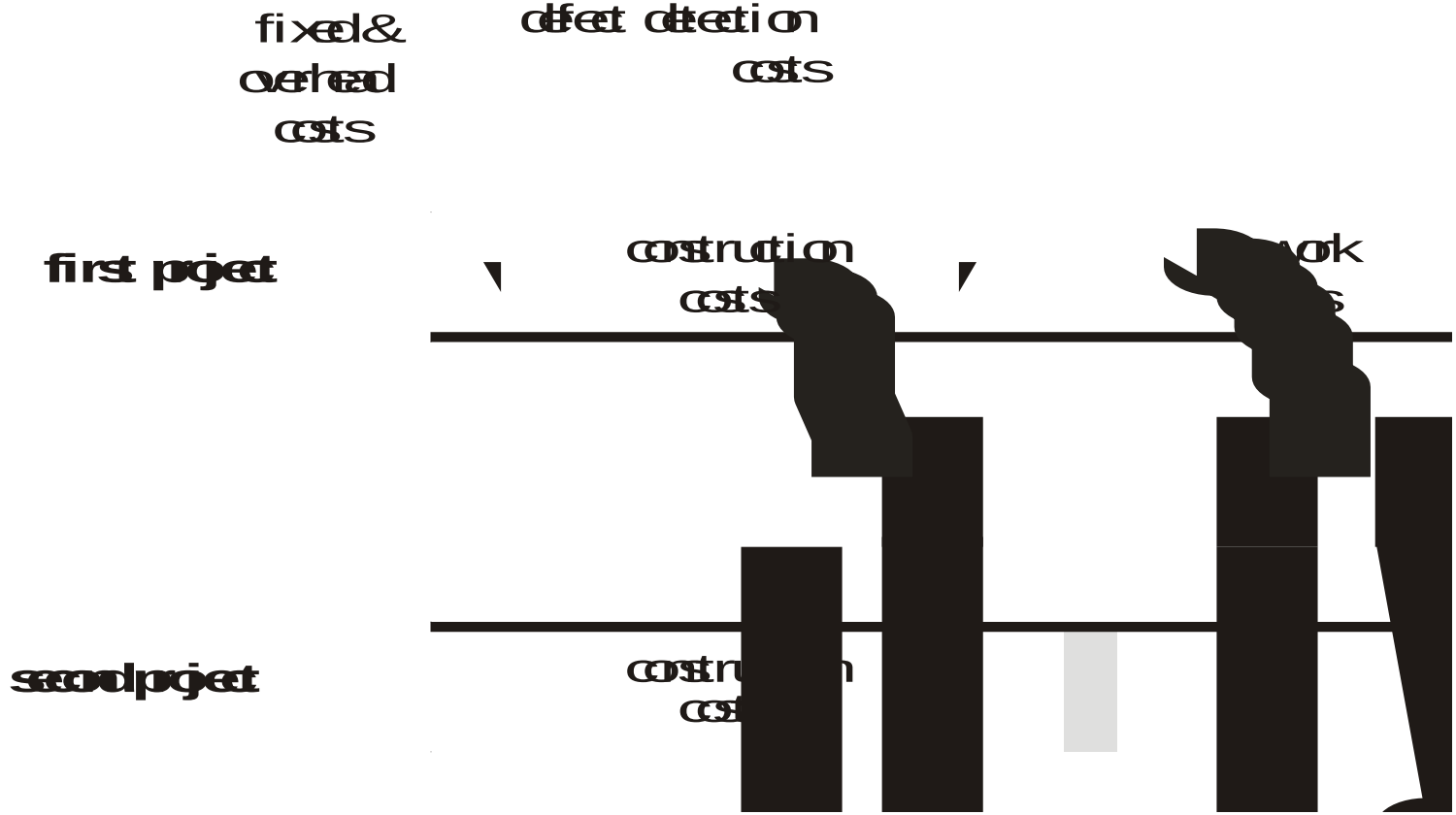
- The percentage of total maintenance resources devoted to bug fixes:

Business Domain	U.S.	Canada
Aerospace	33%	30%
Financial	22%	40%
Software	55%	41%
Distribution	18%	N/A
Telecom. Equip.	86%	50%
Telecom. Services	46%	31%

