



Q/P MANAGEMENT
GROUP, INC.

Relationships Among Software Metrics in Benchmarking

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Agenda



- **Introduction and Background**
- **Trends and Attributes Impacting Productivity**
- **Using the Results**

Introduction – Q&A

Questions often arise when analyzing productivity data

- How does productivity correlate with size, technology, time to market, quality and process maturity?
- How has productivity changed overtime?
- Why are there significant variations in productivity?
- How do we make sense of and use our organization's productivity data?

Answers to these questions require:

- Adequate organizational and historical data
- A good understanding of software development including knowledge of the factors that impact productivity and historical trends
- Analysis techniques based on software metrics experience

Common Expectations Related to Productivity Data are Often Not Met

- Productivity should be fairly consistent across an organization
- Productivity differences between organizations should not be significant
- Factors impacting productivity should be easy to identify and isolate
- Productivity data should follow a normal distribution

Metrics Analysis Findings

- Productivity can vary substantially across an organization due to many factors impacting projects
- Productivity can differ significantly between organizations due to organizational and project characteristics
- All the factors impacting productivity are difficult to identify and isolate as independent variables
- Productivity data does not typically follow a normal distribution

This does not mean that productivity data is less useful

Real Estate Example

Other industries that rely heavily on data and statistics have characteristics similar to the software industry

- Wide variations in critical measures
 - Home cost vs. Project cost
 - Cost per Square Foot vs. Cost per FP
- Many variables that impact price
 - Location, location, location
 - Time (10 years, 2 years, current)
 - Size
 - Other variables

Both software and homes are highly variable
“Customized” products

Real Estate Example (Continued)

Real Estate Values Dataset

- Un-segmented dataset
 - Multiple locations
 - Various types
 - Wide historical timeframe
 - Wide range of sizes
- Segmented dataset
 - Single location
 - Single type
 - Current market
 - Similar size

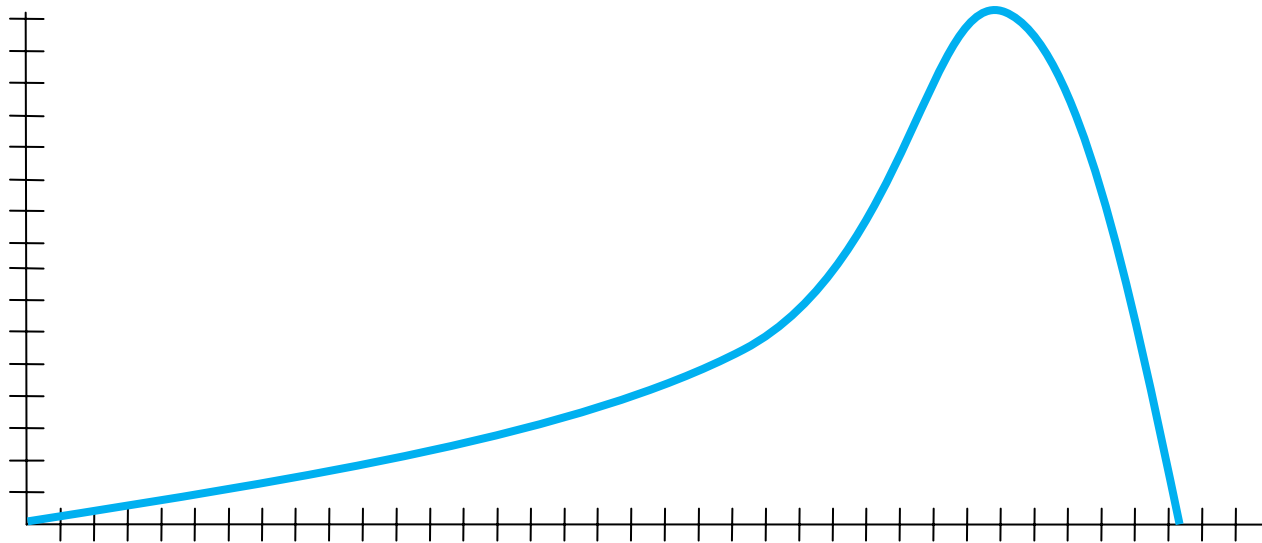
Means, Medians and Standard Deviations Vary Significantly

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Software Project Productivity

Project Productivity Distribution



- **Project productivity data is not always as expected**
 - Wide range of productivity rates
 - Non-normal distributions
 - Large standard deviations
 - Substantial differences between mean and median

Many Factors Impact Productivity

- Measurement time period
- The impact of process maturity
- Focus on quality
- The impact of new tools and technologies
- Management strategies and decisions
- The tradeoffs between productivity and schedule
- The impact of function point counting practices
- Time accounting standards

