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Using Benchmarks to Accelerate Process Improvement

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Goals of the Presentation

1. Establish a brief framework for benchmarking: definition, benefits, approach
2. Using a real life story, explore some of the motivation for benchmarking
3. Present several examples of why cost and schedule data, without some notion of product quality can be misleading
4. Provide compelling evidence for the need for meaningful size attributes
5. Provide insights regarding the need for benchmark data to support process improvement
6. Identify what makes measurements useful (5 Cs)

Abstract

Using Benchmarks to Accelerate Process Improvement

Organizations are constantly pressured to prove their value to their leadership and customers. A relative comparison to "peer groups" is often seen as useful and objective, thus benchmarking becomes an apparent alternative. Unfortunately, organizations new to benchmarking may have limited internal data for making valid comparisons. Feedback and subsequent "action" can quickly lead to the wrong results as organizations focus on improving their comparisons instead of improving their capability and consistency.

Adding to the challenge of improving results, software organizations may rely on more readily available schedule and financial data rather than indicators of product quality and process consistency. This presentation provides measurement program lessons learned and insights to accelerate benchmark and quantification activities relevant to both new and mature measurement programs.

Benchmarking Defined

Benchmarking is the process of comparing one's business processes and performance metrics to industry bests or best practices from other industries. Dimensions typically measured are quality, time and cost. In the process of best practice benchmarking, management identifies the best firms in their industry, or in another industry where similar processes exist, and compares the results and processes of those studied (the "targets") to one's own results and processes. In this way, they learn how well the targets perform and, more importantly, the business processes that explain why these firms are successful.

Benchmarking is used to measure performance using a specific indicator (cost per unit of measure, productivity per unit of measure, cycle time of x per unit of measure or **defects per unit of measure**) resulting in a metric of performance that is then compared to others.

Also referred to as "best practice benchmarking" or "process benchmarking", this process is used in management and particularly strategic management, in which organizations evaluate various aspects of their processes in relation to best practice companies' processes, usually within a peer group defined for the purposes of comparison. This then allows organizations to develop plans on how to make improvements or adapt specific best practices, usually with the aim of increasing some aspect of performance. Benchmarking may be a one-off event, but is often treated as a continuous process in which organizations continually seek to improve their practices.

Wikipedia: 5/31/2013

Benchmarking and Other Tools

In 2008, a comprehensive survey on benchmarking was commissioned by The Global Benchmarking Network, a network of benchmarking centers representing 22 countries. Over 450 organizations responded from over 40 countries. The results showed that organizations using 20 improvement tools:

- 77% use Mission and Vision Statements and Customer (Client) Surveys
- 72% use SWOT analysis
- 68% use Informal Benchmarking (68%)
- 49 % use Performance Benchmarking
- 39% use Best Practice Benchmarking

The tools that are likely to increase in popularity the most over the next three years are:

- Performance Benchmarking
- Informal Benchmarking
- SWOT
- Best Practice Benchmarking

Over 60% of organizations that are not currently using these tools indicated they are likely to use them in the next three years.

Wikipedia: 5/31/2013

Benchmarking Approaches

Identify problem areas: Because benchmarking can be applied to any business process or function, a range of research techniques may be required. They include informal conversations with customers, employees, or suppliers; exploratory research techniques such as focus groups; or in-depth marketing research, quantitative research, surveys, questionnaires, re-engineering analysis, process mapping, quality control variance reports, financial ratio analysis, or simply reviewing cycle times or other performance indicators. Before embarking on comparison with other organizations it is essential to know the organization's function and processes; base lining performance provides a point against which improvement effort can be measured.

Identify other industries that have similar processes: For instance, if one were interested in improving hand-offs in addiction treatment one would identify other fields that also have hand-off challenges. These could include air traffic control, cell phone switching between towers, transfer of patients from surgery to recovery rooms.

Identify organizations that are leaders in these areas: Look for the very best in any industry and in any country. Consult customers, suppliers, financial analysts, trade associations, and magazines to determine which companies are worthy of study.

Survey companies for measures and practices: Companies target specific business processes using detailed surveys of measures and practices used to identify business process alternatives and leading companies. Surveys are typically masked to protect confidential data by neutral associations and consultants.
Visit the "best practice" companies to identify leading edge practices: Companies typically agree to mutually exchange information beneficial to all parties in a benchmarking group and share the results within the group.

Implement new and improved business practices: Take the leading edge practices and develop implementation plans which include identification of specific opportunities, funding the project and selling the ideas to the organization for the purpose of gaining demonstrated value from the process.

Wikipedia: 5/31/2013

Selected Benchmarking Types 1 0f 2

Process benchmarking - the initiating firm focuses its observation and investigation of business processes with a goal of identifying and observing the best practices from one or more benchmark firms. Activity analysis will be required where the objective is to benchmark cost and efficiency; increasingly applied to back-office processes where outsourcing may be a consideration.

