



Metrics-driven Risk Management in IC Development

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Topics

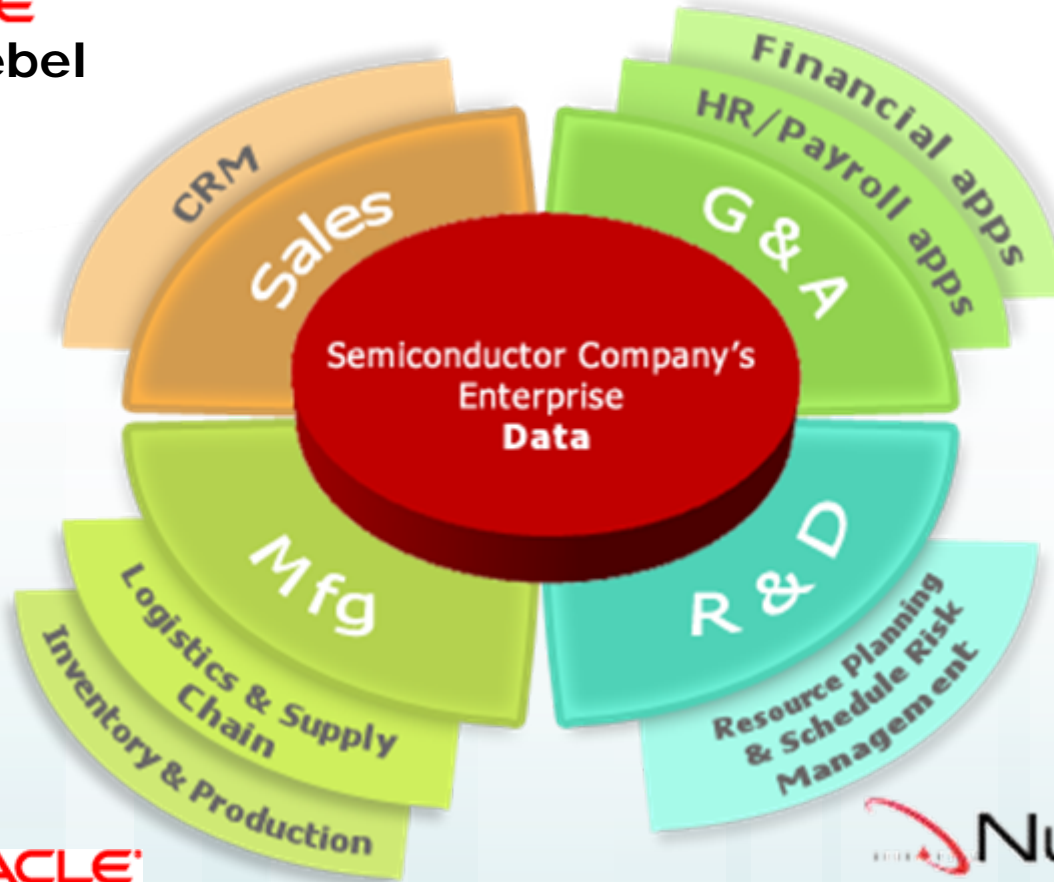
- About Numetrics today (brief, I promise!)
- How we got started and why
- Benchmarking with Metrics
- Planning and Risk Analysis with Metrics
- Discussion