Understanding Productivity Variations Requires a Great Deal of Historical Data

Benchmark Database Statistics

- Over 15,000 data points
- Over 150 organizations
- 1992 to present

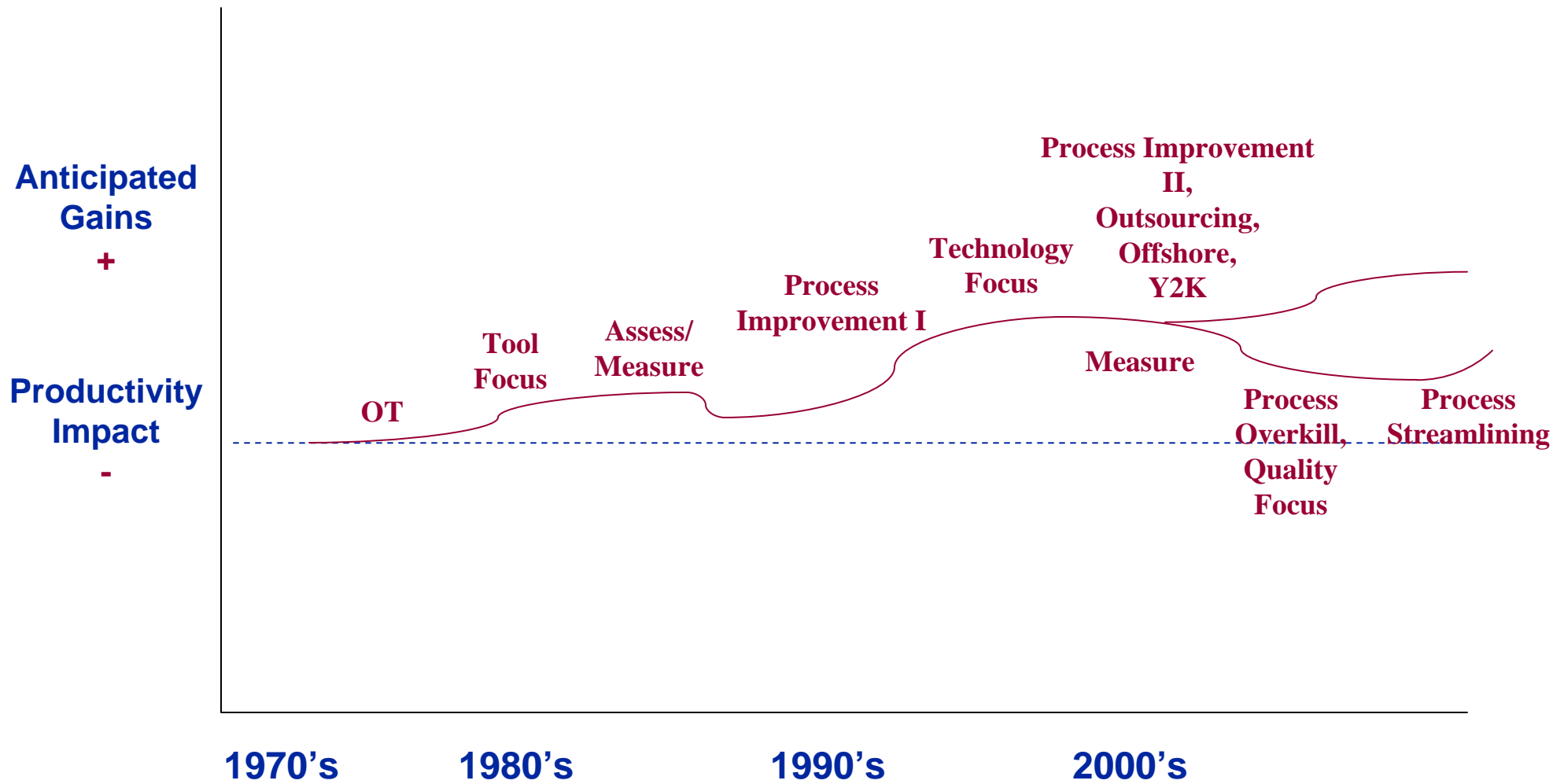
Productivity and Quality Data

- Effort normalized to standard lifecycle
- Cost (labor rates or fixed price)
- Function point size (IFPUG)
- Defects
- Schedule

Other Classifications

- Development Type (New Development, Enhancement or Maintenance)
- Capability Maturity Model (CMMI) Level
- Technical Platform
- Industry
- CPM version
- Project Attributes and Practices

Industry Trends have Significantly Impacted Productivity Over the Years

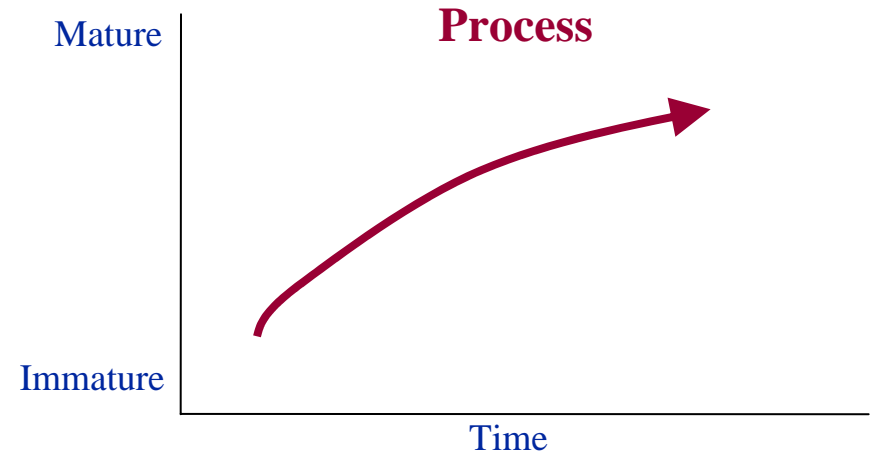
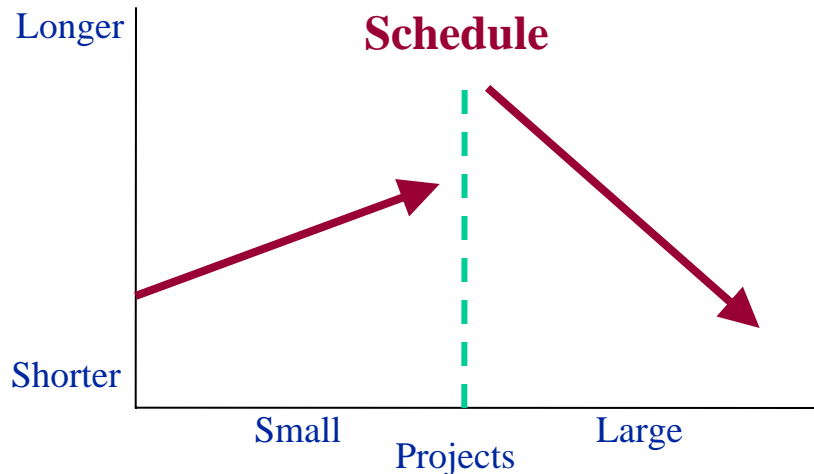
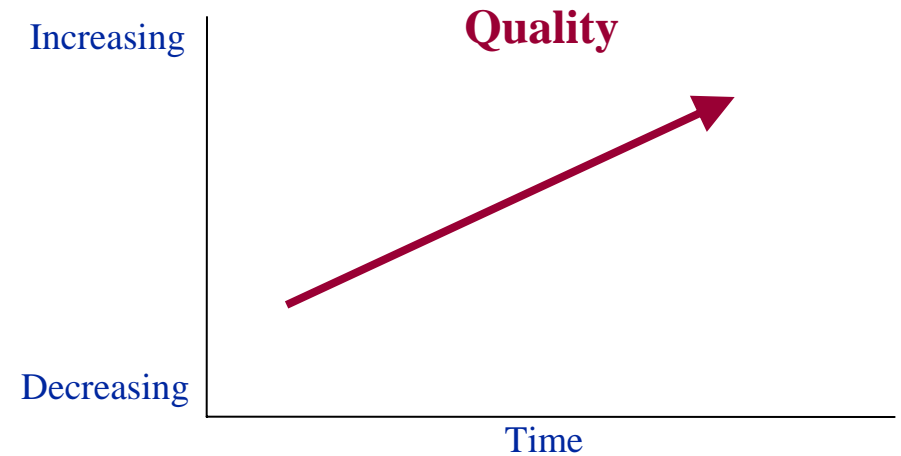
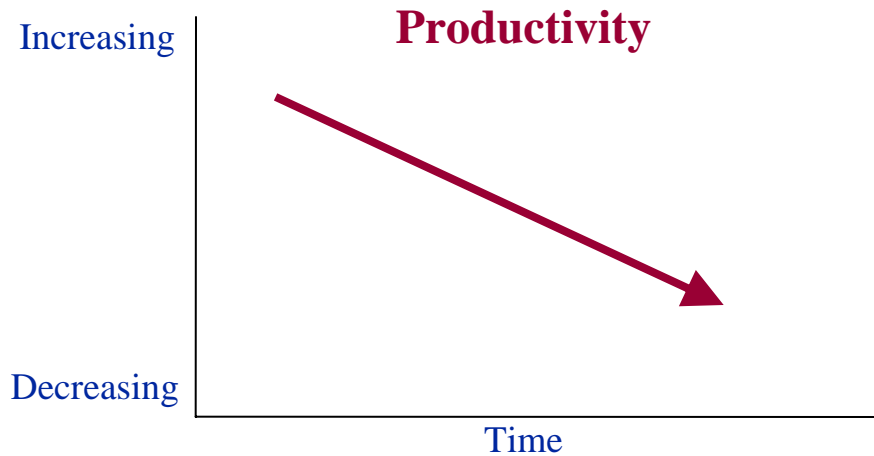


