

Evaluating Bids / Monitoring Performance Using Software Metrics

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Outline

- **Objectives**
- **Evaluating Bids**
 - **Conflicting Pressures**
 - **Simple Principles**
 - **Putting Principles to Practice**
- **Monitoring Performance**
 - **Simple Principles**
 - **Monitoring Progress**
 - **Forecasting Probable Outcomes**

Objectives

- **Demonstrate how software metrics can be used to help screen vendors of software development services**
- **Illustrate how software project metrics can be used as an “early warning system” to predict project performance**

Evaluating Bids

Conflicting Pressures

- **Purchaser (Contracting Agency)**

- Well functioning system delivered on time
- Minimize cost

- **Vendor**

- Maximize profit
- Minimize changes
- Customer satisfaction (repeat business)

- **Each party also has internal conflicting pressures**

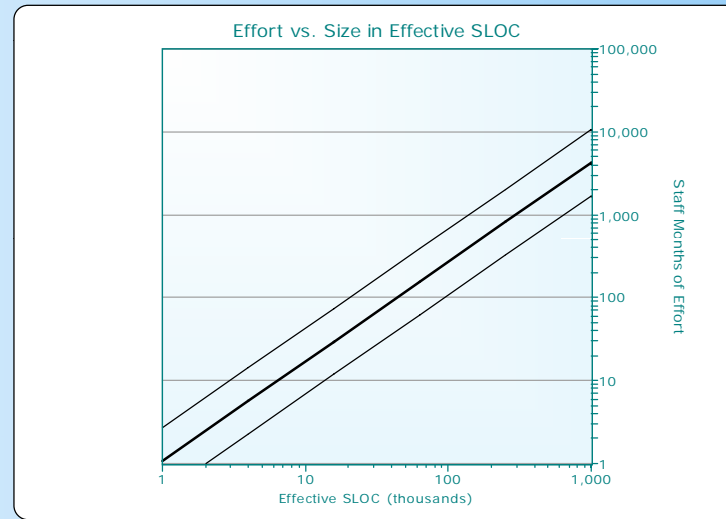
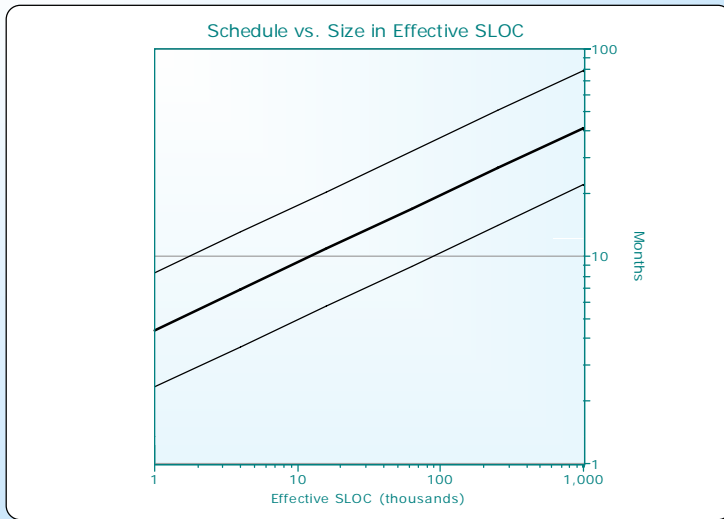


Simple Principles

- **Project size related to staff, effort, cost, and schedule**
 - **Size is a quantitative measure of what a project delivers; not the effort required to deliver it**
- **Organizations have performance patterns**
- **Bids should be consistent with organizational history**
- **Requirements should be achievable**

Staff, Effort, Schedule, & Size

Project Trends



Outsourcer projects — QSM 2005 C & C — Avg. Line Style — 1 Sigma Line Style

Staff, Effort, Schedule, & Size

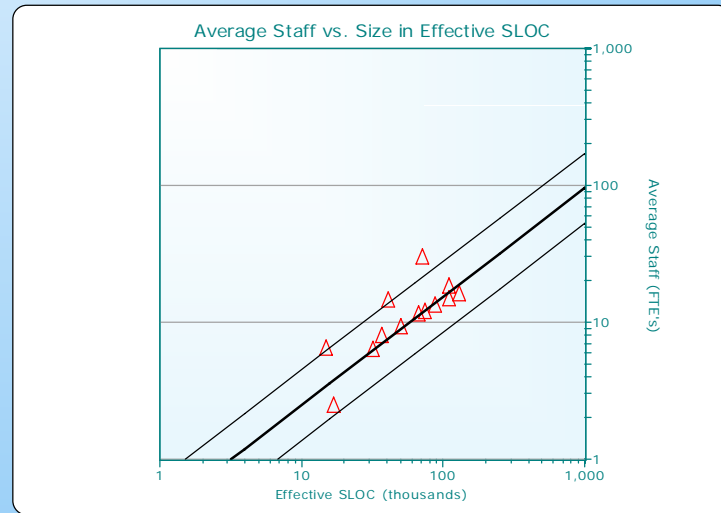
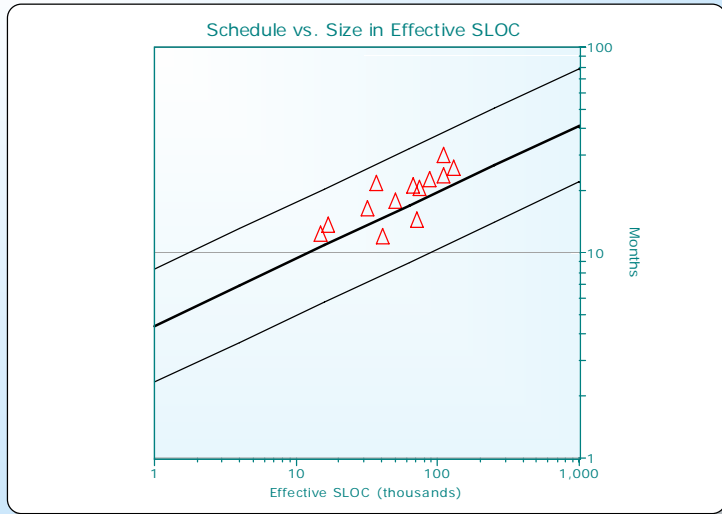
- **Trend lines from QSM Database for Command & Control projects**
 - **Lines represent Average and Plus and Minus 1 Standard Deviation**
 - **2/3 of C&C projects between inner and outer lines**
- **Logarithmic scale (1, 10, 100, 1000, etc.)**
 - **Relationship between size and schedule, effort, or staff is Non-linear**

Vendor Evaluation Process

- **Vendor should provide a relevant sample of data from past projects that includes**
 - **Size**
 - **Schedule**
 - **Staff & Effort**
 - **Defects**
- **If unwilling or unavailable this is a BIG risk**
 - **No empirical way to evaluate vendor's capabilities**

