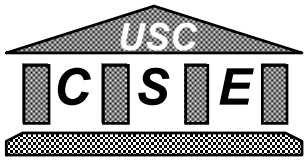

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Value-Based Estimation and Monitoring

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Outline

- Value-Based Software Engineering (VBSE) Overview
  - Motivation
  - 7 key steps and practices
- Value-Based Estimation and Monitoring Example
  - Example project: Sierra Mountainbikes
  - Business case estimation and analysis
  - A Value-based earned value monitoring system
- Conclusions

Motivation for Value-Based SE

- Current SE methods are basically value-neutral

  - Every requirement, use case, object, and defect is equally important

  - Object oriented development is a logic exercise

  - "Earned Value" Systems don't track business value

  - Separation of concerns: SE's job is to turn requirements into verified code

  – Practitioners escape from blame

  – Academics escape from reality

- Value – neutral SE methods are increasingly risky

  – Software decisions increasingly drive system value

  – Corporate adaptability to change achieved via software decisions

  – System value-domain problems are the chief sources of software project failures

The "Separation of Concerns" Legacy

- "The notion of 'user' cannot be precisely defined, and therefore has no place in CS or SE."

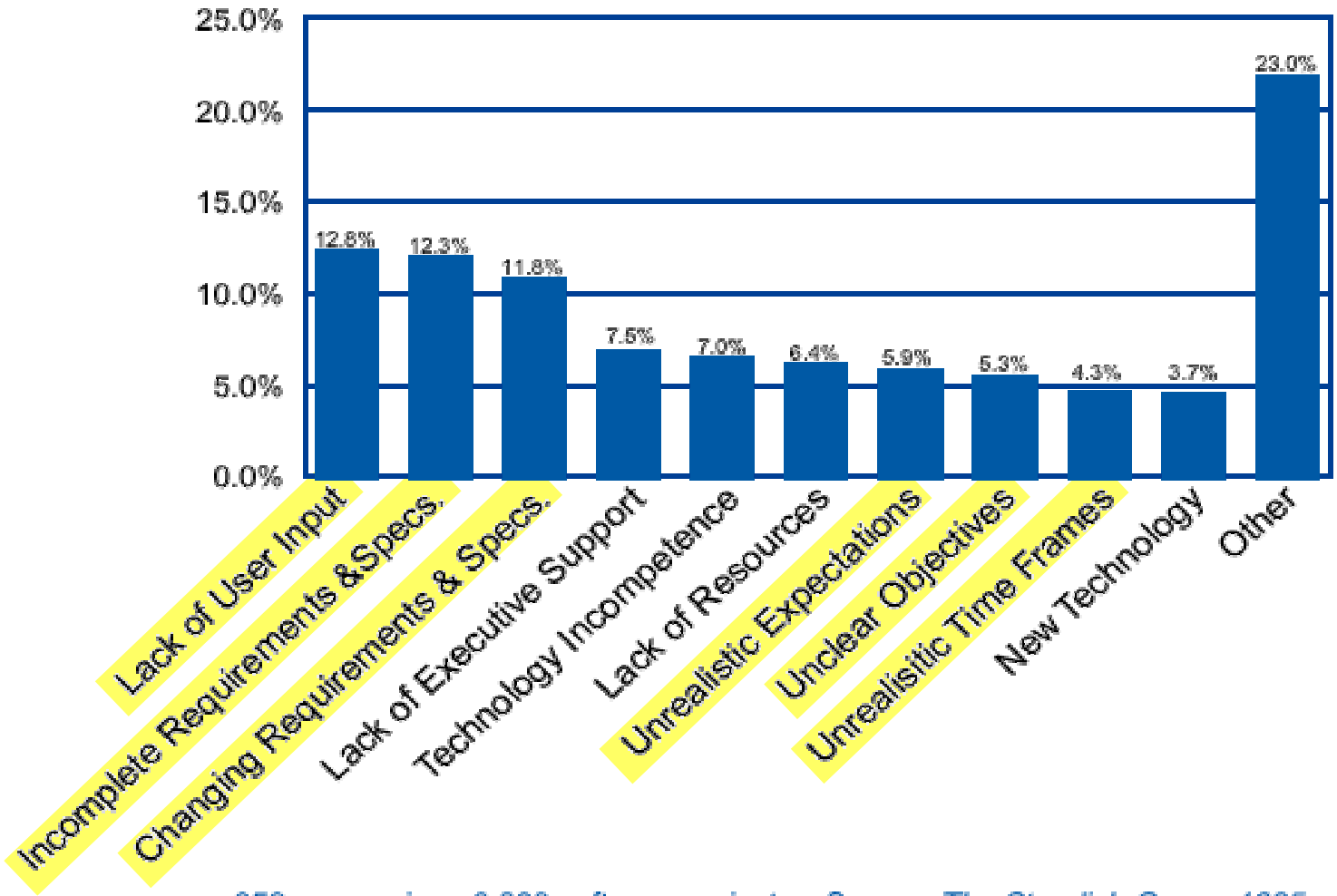
  - Edsger Dijkstra, ICSE 4, 1979

- "Analysis and allocation of the system requirements is not the responsibility of the SE group but is a prerequisite for their work"

  - Mark Paulk at al., SEI Software CMM* v.1.1, 1993

* Capability Maturity Model

Why Software Projects Fail



352 companies - 8,000 software projects. Source: *The Standish Group, 1995*

7 Key Elements of VBSE

1. Benefits Realization Analysis
2. Stakeholders' Value Proposition Elicitation and Reconciliation
3. Business Case Analysis
4. Continuous Risk and Opportunity Management
5. Concurrent System and Software Engineering