Recent Sources of Productivity Problems

The quest for process maturity, high quality, low cost and reduced cycle time have had a major impact on productivity

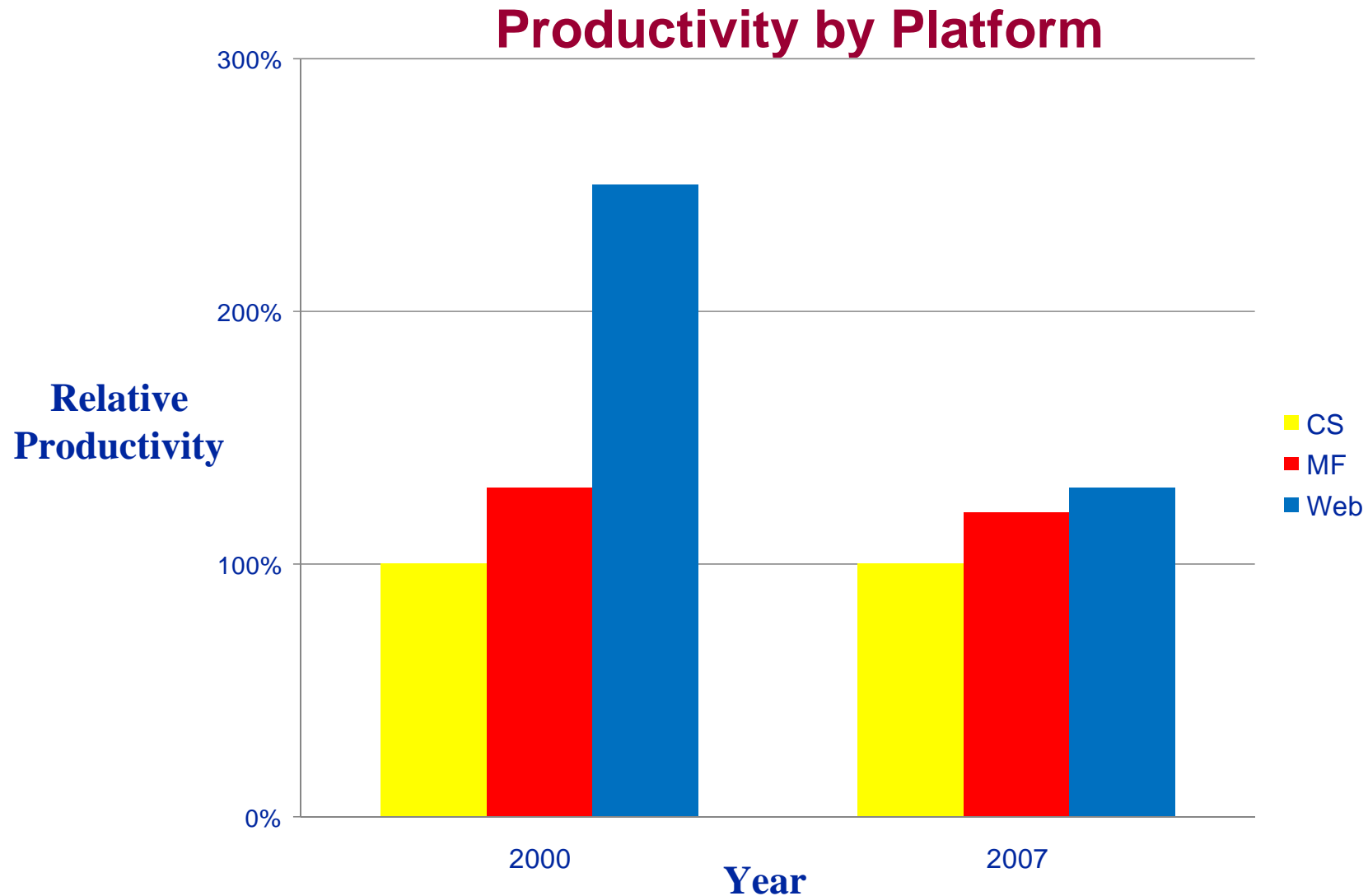
- Outsourcing
- Offshoring
- Process overhead can be very high
- Newly implemented processes are not always effective
- The learning curve can mask effectiveness
- Tradeoffs exist between schedule and productivity
- Quality can hit a point of diminishing return