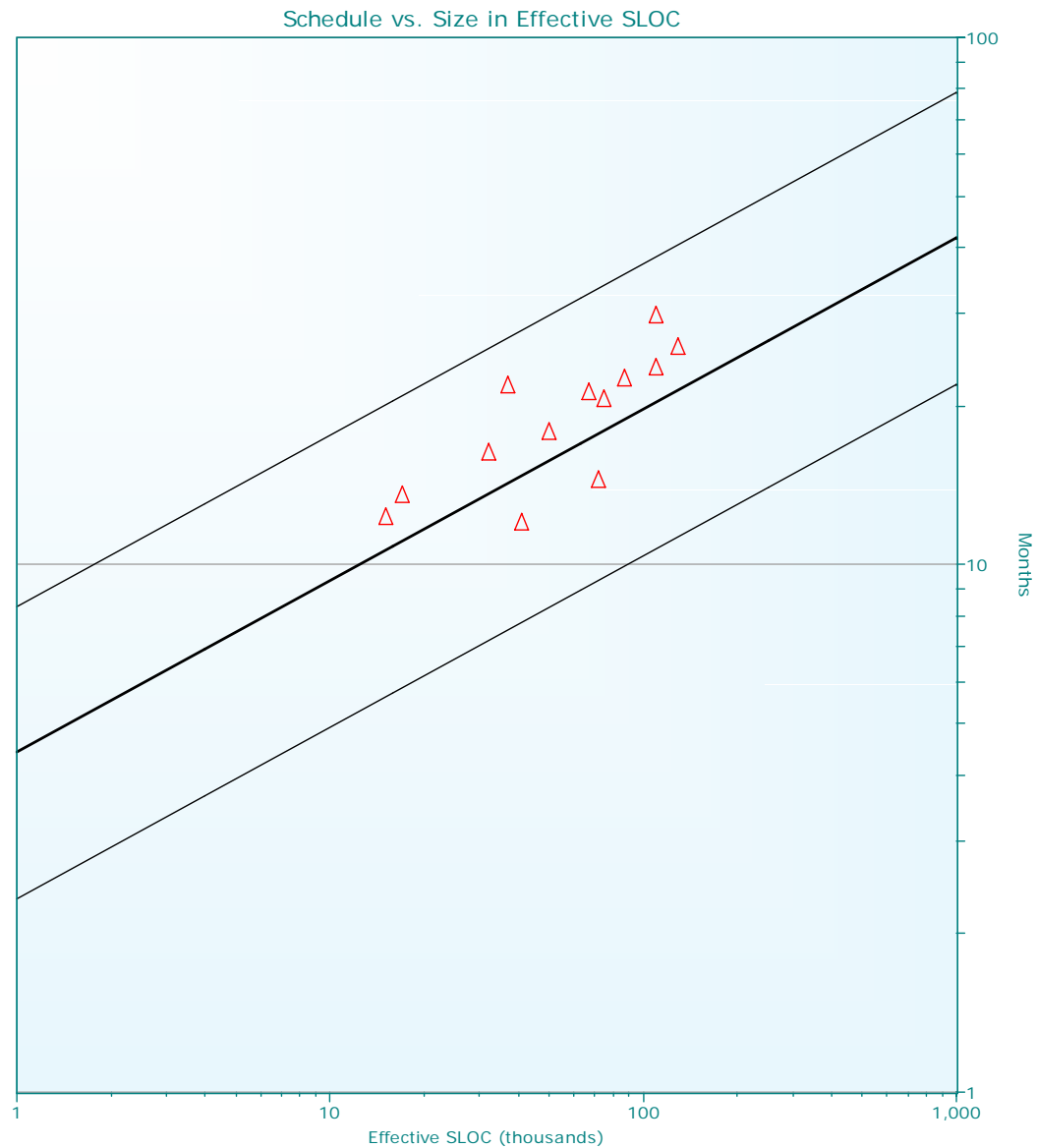
Vendor Historical Performance

Project Trends

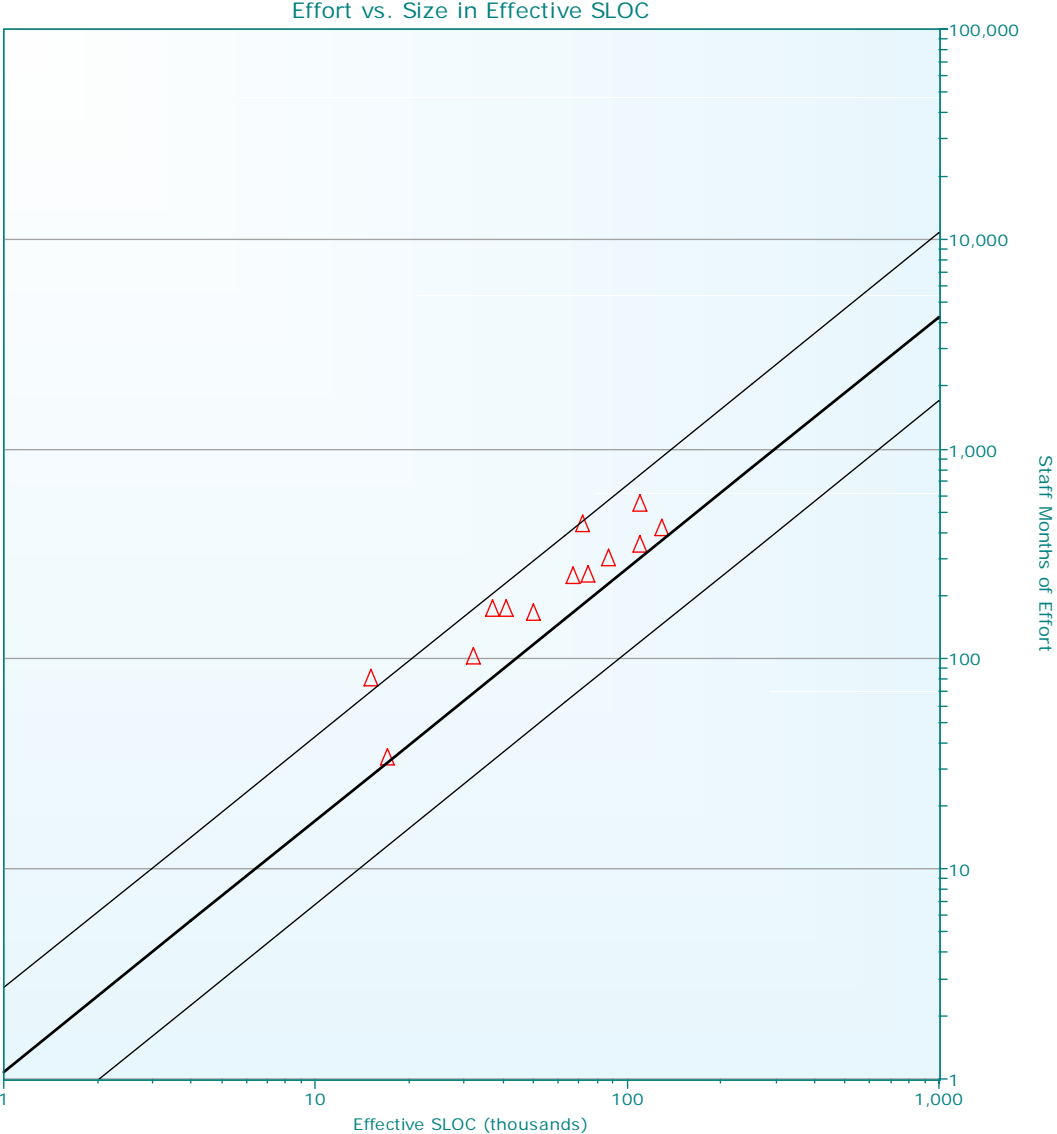


△ Outsourcer projects
 — QSM 2005 C & C
 — Avg. Line Style
 — 1 Sigma Line Style

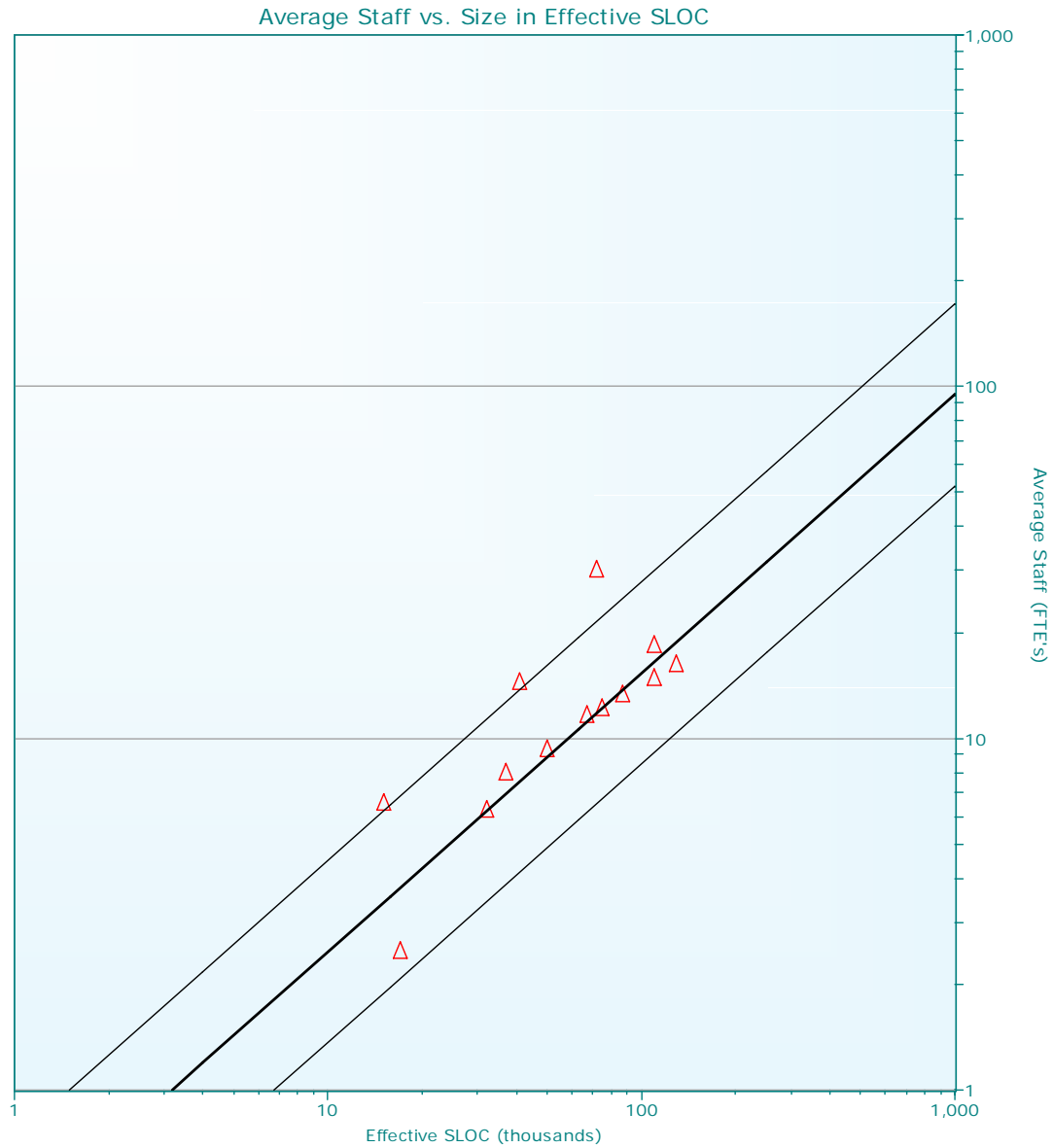
Vendor Schedule Performance



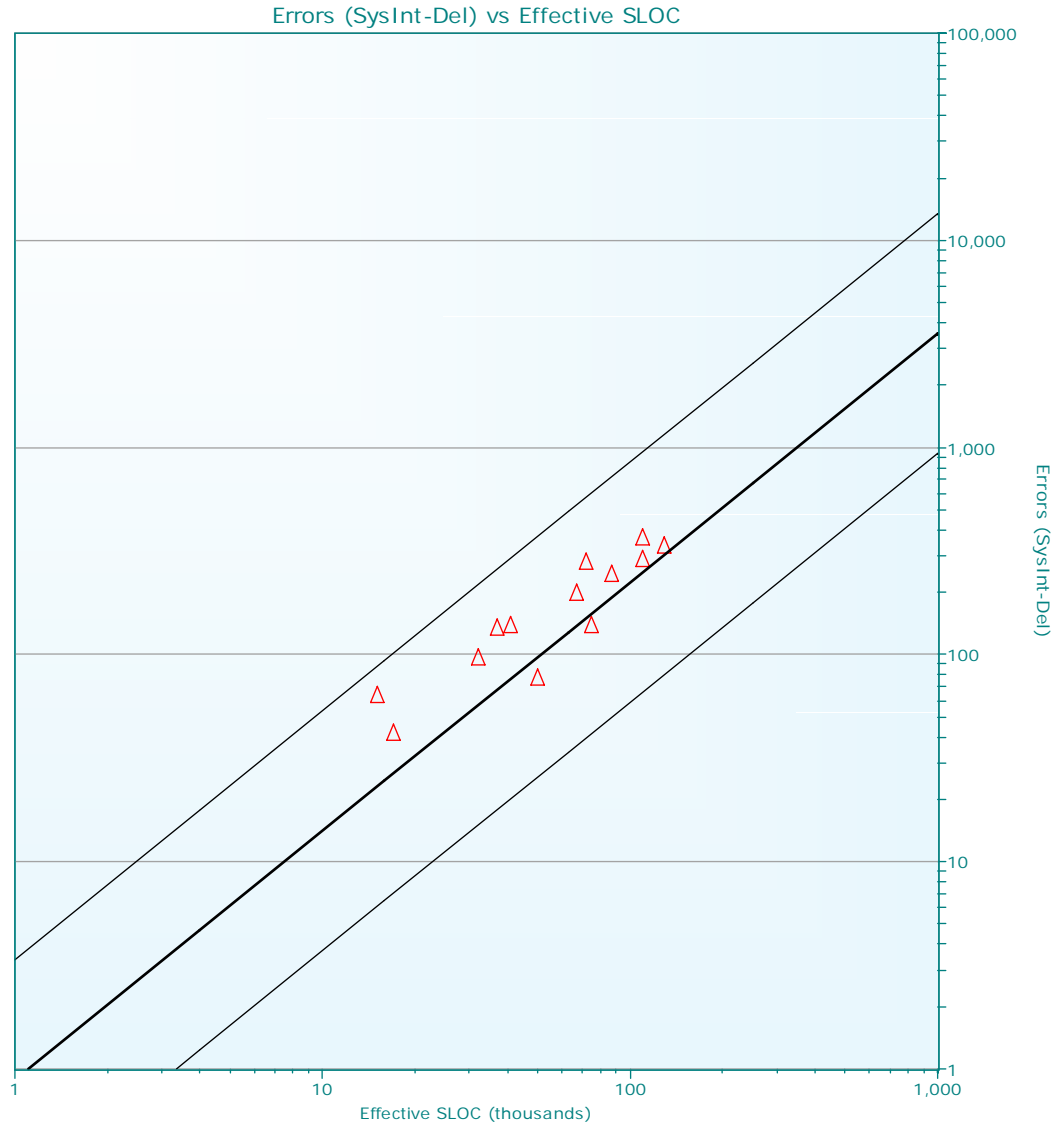
Vendor Effort (Cost) Performance



Vendor Staffing



Vendor Quality (Defects)



Observations

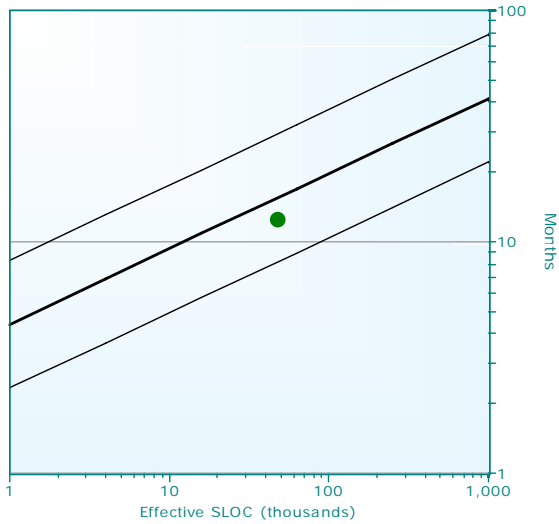