ERP for Semiconductor R&D Organizations


Enterprise Resource Planning (ERP) Software

ORACLE®
Siebel

ORACLE®
People Soft



ORACLE®

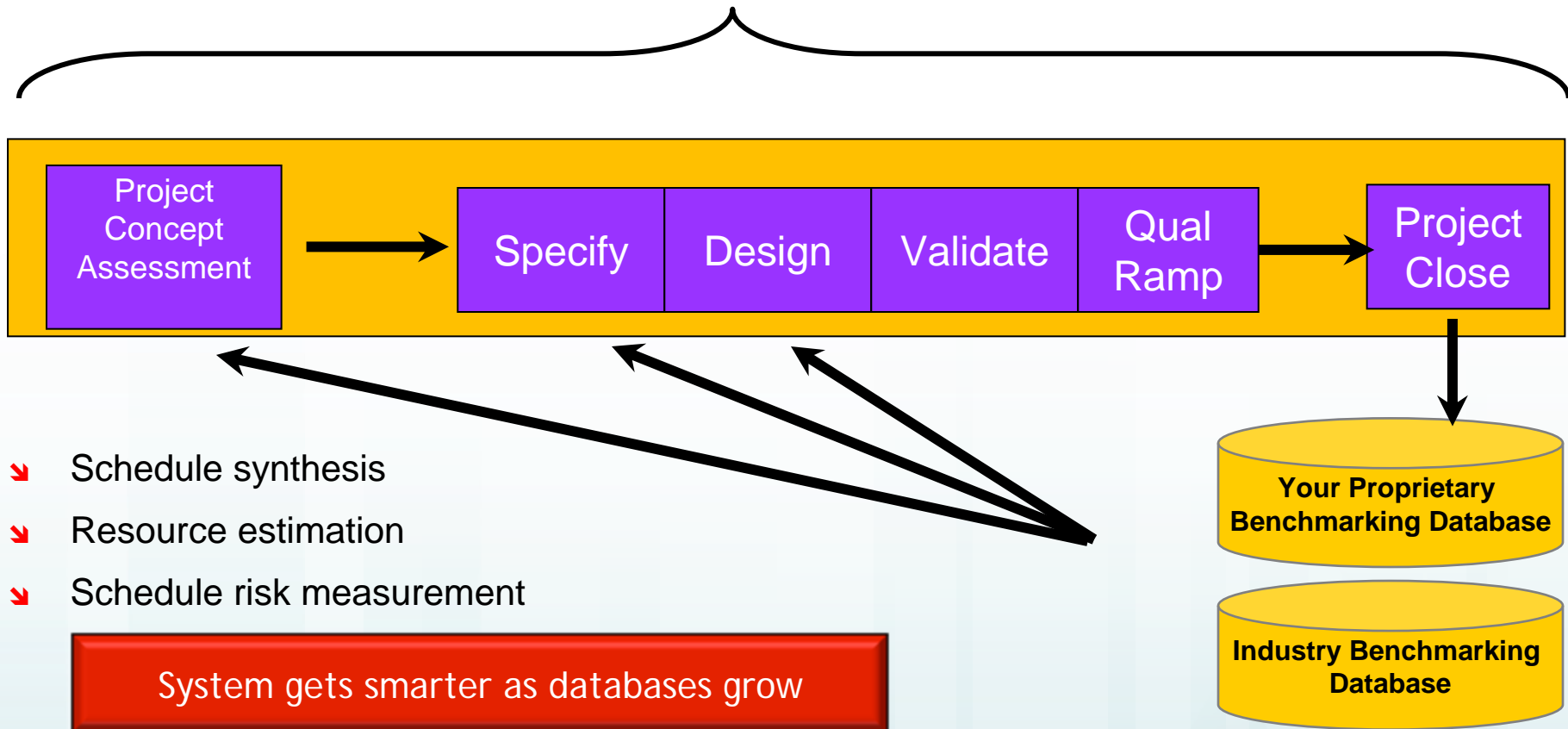
 Numetrics

Top Semiconductor Companies Adopting Numerics

- Solution becoming industry standard for project planning
 - Examples of major deployments starting and underway
 - Intel , Texas Instruments, NXP, AMD (just starting), NEC
- Customer-reported benefits
 - Predictable schedules (= minimum schedule slip)
 - Unrealistic project plans identified early
 - Schedule risk accurately measured at project start
 - Optimized resource planning (project staffing)
 - Enables better dialog & decision-making between engineering, marketing and executive management

Project Estimation & Schedule Risk Measurement Solution

IC Project Lifecycle



Numetrics' IC Industry Database



How We Got Started

Initial Opportunity: Mid-90s

↘ Economic environment

- Manufacturing revolution mature (JIT, TQM, ...)
- Consumer electronics emerging as big \$\$
- Time-to-market pressures on R&D

↘ Electronics Systems companies asked:

- “How can we measure our R&D productivity?”
- “Can we benchmark ourselves to other companies, especially apples-to-apples?”
- “How do we reduce our cycle times?”