Major Trends in Software Development



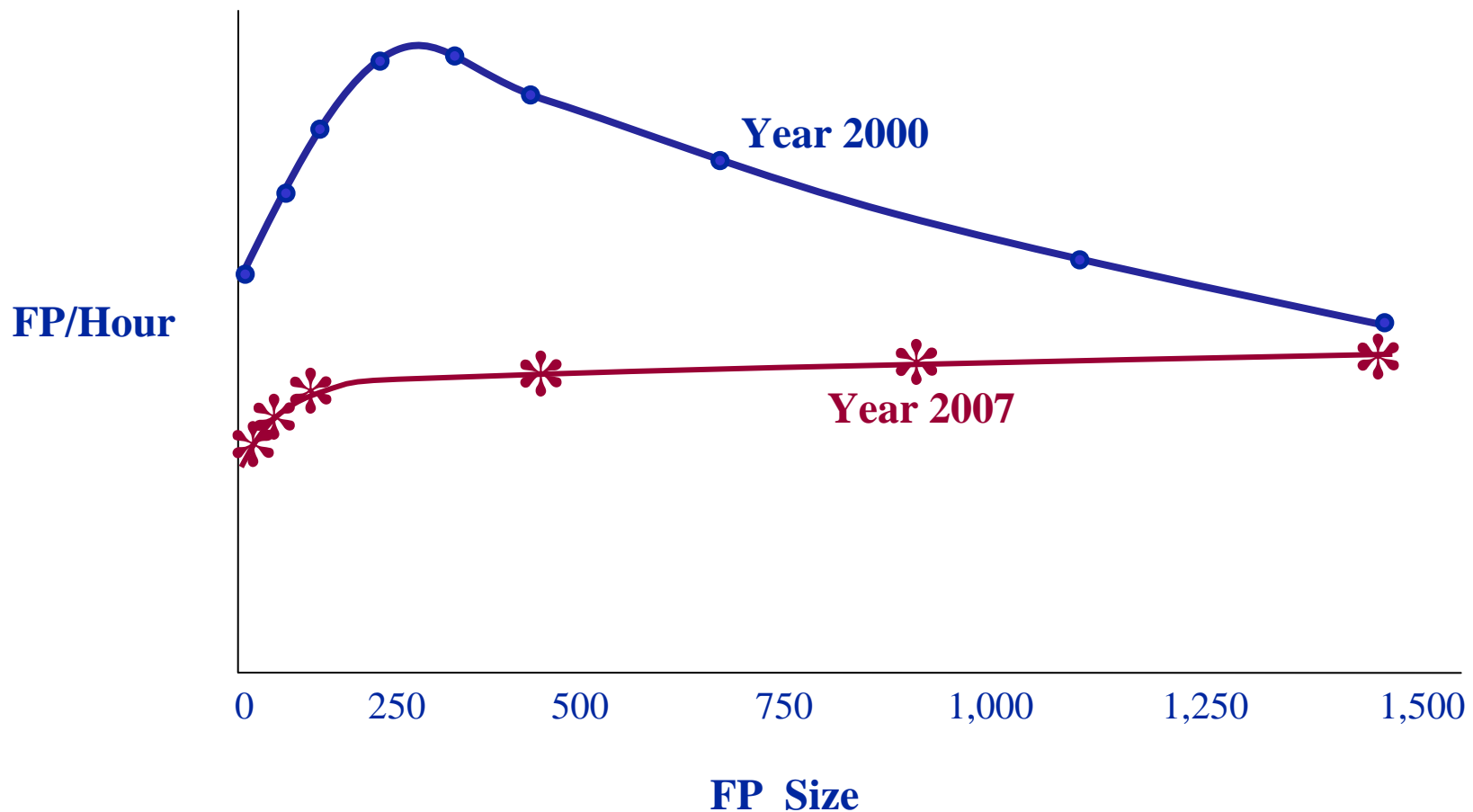
Measurement results have been mixed over the past decade