- **Vendor required slightly more than average for schedule and effort and was close to average for staff**
 - Slightly below average productivity
- **Quality consistent but not exceptional**
- **Data is consistent with no extreme outliers**
 - May indicate some process maturity
 - Capable of developing software in a repeatable fashion

Bid Proposal

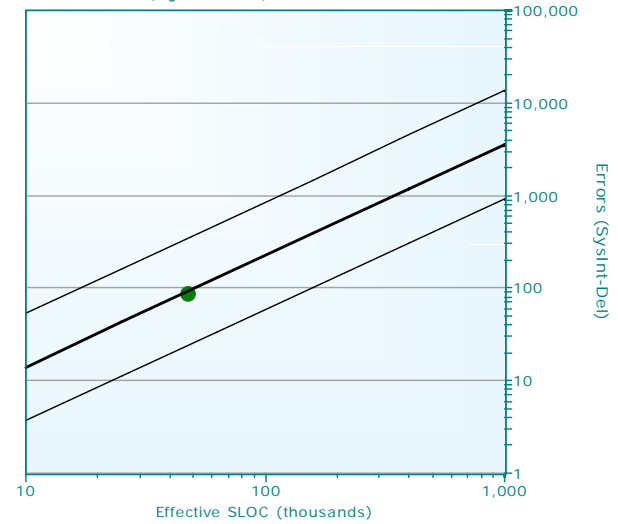
Bid Proposal	
Estimated Size	47,000 ESLOC
Schedule	< 21 Months
Effort	127 Staff Months
Quality	Average or Better