How We Got Started

Q. What to benchmark?

A. First computers, then telecom, then chips

Q. What data to collect?

A. Collect everything

Q. How to get people to collect the data?

A. Charge them money to do it

Q. How to report on sensitive data?

A. NDA-protect the *source*, show anonymous data

How Did it Work Out?

- 12 months to reach critical mass of participants
- 6-9 months in legal
- 135 page paper questionnaire
- 3 person-weeks per project to gather data
- 12 months to collect all the data
- 21 projects
- 1 Productivity metric, patent #6,823,294



Benchmarking with Metrics

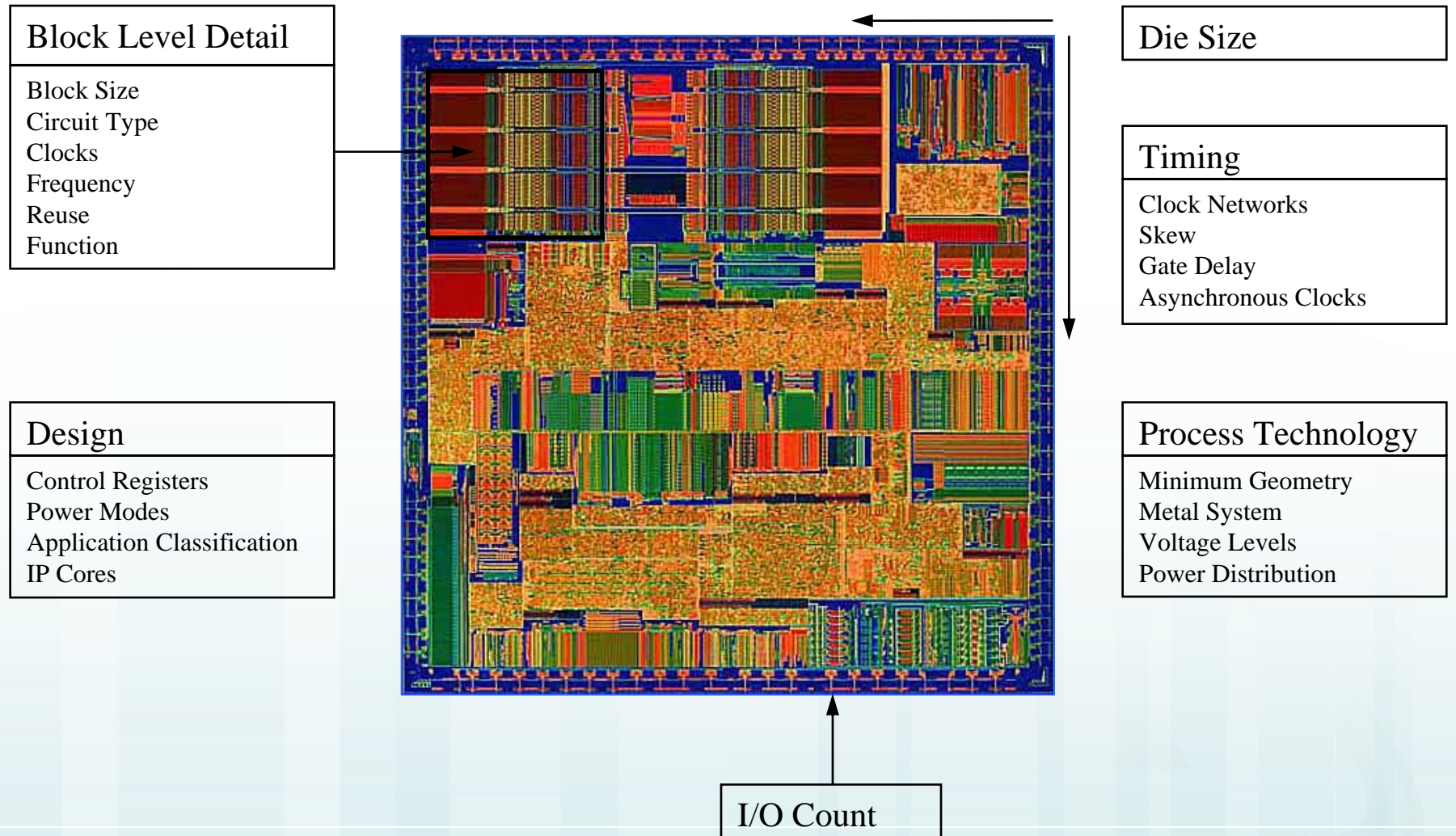
How to Measure Productivity?