Platform Variations Have Impacted Productivity Over the Years

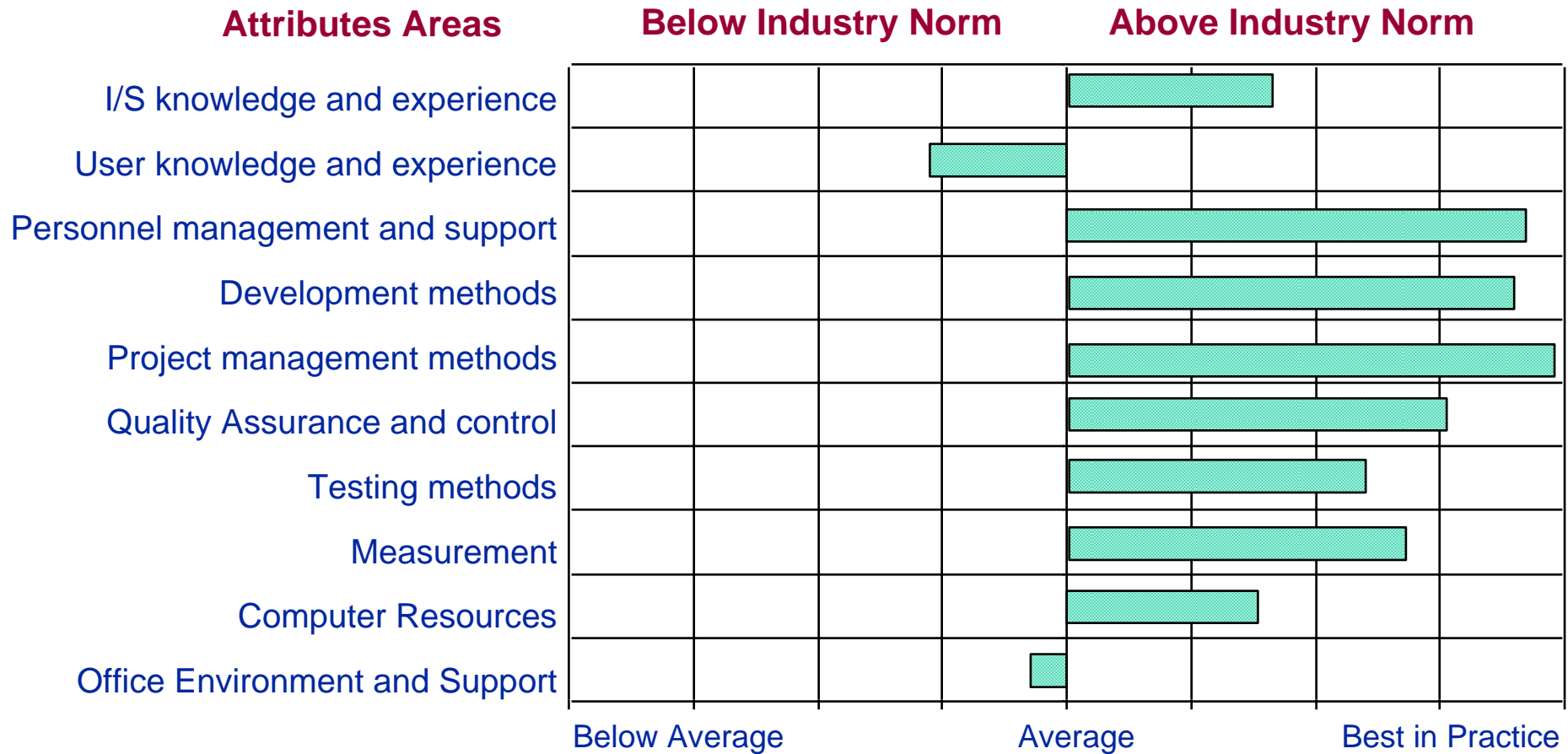


Size Variations Have Impacted Productivity Over the Years

Productivity by Size



Project Attributes and Practices



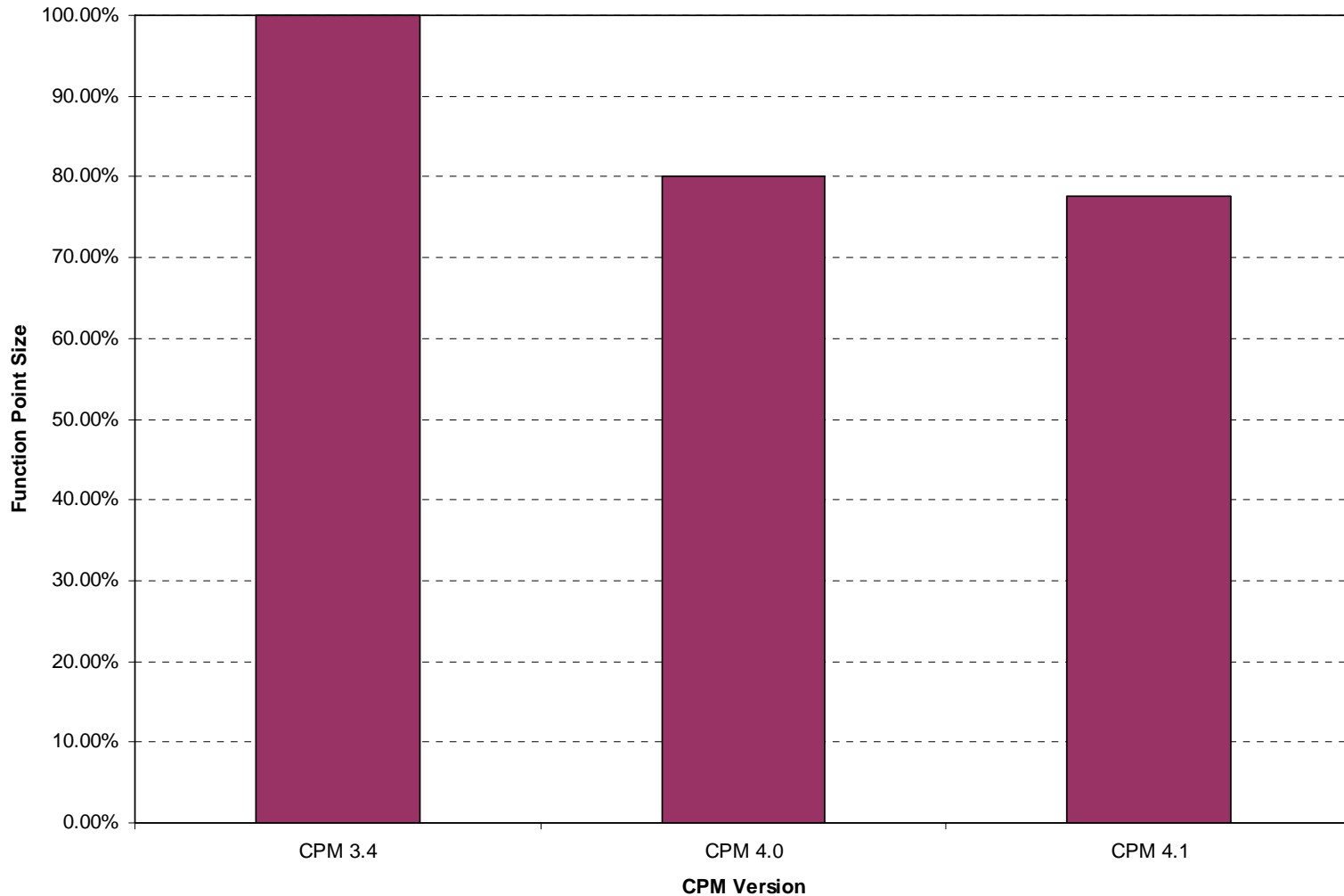
Over 100 factors impact productivity, quality and cost

High Impact Attributes and Practices

Focus first on those factors that have the greatest impact

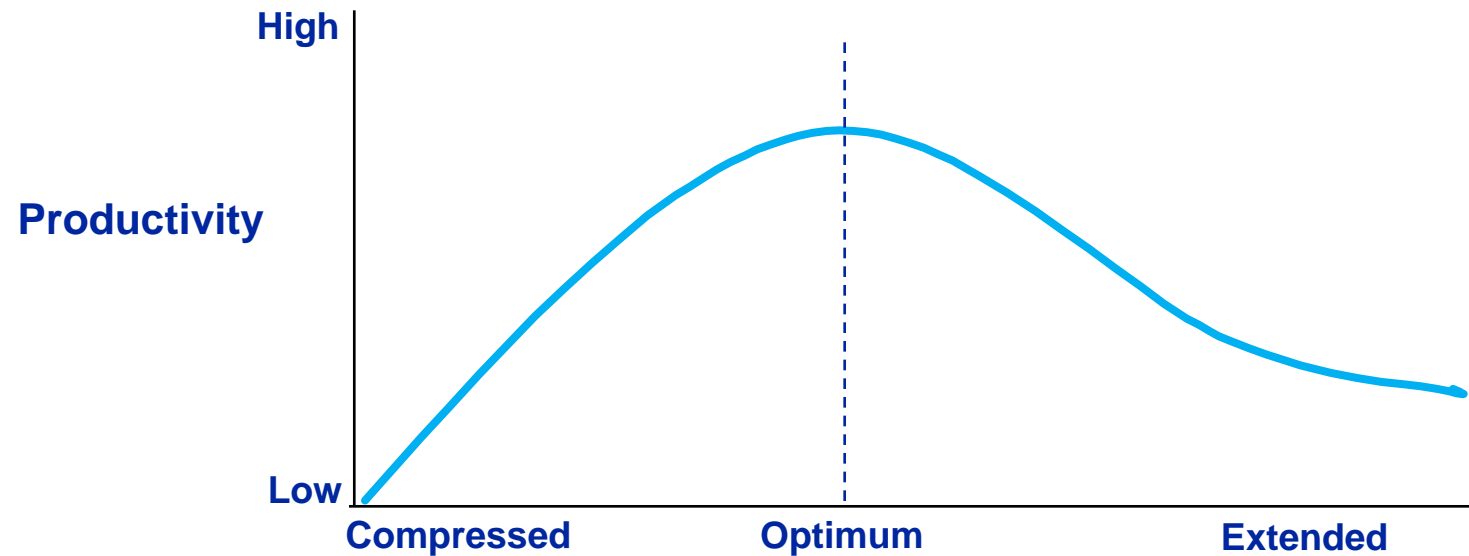
- IT Experience in various disciplines
- User involvement in requirements definition
- Stability and clarity of requirements
- Project management
- Proper staffing levels (especially offshore)
- Reasonable estimates and schedules
- Appropriate lifecycle methods for project type
- Formal quality inspections
- Good communications across locations