6. Value-Based Monitoring and Control
7. Change as Opportunity

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Example Project: Sierra Mountainbikes

- Based on what would have worked on a similar project
- Quality leader in specialty area
- Competitively priced
- Major problems with order processing
  - Delivery delays and mistakes
  - Poor synchronization of order entry, confirmation, fulfillment
  - Disorganized responses to problem situations
  - Excess costs; low distributor satisfaction

Order Processing Project GQM

Goals: Improve profits, market share, customer satisfaction via improved order processing

Questions: Current state? Root causes of problems? Keys to improvement?

Metrics: Balanced Scorecard of benefits realized, proxies

- Customer satisfaction ratings; key elements (ITV: in-transit visibility)
- Overhead cost reduction
- Actual vs. expected benefit and cost flows, ROI

Business Case Analysis

- Estimate costs and schedules
  - COCOMO II and/or alternative
- Estimate financial benefits
  - Increased profits
  - Reduced operating costs
- Compute Return on Investment
  - ROI = (Benefits – Costs) / Costs
  - Normalized to present value
- Identify quantitative metrics for other goals
  - Customer satisfaction ratings
    - Ease of use; In-transit visibility; overall
  - Late delivery percentage

Order Processing System Schedules and Budgets

Milestone	Due Date	Budget ($K)	Cumulative Budget ($K)
Inception Readiness	1/1/2004	0	0
Life Cycle Objectives	1/31/2004	120	120
Life Cycle Architecture	3/31/2004	280	400
Core Capability Demo	7/31/2004	650	1050
Initial Oper. Capability: SW	9/30/2004	350	1400
Initial Oper. Capability: HW	9/30/2004	2100	3500
Developed IOC	12/31/2004	500	4000
Responsive IOC	3/31/2005	500	4500
Full Oper. Cap'y CCD	7/31/2005	700	5200
FOC Beta	9/30/2005	400	5600
FOC Deployed	12/31/2005	400	6000
Annual Oper. & Maintenance		3800	
Annual O&M; Old System		7600	