Project Trends

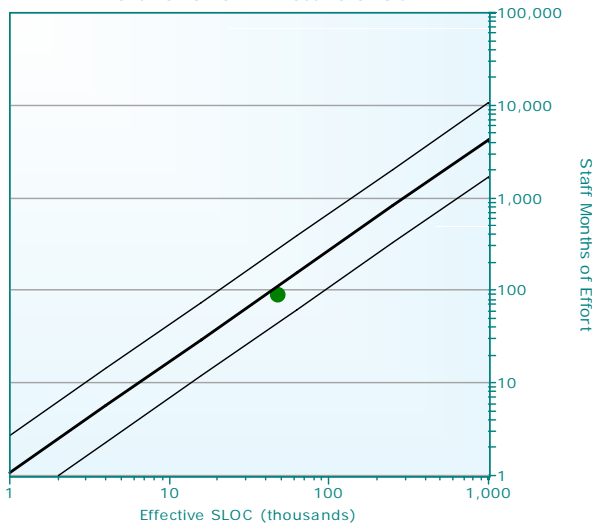
Schedule vs. Size in Effective SLOC



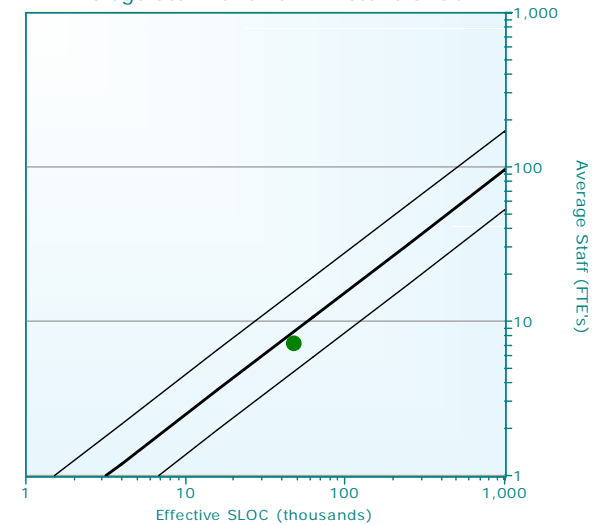
Errors (SysInt-Del) vs Effective SLOC



Effort vs. Size in Effective SLOC

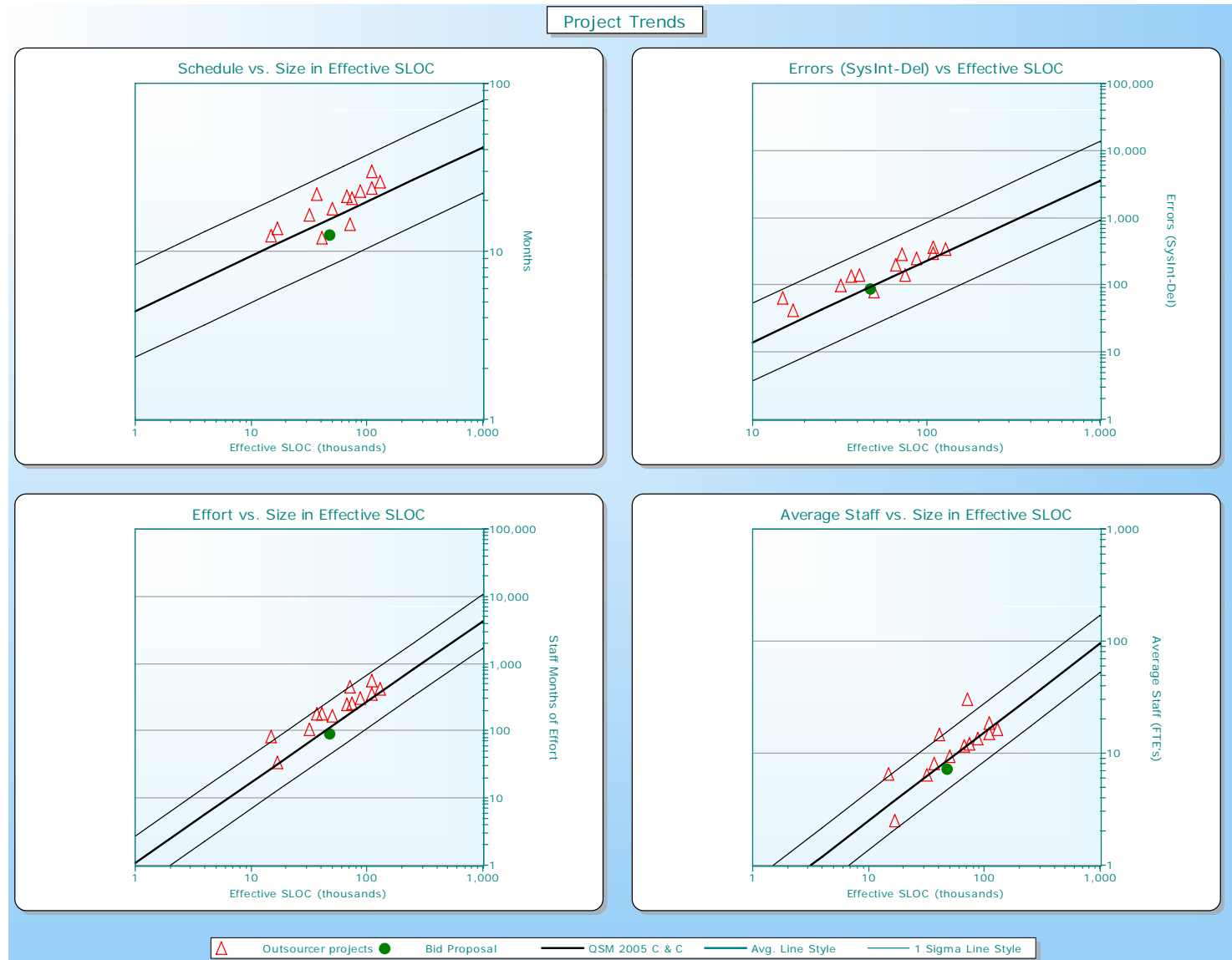


Average Staff vs. Size in Effective SLOC



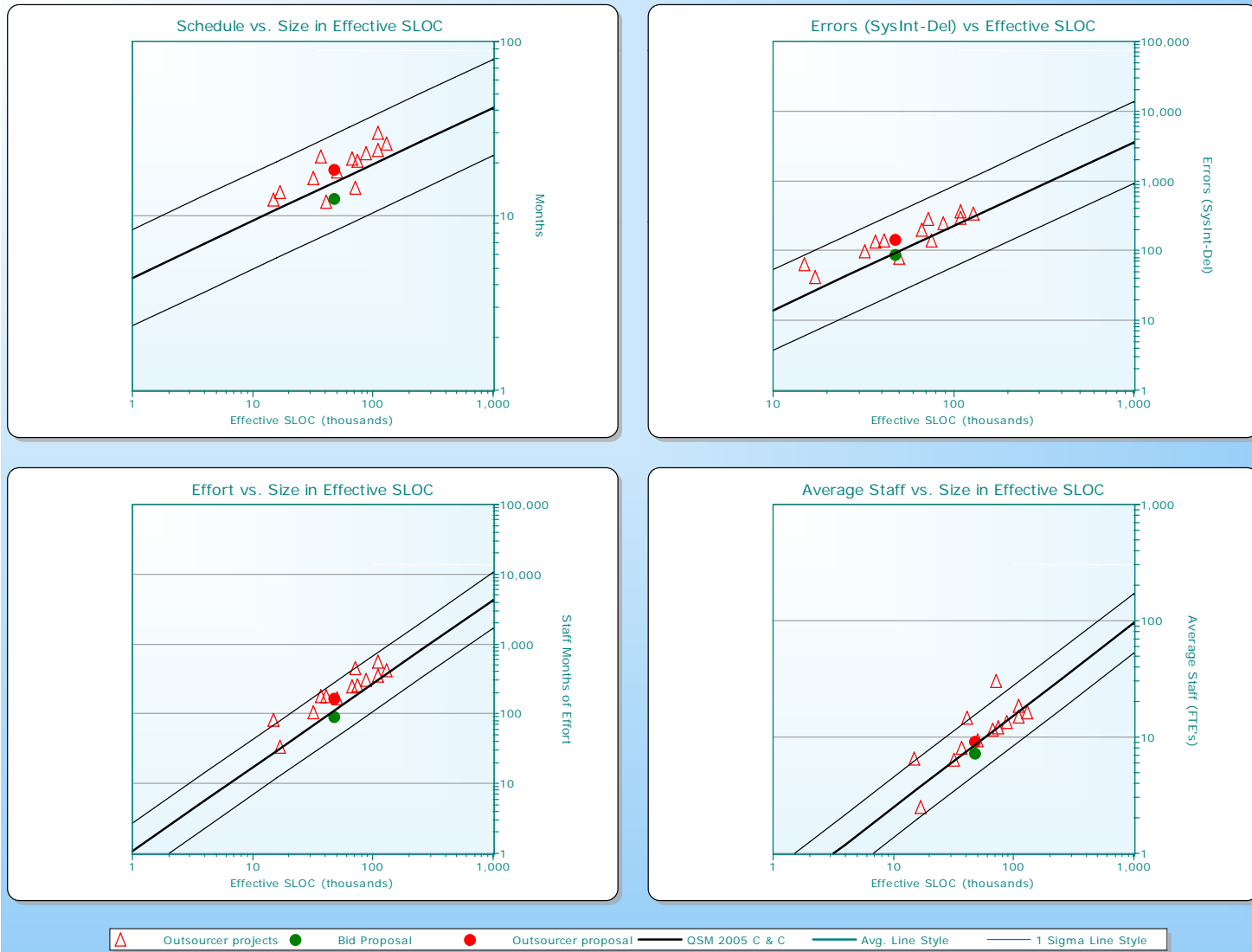
Outsourcer projects ● Bid Proposal — QSM 2005 C & C — Avg. Line Style — 1 Sigma Line Style

How Does the Vendor Compare?



What is the Vendor's Likely Performance?

Project Trends



Comparison

Bid Proposal		Likely Vendor Performance	
Estimated Size	47,000 ESLOC	Estimated Size	47,000 ESLOC
Schedule	< 21 Months	Schedule	28 Months
Effort	127 Staff Months	Effort	230 Staff Months
Quality	Average or Better	Quality	Average

Vendor unlikely to meet schedule & cost/effort objectives

Monitoring Performance

Simple Principles

- **Project plans should not exceed proven capabilities**
- **Bad news is best delivered early**
- **Trends (good & bad) do not magically change**
- **If only financial measures are used to monitor project performance, by the time problems become apparent it will be too late to correct them**