CPM Version Impacts Project Size and Therefore Productivity, Cost and Quality



Project Schedules Often Impact Productivity

Productivity versus Schedule



Severely compressed or extended schedules can significantly impact productivity

Segmenting the Historical Dataset and Isolating Key Variables is Required

- Limit timeframe of dataset
- Separate by technology and project type
- Analyze data by size range
- Carefully remove outliers
- Evaluate impact of schedules
- Compare to similar organizations as appropriate
- Analyze by offshore penetration

Results: Tighter productivity range, higher correlation between size and productivity, and smaller standard deviation

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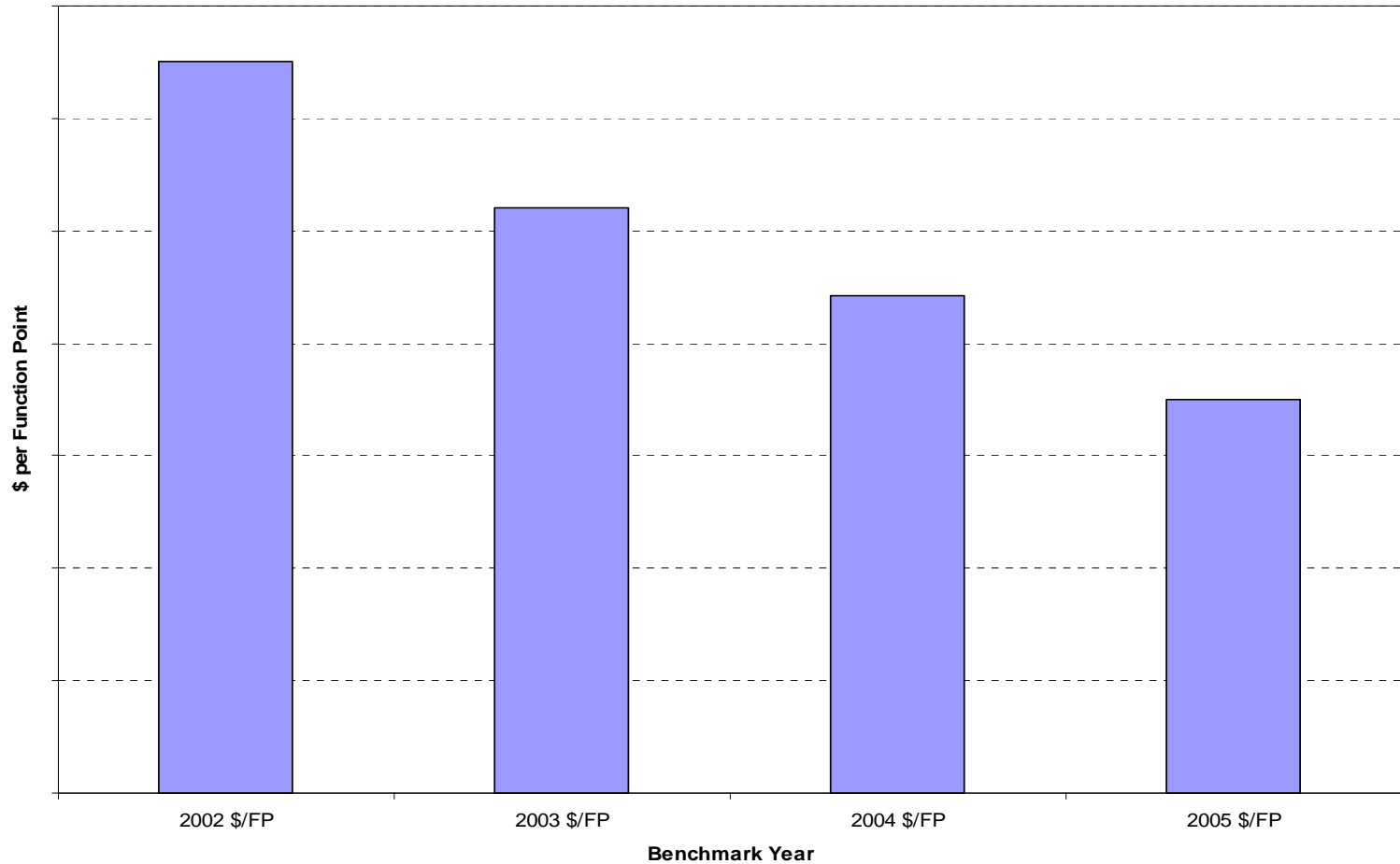
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Use the Results to Maximize the Benefits of Measurement

Uses of measurement should be aligned with organizational goals

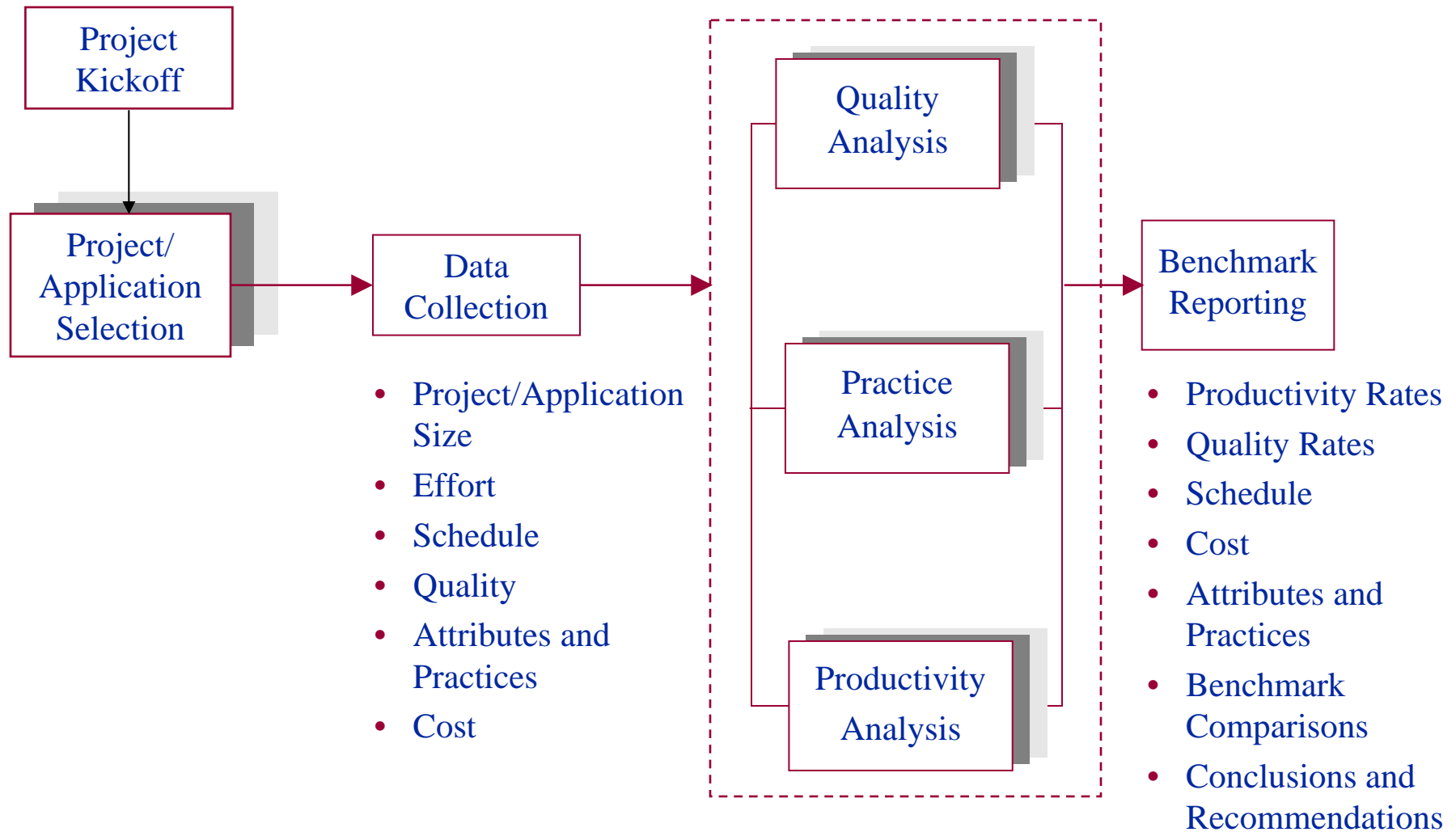
- Manage Internal Performance
- Improve Project Management (estimating and staffing)
- Improve Vendor Performance Management
- Increase Productivity and Quality
- Reduce Costs
- Reduce Time to Market
- Improve Software Engineering Processes