Order Processing System: Expected Benefits and Business Case

		Current System			New System										
Date	Market Size ($M)	Market Share %	Sales	Profits	Market Share %	Sales	Profits	Cost Savings	Change in Profits	Cum. Change in Profits	Cum Cost	ROI	Late Delivery %	Cust. Statis. 0-5	In-Tran. Visib. 0-5	Ease of Use 0-5
12/31/03	360	20	72	7	20	72	7	0	0	0	0	0	12.4	1.7	1.0	1.8
12/31/04	400	20	80	8	20	80	8	0	0	0	4	-1	11.4	3.0	2.5	3.0
12/31/05	440	20	88	9	22	97	10	2.2	3.2	3.2	6	-4.7	7.0	4.0	3.5	4.0
12/31/06	480	20	96	10	25	120	13	3.2	6.2	9.4	6.5	.45	4.0	4.3	4.0	4.3
12/31/07	520	20	104	11	28	146	16	4.0	9.0	18.4	7	1.63	3.0	4.5	4.3	4.5
12/31/08	560	20	112	12	30	168	19	4.4	11.4	29.8	7.5	2.97	2.5	4.6	4.6	4.6

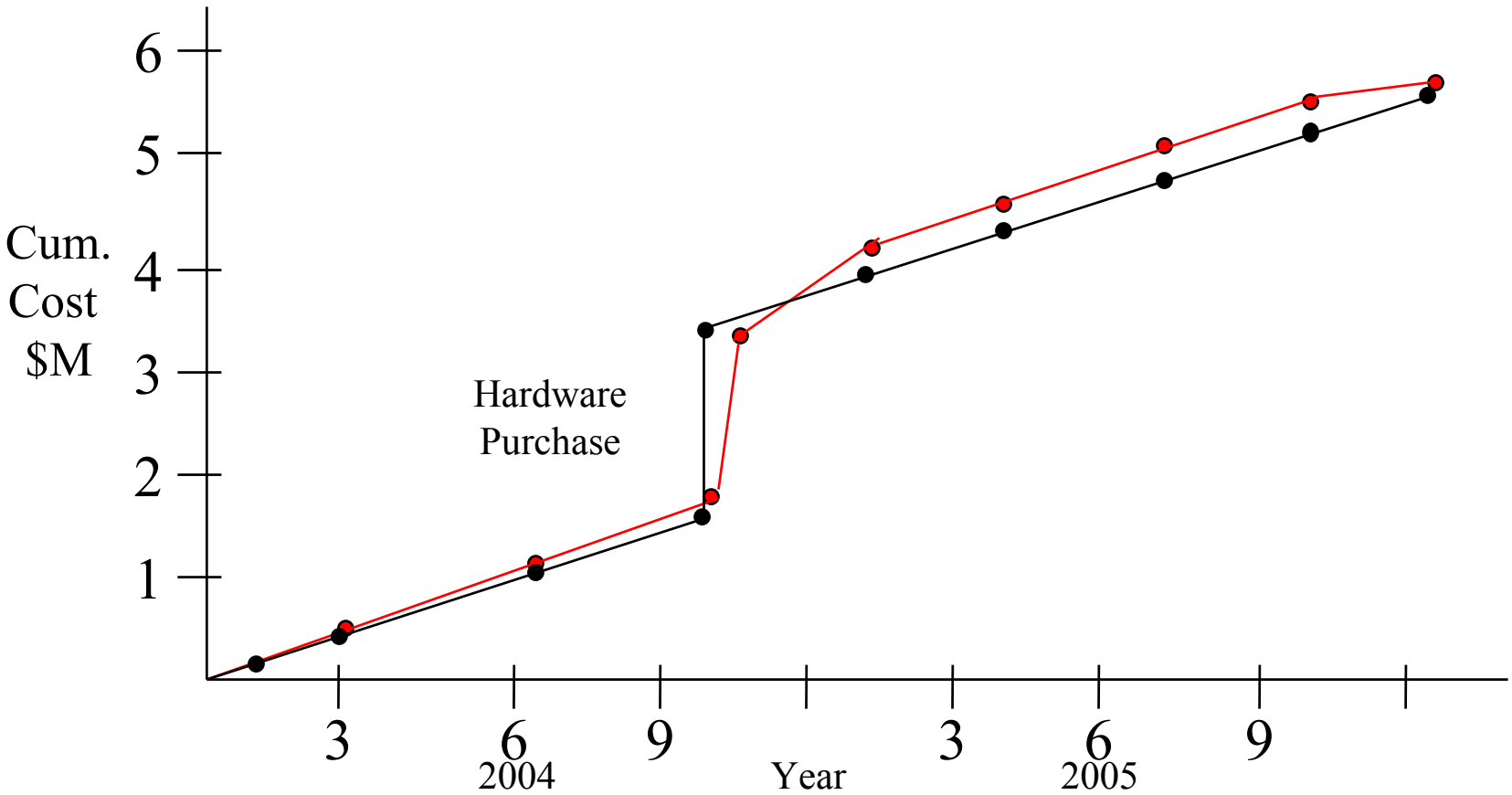
A Real Earned Value System

- Current "earned value" systems monitor cost and schedule, not business value
  - Budgeted cost of work performed ("earned")
  - Budgeted cost of work scheduled ("yearned")
  - Actual costs vs. schedule ("burned")
- A real earned value system monitors benefits realized
  - Financial benefits realized vs. cost (ROI)
  - Benefits realized vs. schedule
    - Including non-financial metrics
  - Actual costs vs. schedule

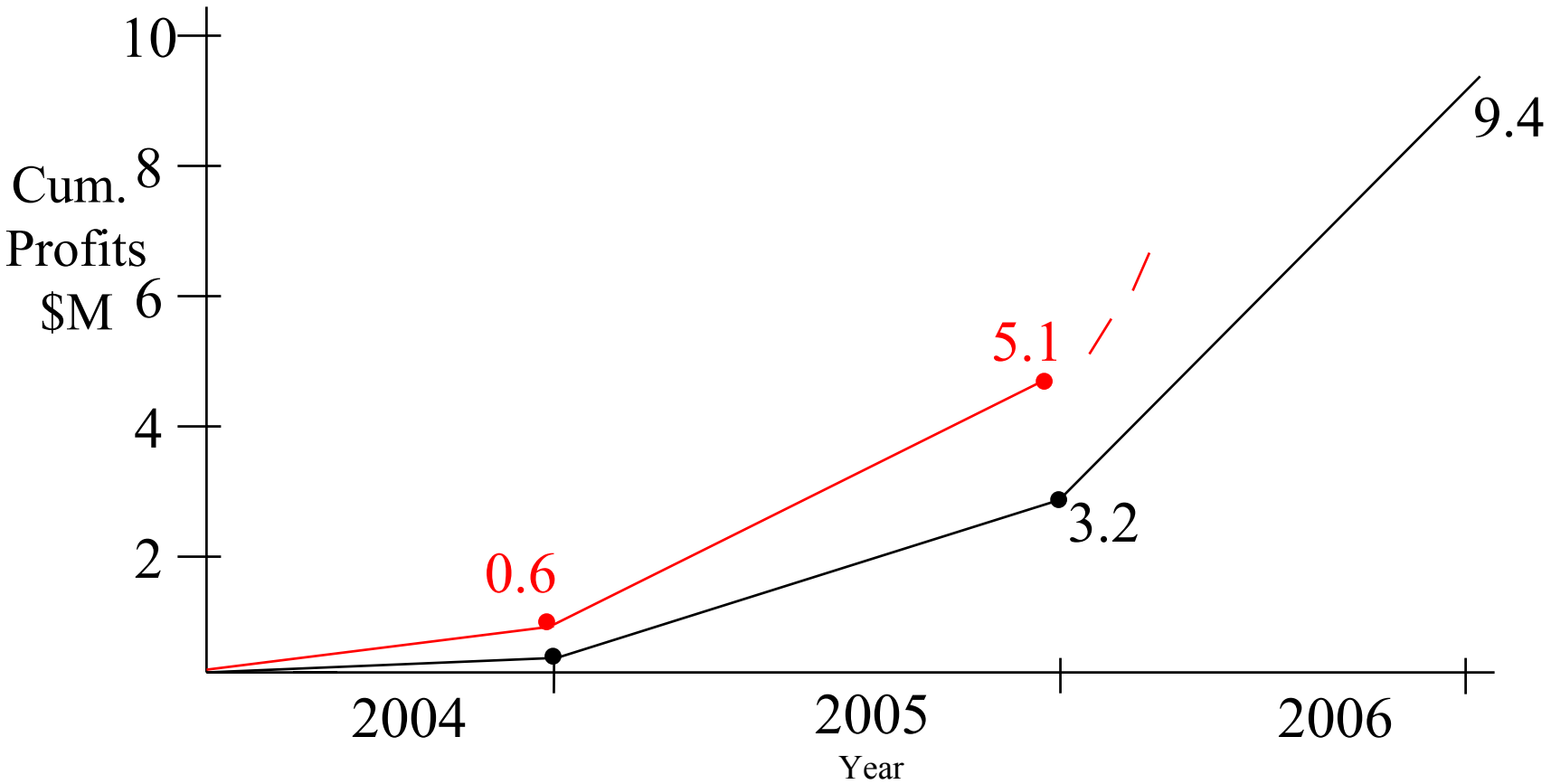
Table 4. Value-Based Expected/Actual Outcome Tracking Capability