Project Costs with Reduced Rework

Contents

- ROI
- TCO
- Evidence
- Benchmarks
- ROI 2
- End



Outcomes

Contents

ROI

TCO

Evidence

Benchmarks

ROI 2

End

- At the project level
  - Reduction in customer costs
  - Reduction in schedule
  - Customer satisfaction
  - Delivered quality
  - Productivity
  - Predictability
  - Morale improvements
- At the organizational unit level:
  - Average across projects
  - Variation among projects

Cost of Ownership – SW-CMM Maturity

Contents

- ROI
- TCO
- Evidence
- Benchmarks
- ROI 2
- End

	ML2	ML3	ML4	ML5
ML1	12.75%	27.75%	52.5%	64.5%
ML2		18%	47.25%	62.25%
ML3			39%	58.5%
ML4				40.5%

Example

Contents

ROI

TCO

Evidence

Benchmarks

ROI 2

End

- We use NIST study data to illustrate
- A 100 person company in manufacturing that is buying a single application has, on average, a cost of ownership of $146,614 per year due to poor quality
- A 20% reduction in cost due to moving from ML2 to ML3 amounts to a saving of around $29k for that single application
- If the company uses say 5 applications, then we are looking at $145k savings just from switching suppliers

Cost of Ownership by Domain

Contents
- ROI
- TCO
- Evidence
- Benchmarks
- ROI 2
- End

	Small	Medium	Large
MIS	62.25%	66.75%	55.5%
Systems Software	71.25%	61.5%	59.25%
Commercial	71.25%	63%	55.5%
Military	71.25%	69%	58.5%

Cost of Ownership Within Country

Contents
ROI
TCO
Evidence
Benchmarks
ROI 2
End

	Best vs. Average	Best vs. Worst
Australia	53.25%	69.75%
Canada	66%	69.75%
India	72%	74.25%
Japan	63.75%	74.25%
Netherlands	60%	69%
UK	60.75%	74.25%
USA	52.5%	70.5%

Evolution of Evidence

Contents

ROI

TCO

Evidence

Benchmarks

ROI 2

End

- The evidence that can be produced depends on the stage in the evolution of a technology
- Two factors are important:
  - The number of adopters of a technology
  - The needs of current adopters of the technology
- Empirical results always lag the adoption of a technology
- It is difficult to conduct large scale studies when the number of adopters is small
- Evidence follows adoption:
  - Innovators will take more risks – more likely to experiment and follow intuition
  - Early adopters only need good case studies to be convinced
  - Early majority need larger studies and stronger evidence to adopt

Types of Evidence

Contents

- ROI
- TCO
- Evidence
- Benchmarks
- ROI 2
- End

- Case studies show what is possible, but are not generalizable
- Larger scale studies are more generalizable

		Measuring Outcomes	
		Questionnaire	**Measurement Program**
Measuring Maturity	**Questionnaire**	Q1	Q2
	Assessment	Q3	Q4

- Need different types of studies

Assessments as Measurements

Contents
ROI
TCO
Evidence
Benchmarks
ROI 2
End

- Need to look at the reliability of assessment results
- There is evidence that the more rigorous assessment methods have high reliability
- More equivocal evidence for ‘light’ methods
- Ideally, there should be a set of evidence-based standards to ‘certify’ assessment methods

Understanding Assessments

Contents

ROI

TCO

Evidence

Benchmarks

ROI 2

End

- About one third of respondents report a marked change in their organizations after assessments
- More reliable assessments are less costly
- Some systematic bias in ratings when assessment team did not include a mix of internal and external assessors
- The details of the method have an impact on reliability (e.g., when ratings are performed)

Benchmarks

Contents

ROI

TCO

Evidence

Benchmarks

ROI 2

End

- Benchmarks can be very useful for understanding how effective the improvement was and how far do we have to go (did we go from terrible to bad)
- There are now a number of good databases out there with a mix of project data that can be used for benchmarking

International Quality Benchmark

Contents
ROI
TCO
Evidence
Benchmarks
ROI 2
End

- Defects per FP

	Small		Medium		Large	
	Avg.	Best	Avg.	Best	Avg.	Best
MIS	0.15	0.025	0.588	0.066	1.06	0.27
Systems	0.25	0.013	0.44	0.08	0.73	0.15
Comm.	0.25	0.013	0.495	0.08	0.79	0.21
Military	0.263	0.013	0.518	0.04	0.82	0.18