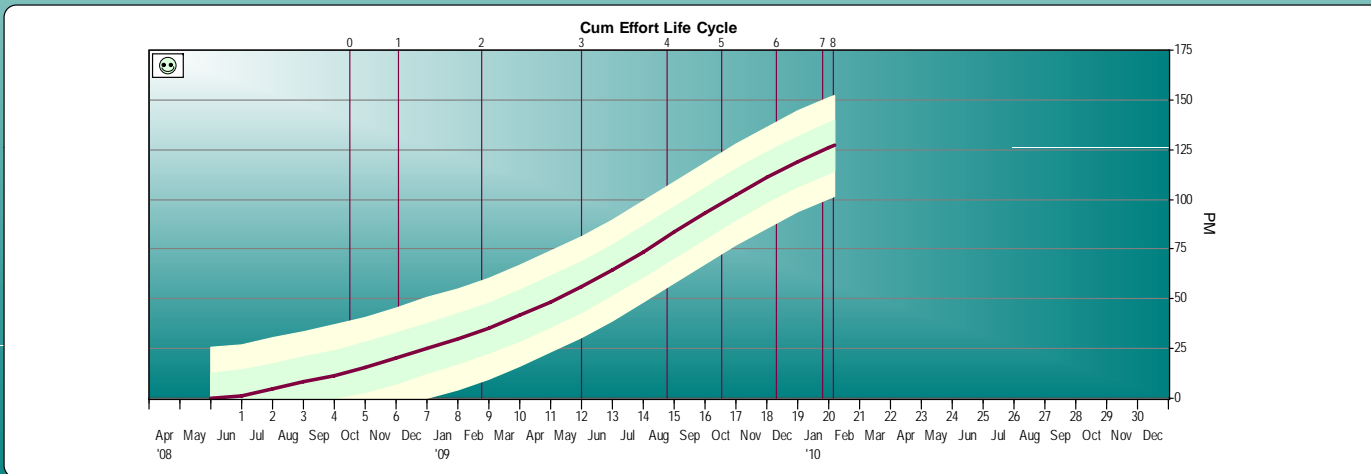
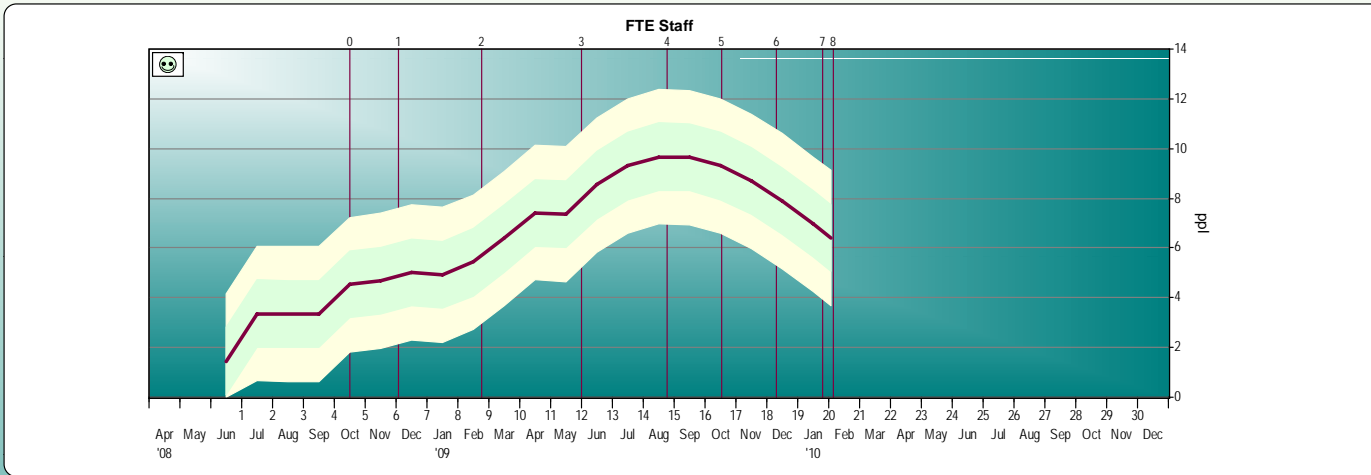
Monitoring Progress

- **Track progress against plan**
- **Look for early indicators**

Project Plan	
Estimated Size	47,000 ESLOC
Schedule	< 21 Months
Effort	127 Staff Months
Quality	Average or Better

Project Plan

Staff and Effort

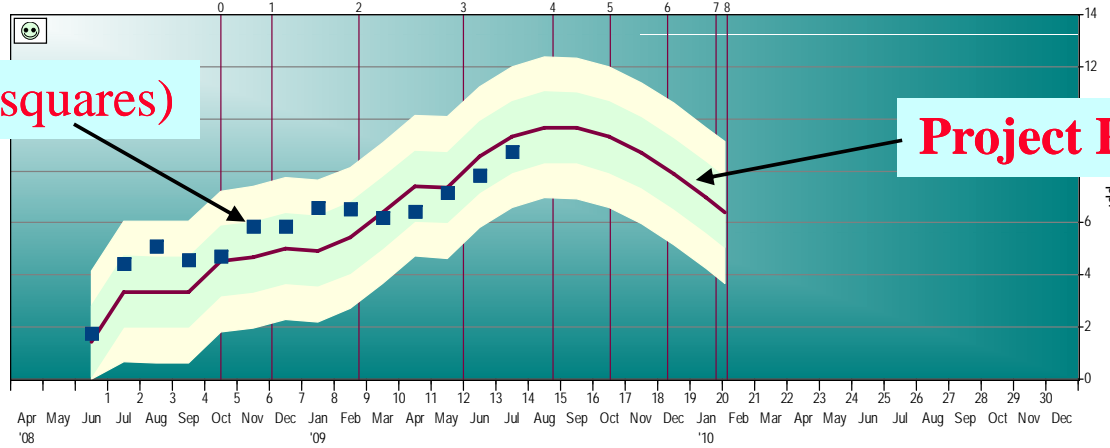


— Current Plan Green Control Bound Yellow Control Bound Project: Bid Proposal

Fourteen Months Later

Staff and Effort

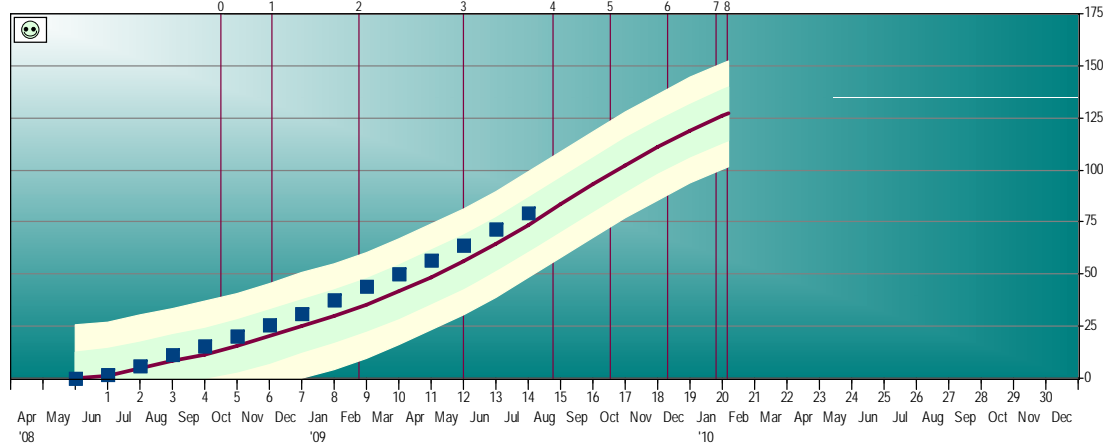
FTE Staff



Actual performance (squares)

Project Plan (line)

Cum Effort Life Cycle



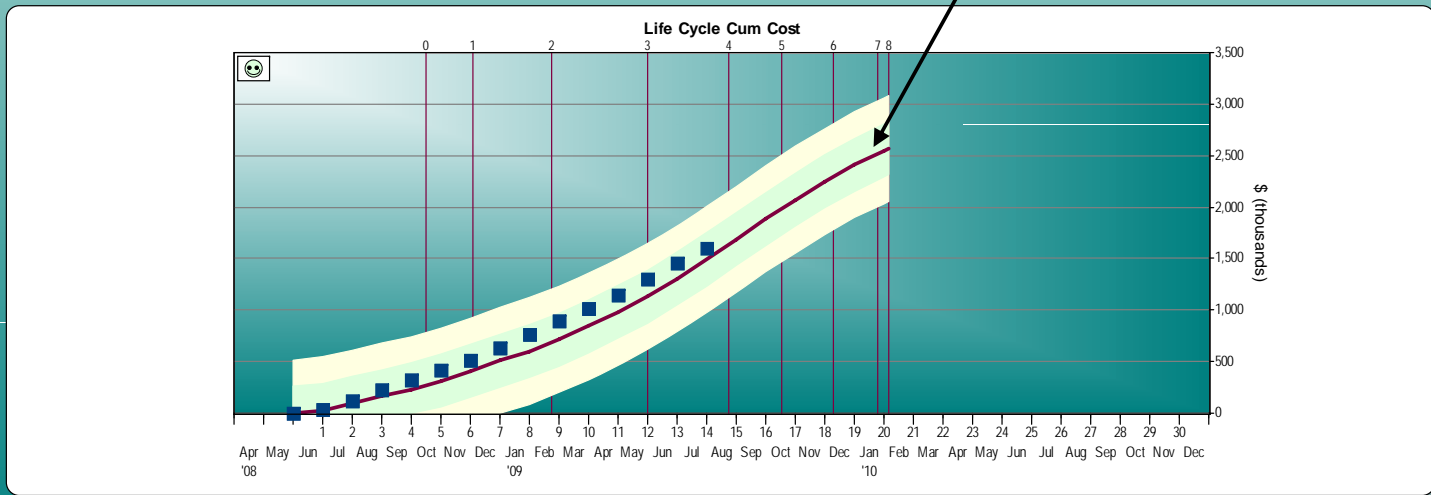
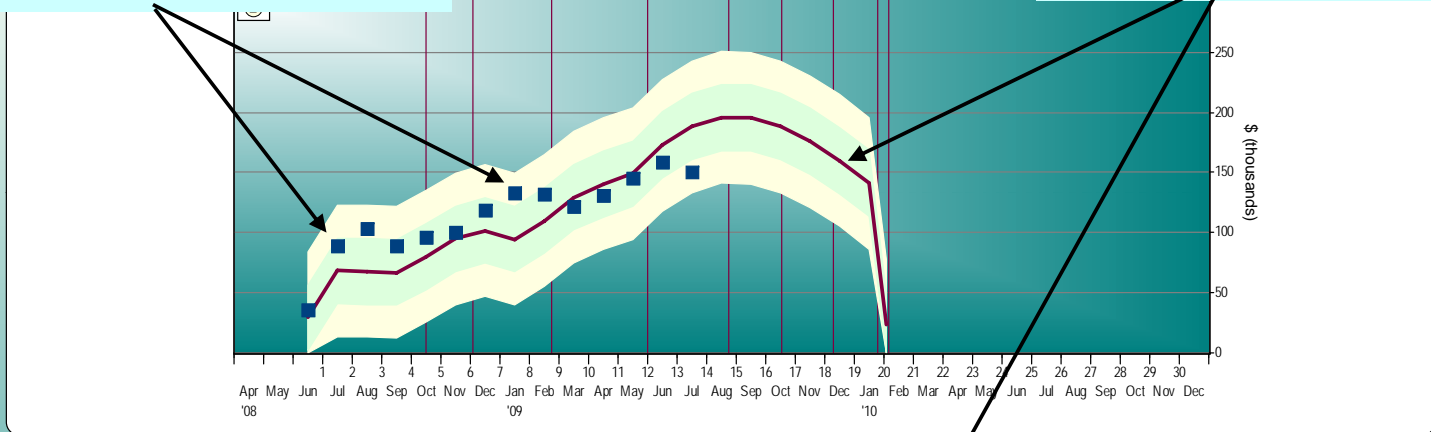
— Current Plan ■ Actuals ■ Green Control Bound ■ Yellow Control Bound ■ Project Bid Proposal