- Traditional definition of labor productivity
 - Amount of “stuff” produced per unit of labor
 - Call center: tickets closed per person-week
 - Steel mill: tons of steel per labor hour
 - Value of “stuff” produced per labor dollar
 - BLS reports “output \$” using index (1992=100)
 - Productivity tracked the most

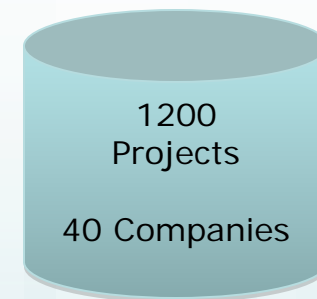
- Numetrics definition

$$\text{Productivity} = \text{Standard Effort} \div \text{Actual Effort}$$

Standard Effort Predictors for ICs



10 Years of Estimation Technology Development



Typical Metrics Used in Benchmarking

- Performance Results
 - Productivity & Key Performance Indicators
 - Cycle Time and Schedule Performance
 - Design Quality
 - Design Reuse
 - Silicon IP
 - Return on R&D Investment
 - Silicon Density

- Cycle Time and Effort Trend
 - Cycle Time and Effort Trend by Phases
 - Post-1st Tapeout Duration Diagnosis

Challenge of Benchmarking

➤ Results can get you half-way to satisfaction

1. Where do I stand?
2. In what ways am I different?
3. What are the best/worst practices
4. What should I do to get better?

➤ Why can't benchmarking provide the silver bullet?

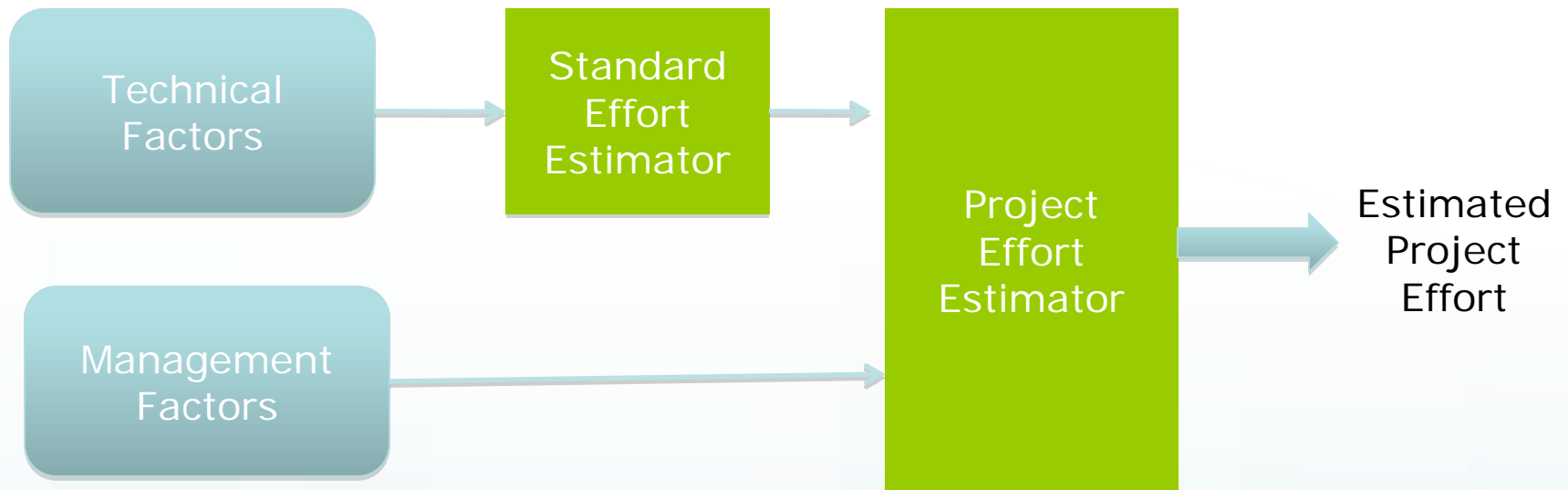
- Too costly to collect data on all causal factors
- Difficult to establish causality