Internal and Ongoing Performance Measurement



Identify improvements and measure progress

Benchmarking for Comparison and Improvement



Deep Dive Analysis to Uncover Root Causes for High and Low Productivity

- Project Attributes beyond the CMMI need to be evaluated
- Methods and techniques need to be analyzed in terms of flexibility and efficiency
- Project effort should be analyzed in detail
- Project schedules by size category should be compared
- Estimating accuracy should be calculated
- Service level and performance goals should be evaluated
- Measurement and governance activities should be reviewed

Metrics to Manage Outsourcing

Metrics and payment options are numerous depending on the goals and contract terms

Pay by the Metric

- Payment is based on Function Points delivered
- \$700/ Function Point for example

Casual Management Interest

- Identify performance productivity improvement
- Does not impact regular payments

Tool to Manage Performance and Terms

- Provide incentives for achieving goals
- Assessing penalties for poor performance
- Benchmarking built into the agreement

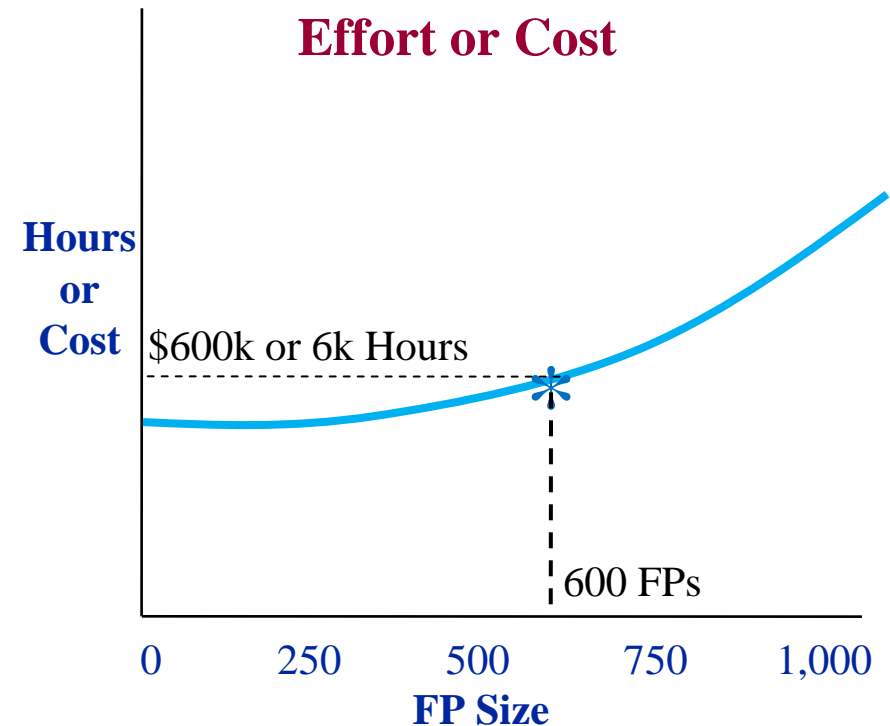
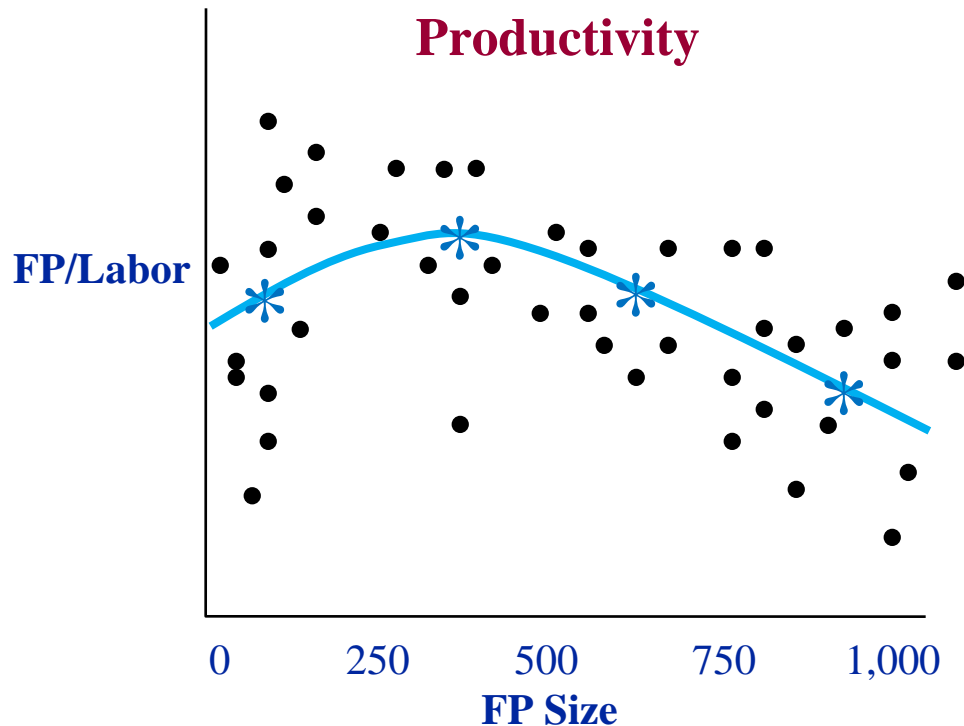
Outsourcing - Cost/FP or FP/Effort Matrices