Fourteen Months Later, Continued

Cost

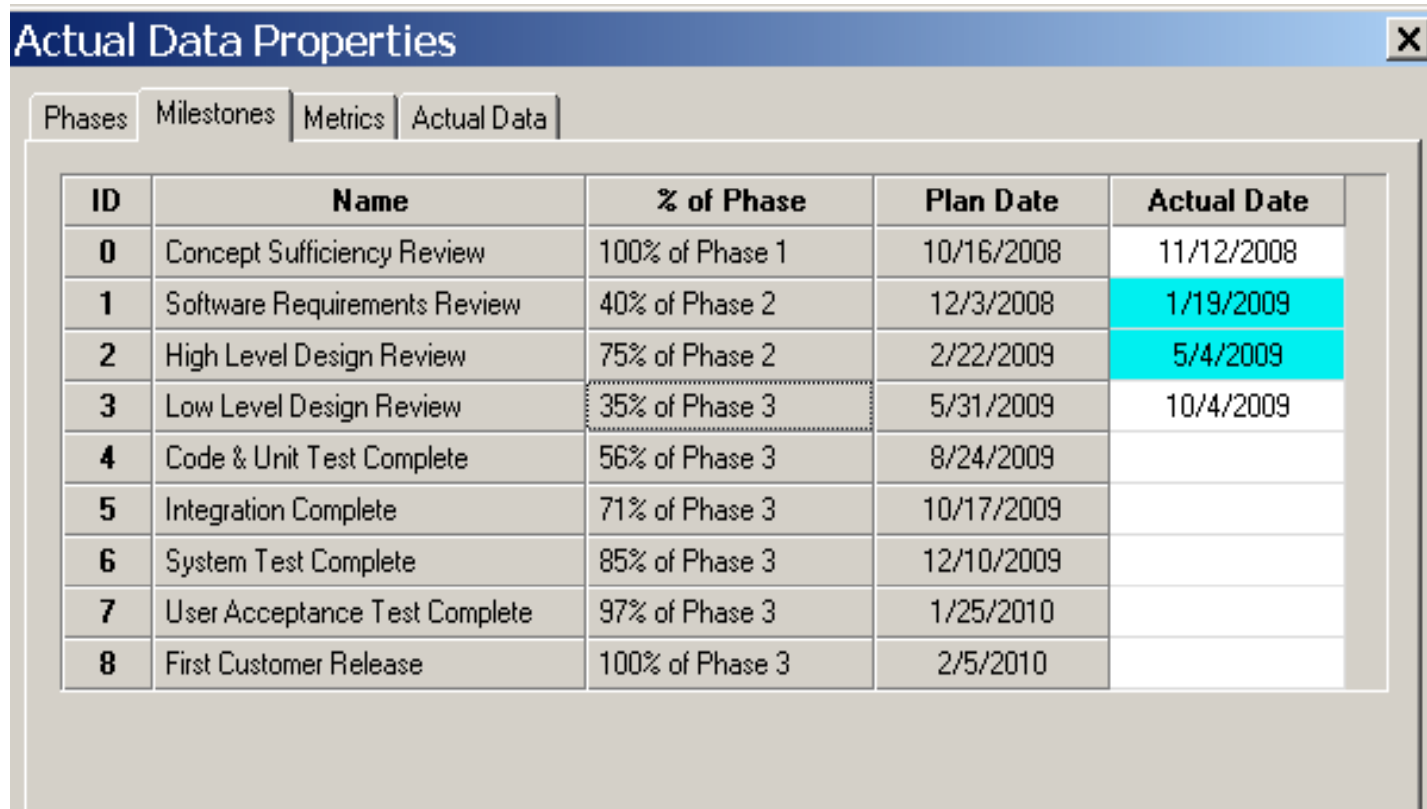
Actual Performance (squares)

Project Plan (lines)



— Current Plan ■ Actuals ■ Green Control Bound ■ Yellow Control Bound Project: Bid Proposal

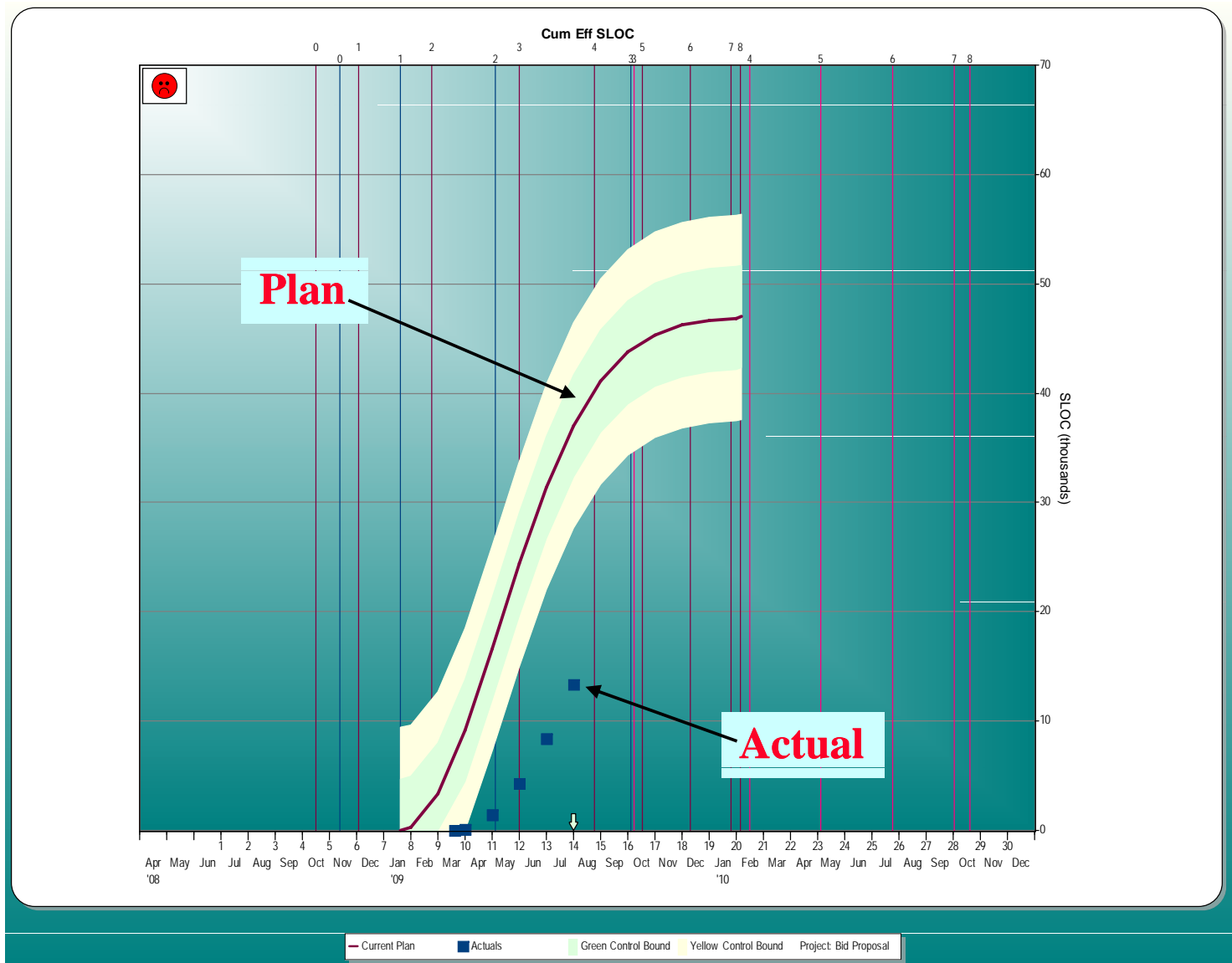
However the Project has Missed Every Milestone