Milestone	Schedule	Cost ($K)	Op-Cost Savings	Market Share %	Annual Sales ($M)	Annual Profits ($M)	Cum Profits	ROI	Late Deliv %	Cust Sat.	ITV	Ease of Use	Risks/Opportunities
Life Cycle Architecture	3/31/04 3/31/04	400 427		20 20	72 72	7.0 7.0			12.4 12.4	1.7 1.7	1.0 1.0	1.8 1.8	Increased COTS ITV Risk. Fallback identified.
Core Capability Demo (CCD)	7/31/04 7/20/04	1050 1096								2.4*	1.0*	2.7*	Using COTS ITV Fallback. New HW Competitor; renegotiating HW
Software Init. Op. Cap'y (IOC)	9/30/04 9/30/04	1400 1532								2.7*	1.4*	2.8*	
Hardware IOC	9/30/04 10/11/04	3500 3432											$200K savings from renegotiated HW
Deployed IOC	12/31/04 12/20/04	4000 4041		20 22	80 88	8.0 8.6	0.0 0.6	-1.0 -.85	11.4 10.8	3.0 2.8	2.5 1.6	3.0 3.2	New COTS ITV source identified, being prototyped
Responsive IOC	3/31/05 3/30/05	4500 4604	300 324						9.0 7.4	3.5 3.3	3.0 1.6	3.5 3.8	
Full Op. Cap'y CCD	7/31/05 7/28/05	5200 5328	1000 946							3.5*	2.5*	3.8*	New COTS ITV source initially integrated
Full Op. Cap'y Beta	9/30/05 9/30/05	5600 5689	1700 1851							3.8*	3.1*	4.1*	
Full Op. Cap'y Deployed Release 2.1	12/31/05 12/20/05 6/30/06	6000 5977 6250	2200 2483	22 24	106 115	12.2 13.5	3.2 5.1	-.47 -.15	7.0 4.8	4.0 4.1	3.5 3.3	4.0 4.2	