Planning & Risk Analysis with Metrics

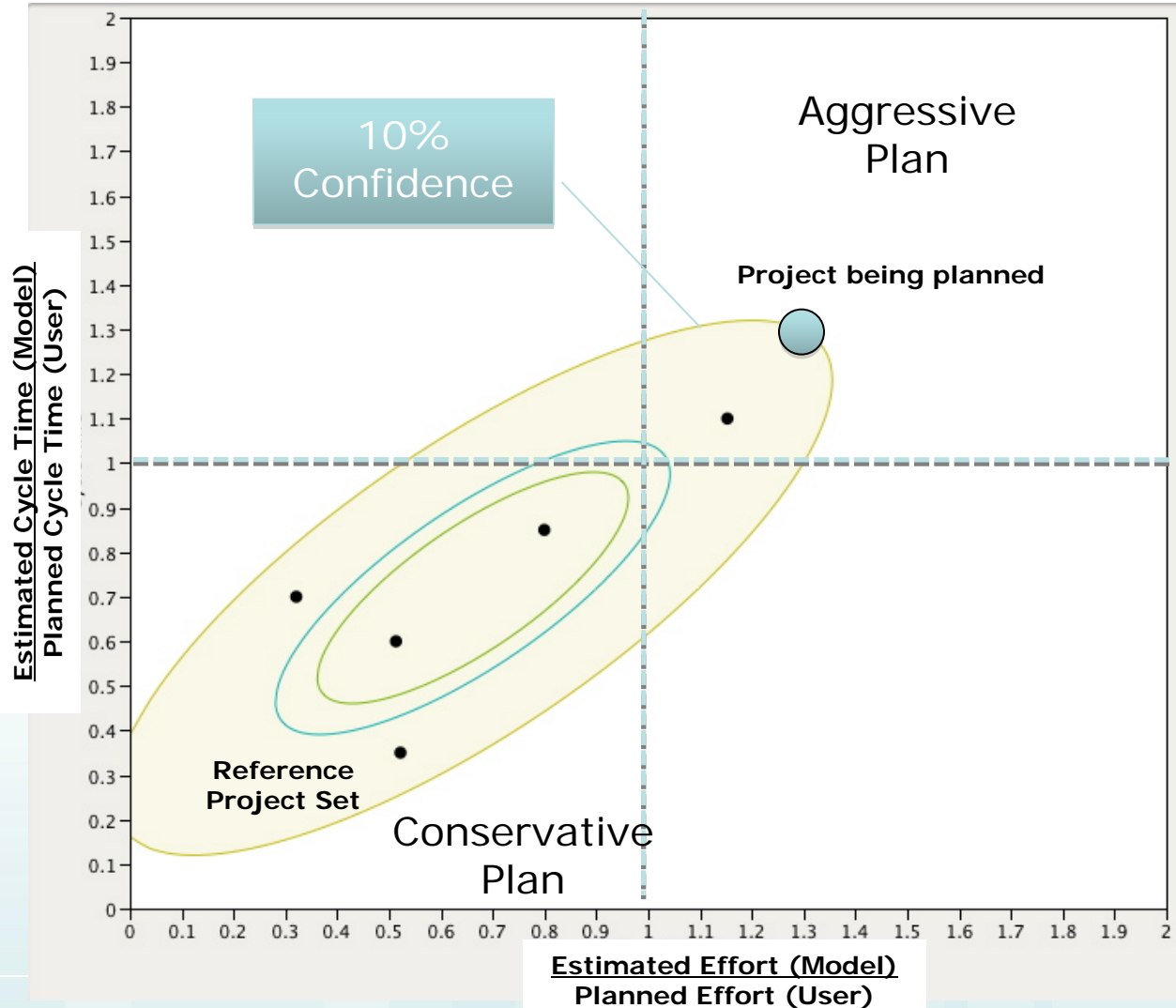
More Useful --- Apply Predictive Model to **New** Projects