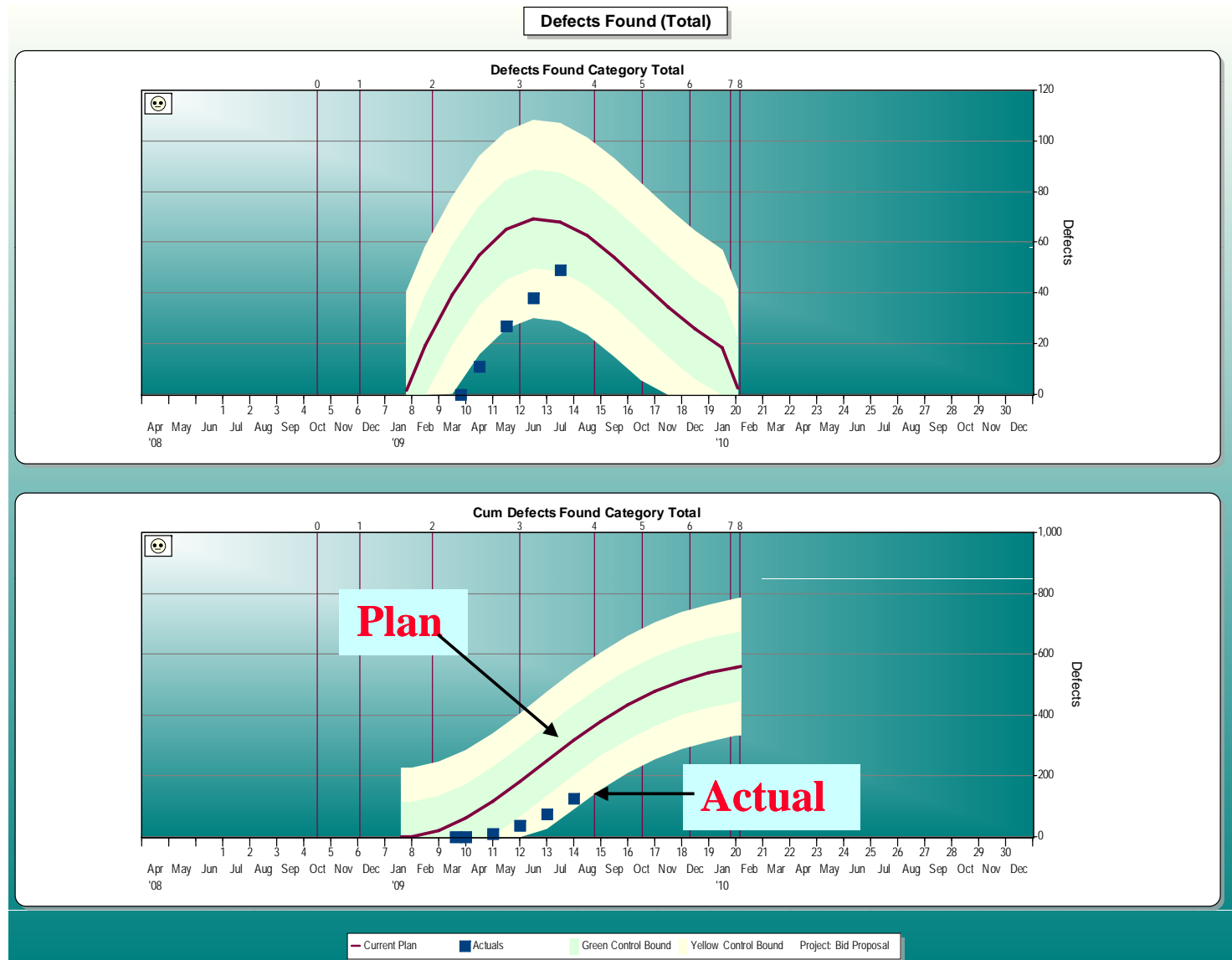
The screenshot shows a window titled "Actual Data Properties" with a close button (X) in the top right corner. Below the title bar are four tabs: "Phases", "Milestones", "Metrics", and "Actual Data", with "Actual Data" being the active tab. The main content is a table with five columns: "ID", "Name", "% of Phase", "Plan Date", and "Actual Date". The table contains nine rows of data. The "Actual Date" column for rows 1 and 2 is highlighted in cyan. The "Actual Date" column for rows 3 through 8 is empty, indicating missed milestones.

ID	Name	% of Phase	Plan Date	Actual Date
0	Concept Sufficiency Review	100% of Phase 1	10/16/2008	11/12/2008
1	Software Requirements Review	40% of Phase 2	12/3/2008	1/19/2009
2	High Level Design Review	75% of Phase 2	2/22/2009	5/4/2009
3	Low Level Design Review	35% of Phase 3	5/31/2009	10/4/2009
4	Code & Unit Test Complete	56% of Phase 3	8/24/2009	
5	Integration Complete	71% of Phase 3	10/17/2009	
6	System Test Complete	85% of Phase 3	12/10/2009	
7	User Acceptance Test Complete	97% of Phase 3	1/25/2010	
8	First Customer Release	100% of Phase 3	2/5/2010	

Code Construction is Way Behind



Defect Detection & Correction is Lagging



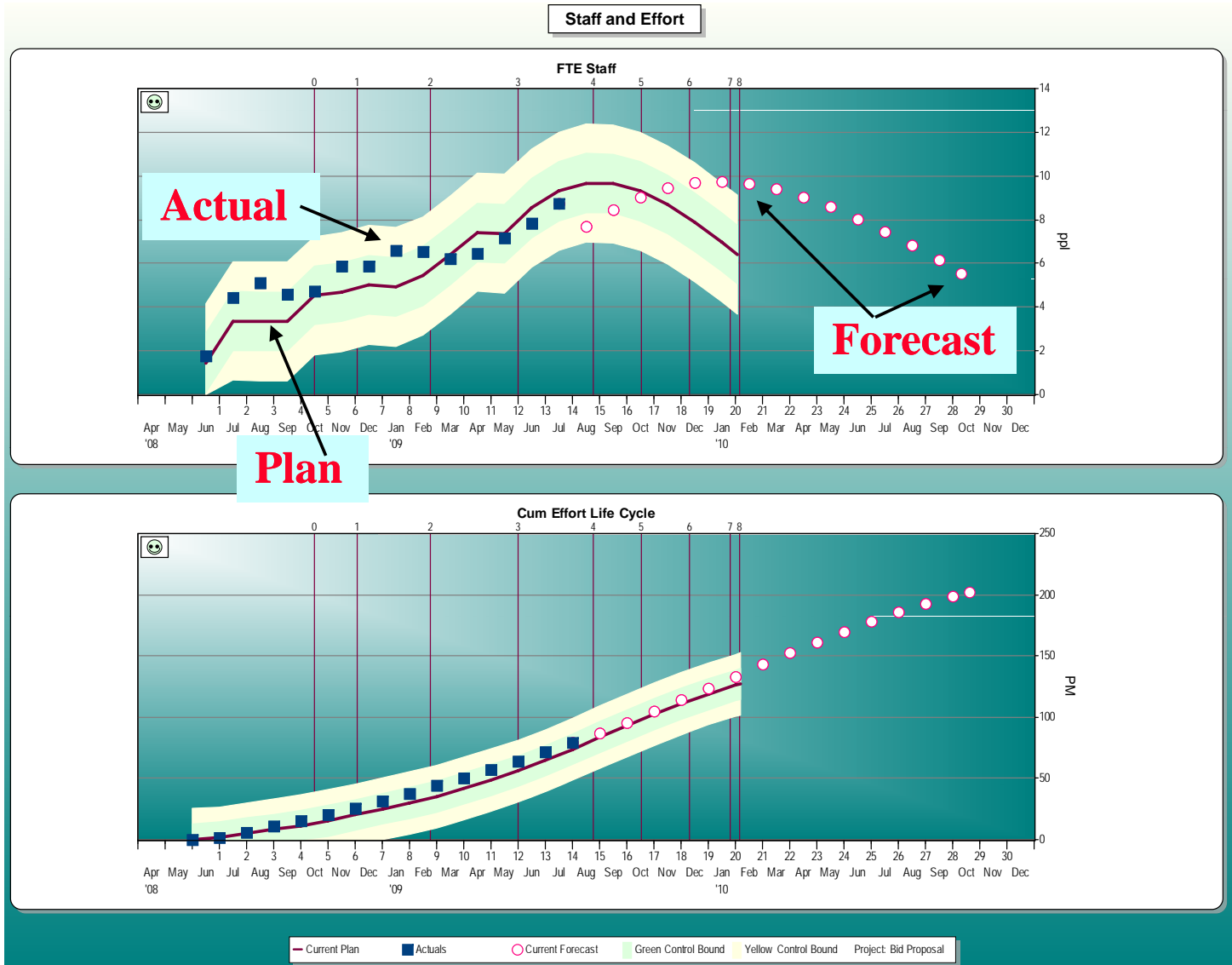
Observations at 14 Months

- **Project is significantly behind schedule**
- **Good financial performance to date masks what is really happening**
- **Milestones, code created, and defects detected are better indicators of project performance**