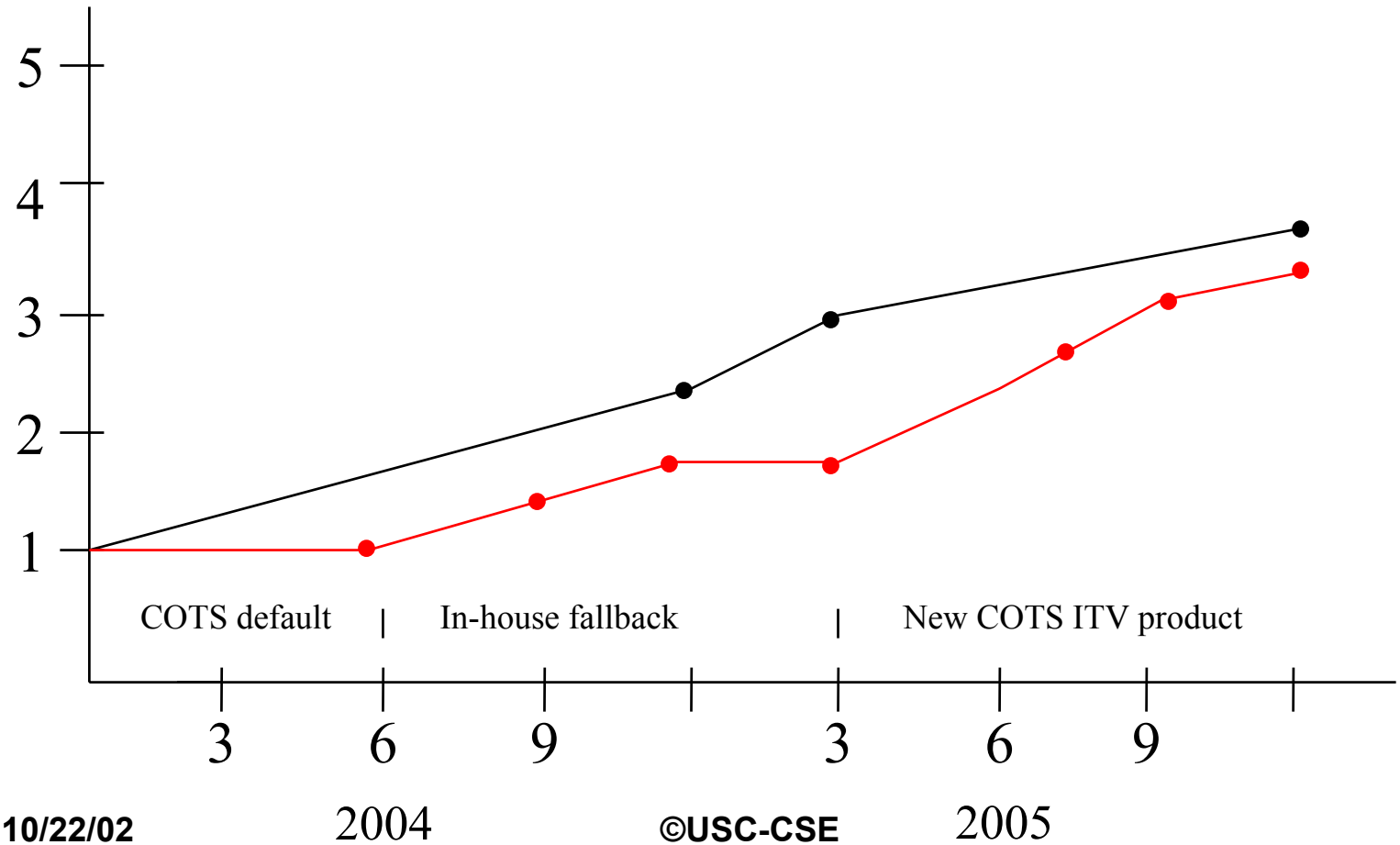
Project Budget and Schedule Plans (vs. Actuals)



Cumulative Increase in Profits: Plans and Actuals



In-Transit Visibility (ITV) Ratings: Plans and Actuals



Conclusions

- Future software-driven products require more system/value-oriented software methods
- VBSE provides viable framework for value-oriented monitoring and control.
  - Early applications providing useful results
- Framework and techniques just getting worked out
  - Many research and applications opportunities

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