- Estimate effort for a new project
- Include technical and managerial predictors in estimation model
- Evaluate risk by comparing model's estimate to the "bottom-up" plan developed by the team
- Stop the disaster *before* it happens

Project Estimation Technology



Risk Analysis: Model Estimate vs. Team's Plan



Estimated Cycle Time:
Schedule predicted by the model

Planned Cycle Time:
Schedule developed by the team

Estimated Effort: Model estimate of manpower

Planned Effort: Team's plan for manpower

Plan Synthesizer

Plan Synthesizer

Input Parameters (Required) ?

[Hide](#)

Input	Units	Working Plan Values	Temporary Plan Values
Reference Productivity	CU/Person-Week	978	978
Design Complexity	CU	1,339,024	1,339,024
Staffing Contour			

Constraints (Optional) ?

Working Plan

Project End Date

-- Select Version --

Temporary Plan

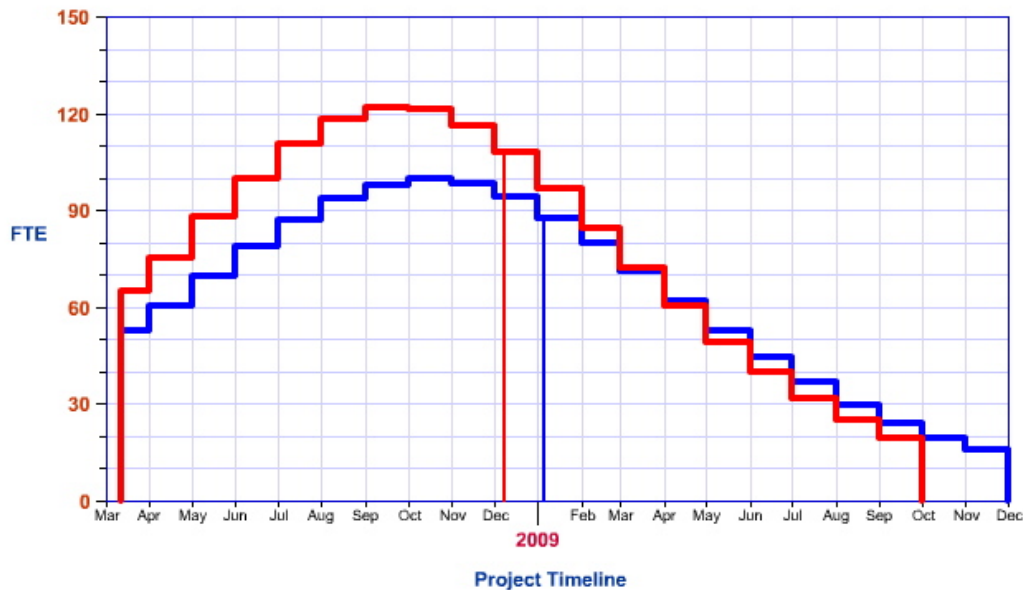
Project End Date

-- Select Version --

Working Plan (—)
Tapeout(s) (—)

Temporary Plan (—)
Tapeout(s) (—)

Synthesize Profile



Discussion Topics

- Do your projects slip schedule? Why?
 - Bad plan or poor execution?
- Is 0% slip the right goal? (Hint: projects are stochastic processes)
- Would your planning behaviors change if you had accurate estimation tools available?

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