Forecasting Probable Outcomes

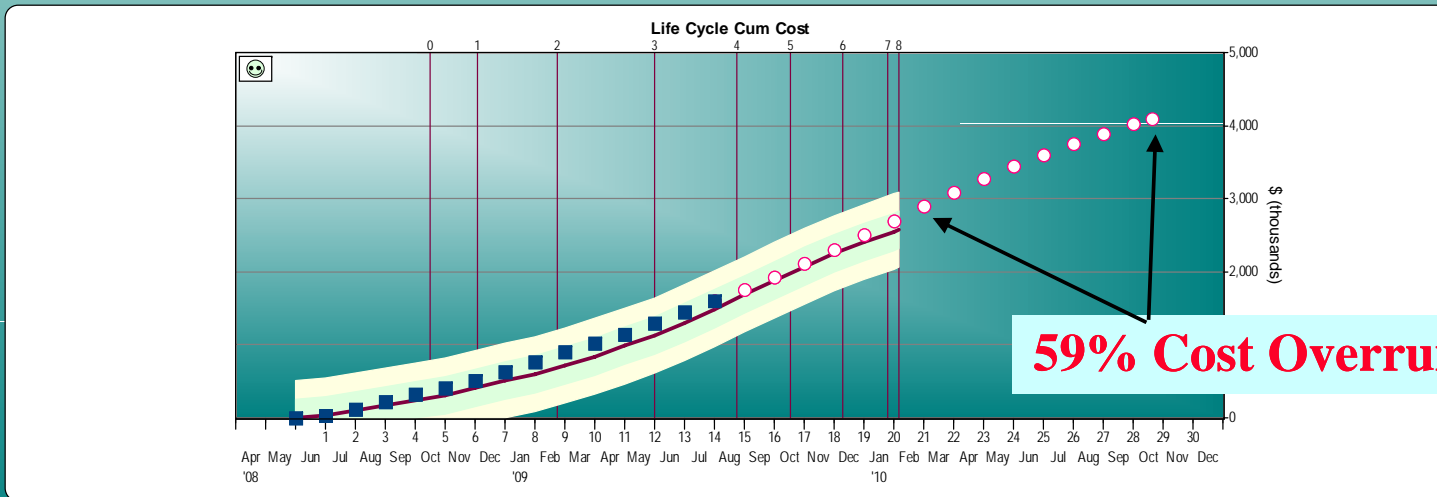
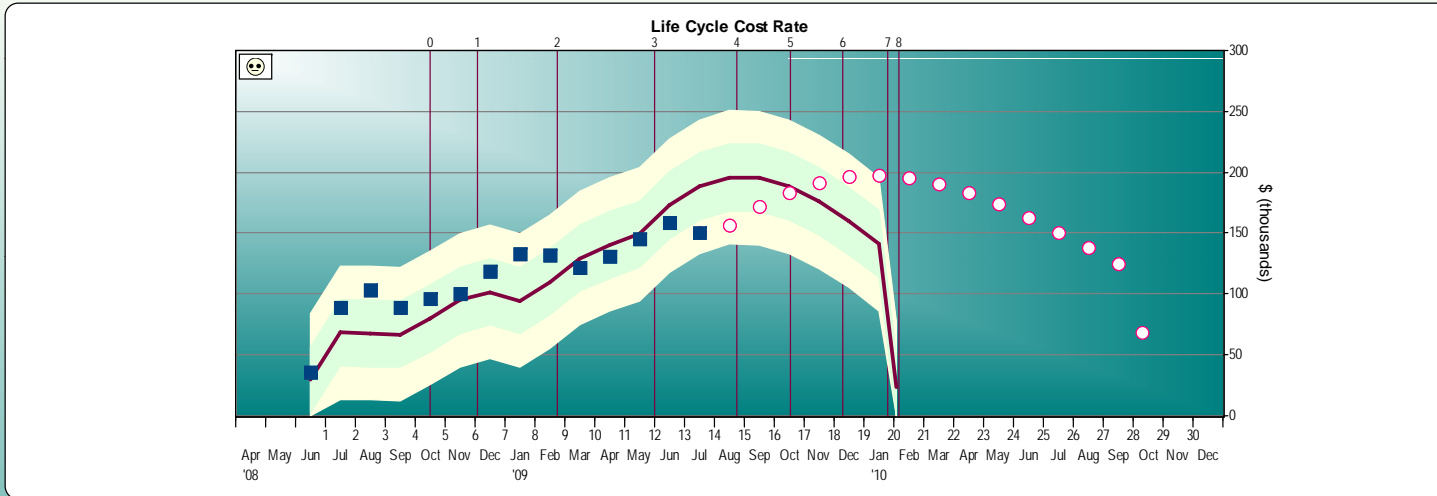
- **Create model(s) of likely outcome(s) based on actual performance to date**
 - **Base projections on code created, defects discovered, and milestones**
- **Model what can be done to alter likely outcome**
 - **Add staff?**
 - **Reduce deliverables?**
 - **Extend schedule?**
- **Revise Plan**

Forecast Project Performance



Forecast Cost

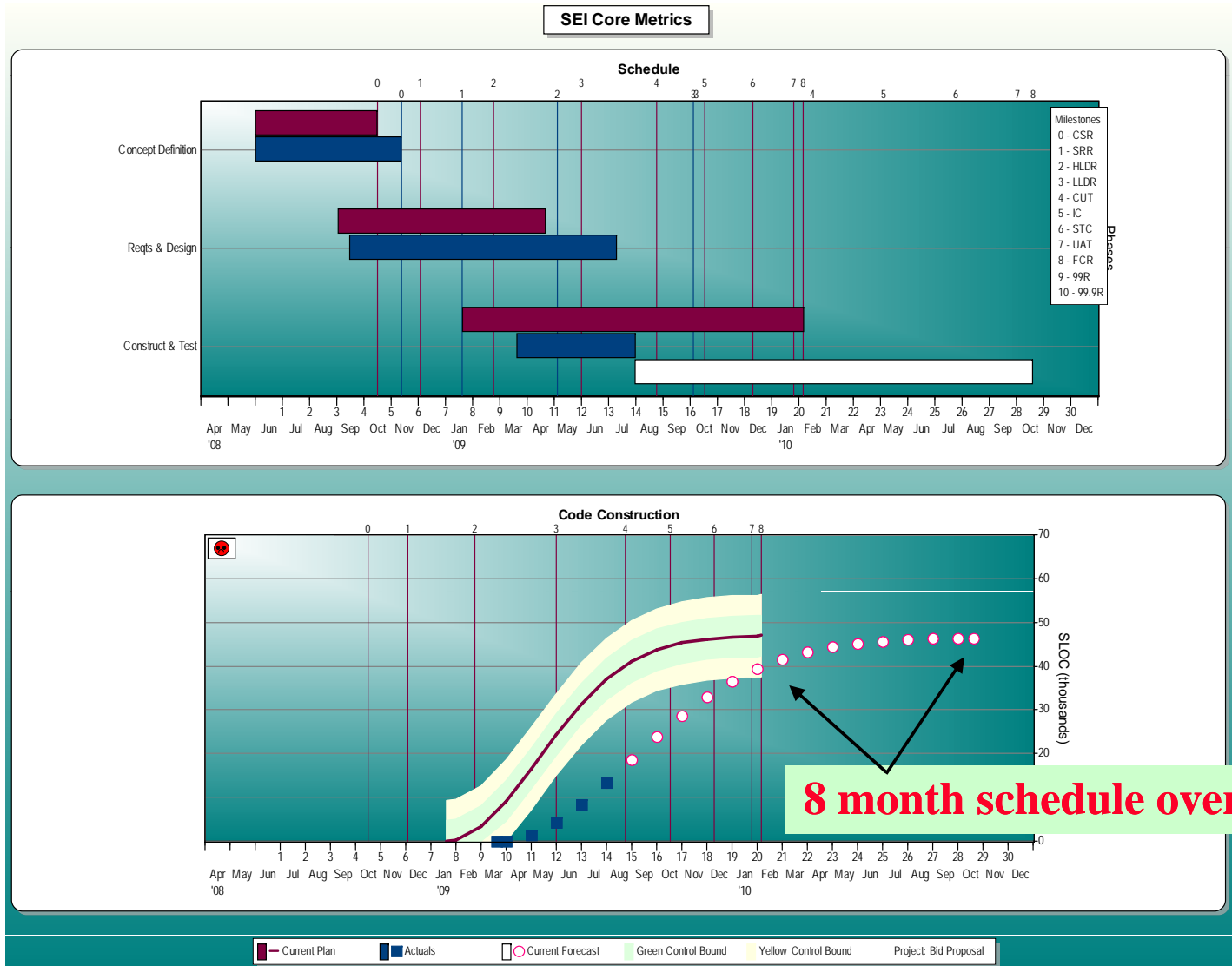
Cost



59% Cost Overrun

— Current Plan ■ Actuals ○ Current Forecast ■ Green Control Bound ■ Yellow Control Bound ■ Project Bid Proposal

Forecast Schedule & Code Construction



Conclusions

- **Vendor history is a powerful tool to evaluate their ability to meet requirements**
- **Contracting Agency and vendors share responsibility**
 - **Contracting Agency's requirements must be achievable**
 - **Vendor's demonstrated capabilities must meet requirements**
- **Financial measures can obscure project problems if used exclusively**
- **Actual performance is the best indicator of the likely outcome**
- **These processes can and should be modeled and tracked**

Questions?