Matrices are often established by project size and platform

| | FP/FTP MO. | | |
|--------------------|------------|-----------|---------------|
| Project Size (FP) | Web | Mainframe | Client Server |
| 1 – 300 | 19 | 12 | 10 |
| 300 – 1,000 | 28 | 21 | 17 |
| > 1,000 | 22 | 19 | 13 |

- Matrices can be used to set price or performance target

Productivity Matrices can be Converted to Linear Rates



Productivity by size range can be converted to continuous effort or cost for all FP project sizes

Measurement for Better Estimating

Development Team

| | |
|-------------------------|----|
| Technology Skill Level | 4 |
| Methodology Skill Level | 7 |
| Business Knowledge | 7 |
| Team Leader Experience | 6 |
| Structure and Roles | 7 |
| Team Location | 10 |
| Q/A and Testing | 5 |

User Attributes

| | |
|-----------------------|----|
| User Involvement | 4 |
| Business Knowledge | 10 |
| Organizational Impact | 7 |

Project Attributes

| | |
|---------------------------|----|
| Development Technology | 4 |
| Development Methodology | 6 |
| Deployment Technology | 3 |
| Schedule Constraints | 10 |
| Requirements Definition | 5 |
| Staff Constraints | 4 |
| Project Management Tools | 4 |
| Quality Controls | 5 |
| Automated Design/Code | 4 |
| Development Cycle | 10 |
| Environmental Constraints | 6 |

Description [Update](#)

0 - All development team members are experts in the development technology being utilized in this project.

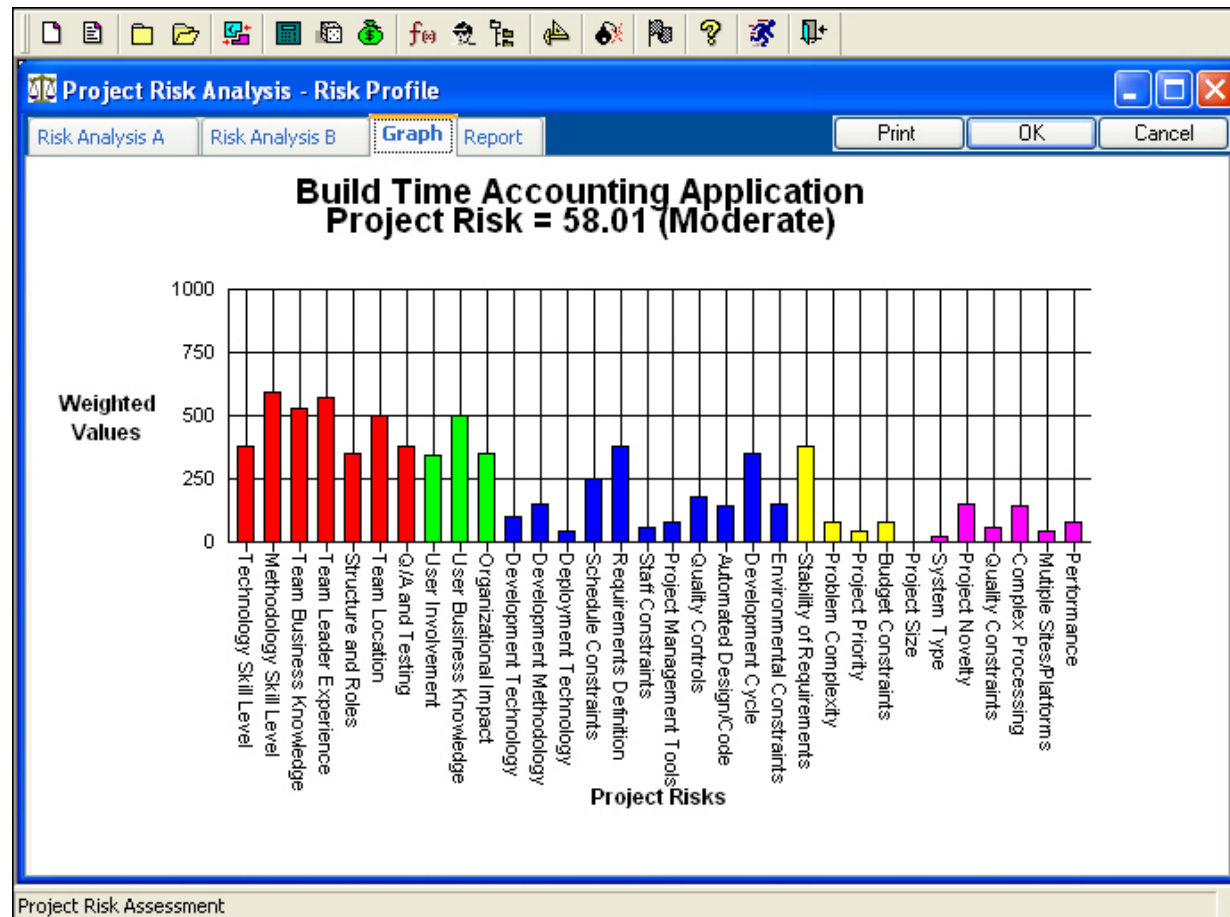
5 - Most development team members have basic knowledge with prior experience in the development technology being utilized in this project. Minimal guidance is required.

10 - The development technology being utilized in this project is new to all team members. The project team has no prior experience or skills with the development technology.

Project...Build Time Accounting Application (UFP=87.00,ROM=102.60) Application...Time Accounting

Estimating tools based on company productivity data or benchmark data adjusted by unique project characteristics

Estimating Tools



Project Attribute (Risk) Score adjusts effort prediction

Summary

Many factors need to be considered to truly understand and utilize productivity data

- Expect productivity rates to vary significantly and follow a non-normal distribution
- Use the variations and knowledge of software development to help identify the appropriate segmentation of measurement data and identify improvements
- Get the most benefit from your measurement data by fully utilizing the results
 - Increase productivity and quality
 - Measure improvements over time
 - Manage internal and external performance
 - Improve estimating and project management