International Quality Benchmark

Contents
ROI
TCO
Evidence
Benchmarks
ROI 2
End

- 2003 benchmark - defects per FP

Business Domain	Defect Density (median)
Financial (excl. banking)	0.029
Banking	0.0158
Insurance	0.0175
Manufacturing	0.0118
Legal	0.0206
Engineering	0.0225
Marketing	0.0322

Finer Granularity

Contents
ROI
TCO
Evidence
Benchmarks
ROI 2
End

- Can also look at specific practices in the CMMI and evaluate the benefits of these
- Then the individual benefits can be aggregated to give a conservative or lower bound on the benefits

ROI Analysis Context

Contents
- ROI
- TCO
- Evidence
- Benchmarks
- ROI 2
- End

- Development project lasts 2 years and costs $1m (today's money)
- Maintenance period lasts 3 years with a total budget of $1m (today's money)
- Typical customer for the product is a 100 person company in the US in the manufacturing sector; customer savings calculated over a 3 year period
- All $ values in today's dollars and all % are in effort (for cost) and days (for schedule)
- We wish to determine the total ROI from:
  - Code inspections
  - Risk assessment driving inspections

Code Inspections

Contents
- ROI
- TCO
- Evidence
- Benchmarks
- ROI 2
- End

Customer Savings	$227,581 (57%)
Pre-release savings	$99,773 (11%)
Post-release savings	$214,084 (26%)
Delivery schedule savings	21 days (3%)

Risk Assessment

Contents
- ROI
- TCO
- Evidence
- Benchmarks
- ROI 2
- End

Customer Savings	$135,750 (34%)
Pre-release savings	$113,379 (12.5%)
Post-release savings	$126,840 (15,4%)
Delivery schedule savings	27 days (3.7%)

Calculating Return on Investment (ROI) - Principles

Contents

- ROI
- TCO
- Evidence
- Benchmarks
- ROI 2
- End

ROI Calculation - I

Contents
- ROI
- TCO
- Evidence
- Benchmarks
- ROI 2
- End

Most Common

$$ROI = \frac{\text{cost saved}}{\text{cost consumed}}$$

ROI Calculation - II

$ROI_1 = 9$
(900%)

ROI Calculation - III

$ROI_1 = 9$

(900%)

ROI Calculation - IV

Contents

ROI

TCO

Evidence

Benchmarks

ROI 2

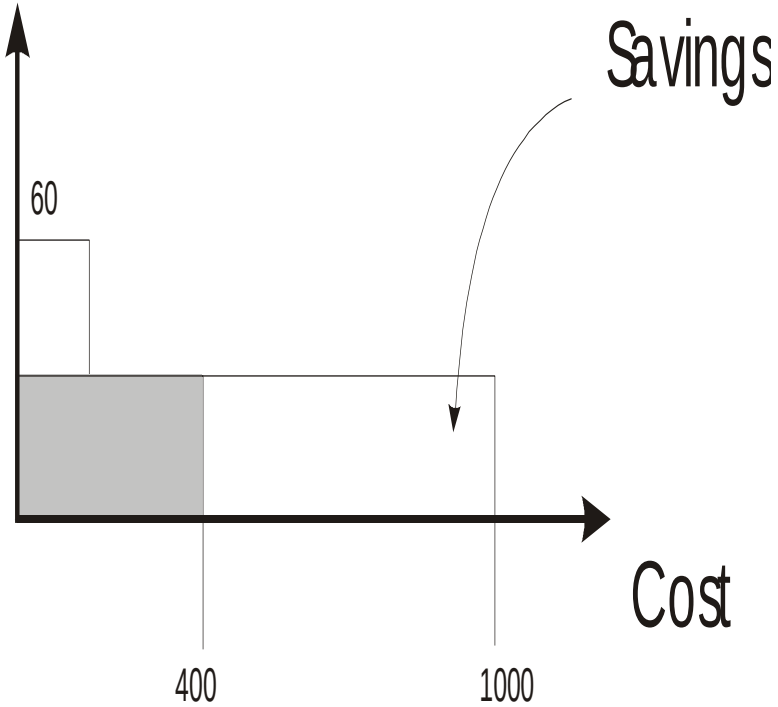
End

Alternative Calculation

$$ROI_2 = \frac{Costs\ Saved - Cost\ Consumed}{Original\ Cost}$$

ROI Calculation - V

$ROI_2 = 9\%$



$ROI_2 = 54\%$