Financial benchmarking - performing a financial analysis and comparing the results in an effort to assess your overall competitiveness and productivity.

Performance benchmarking - allows the initiator firm to assess their competitive position by comparing products and services with those of target firms.

Product benchmarking - the process of designing new products or upgrades to current ones. This process can sometimes involve reverse engineering which is taking apart competitors products to find strengths and weaknesses.

Wikipedia: 5/31/2013

Benchmarking Types 2 0f 2

Strategic benchmarking - involves observing how others compete. This type is usually not industry specific, meaning it is best to look at other industries.

Functional benchmarking - a company will focus its benchmarking on a single function to improve the operation of that particular function. Complex functions such as Human Resources, Finance and Accounting and Information and Communication Technology are unlikely to be directly comparable in cost and efficiency terms and may need to be disaggregated into processes to make valid comparison.

Best-in-class benchmarking - involves studying the leading competitor or the company that best carries out a specific function.

Operational benchmarking - embraces everything from staffing and productivity to office flow and analysis of procedures performed.

Wikipedia 5/31/2013

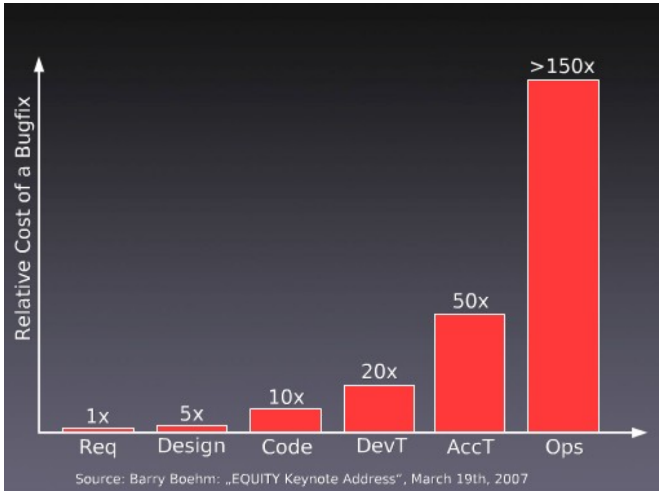
Benchmarking Comments

- **Organizations are reluctant to publicly share their data; therefore, purchase data from ISBSG** Deeper Reading: *Effective Applications Development and Maintenance;* The IFPUG Guide to IT and Software Measurement; Pam Morris; 2012
- **It is much more difficult to obtain correct and reliable information with regard to external organizations. Benchmark defect turnaround times, defect age.** Deeper Reading: *Benchmarking Techniques and Their Applications in IT;* The IFPUG Guide to IT and Software Measurement; Nishant Pandey; 2012
- **Improvement Needs Measurement : Measurement Needs Improvement**, **me 6-13-2013**

If Published Data is True . . .

Barry Boehm – requirements defects that made their way into the field could cost 50-200 times as much to correct as defects that were corrected close to the point of creation.

Boehm, Barry W. and Philip N. Papaccio. "Understanding and Controlling Software Costs," *IEEE Transactions on Software Engineering,* v. 14, no. 10, October 1988, pp. 1462-1477.



Source: Barry Boehm: „EQUITY Keynote Address", March 19th, 2007

An example: These four Projects (A, B, C, D) produced the same product using the same technology, but different verification processes

Project	Cost	Person Months	Reviews	Variation
Project A	$250K	10	Often and disciplined (rigorous, CRM, . . .)	
Project B	$500K	20	Often but not disciplined	100 %
Project C	$1,000K	40	Not often and not disciplined	400 %
Project D	$50,000K	2000	Worst case per Boehm (100x)	2000 %

If Published Data is True . . .

Capers Jones – reworking defective requirements, design, and code typically consumes 40 to 50 percent or more of the total cost of most software projects and is the single largest cost driver.

Jones, Capers. *Estimating Software Costs*, New York: McGraw-Hill, 1998.

An example: These two Projects produced the same product using the same technology, but used different requirements elicitation techniques

Project	Cost	Person Months	Requirements	Variation
Project A	$250K	10	Captured and understood early	
Project B	$500K	20	Requirements volatility at high-end (50%)	100 %

If Research is True . . .

Capers Jones – as a rule of thumb, every hour you spend on technical reviews upstream will reduce your total defect repair time from three to ten hours.

Jones, Capers. *Assessment and Control of Software Risks*. Englewood Cliffs, N.J.: Yourdon Press, 1994.

An example: These three Projects produced the same product using the same technology, but one used technical reviews, the others did not

Project	Cost	Person Months	Reviews	Variation
Project A	$25K	1	Spent 1 person month in reviews	
Project B	$75K	3	Did not conduct reviews (3 months of repair time)	300 %
Project C	$250K	10	Worst case with data	1000 %

If Research is True . . .

Don O'Neill – calculated the ROI for software inspections between four and eight to one.

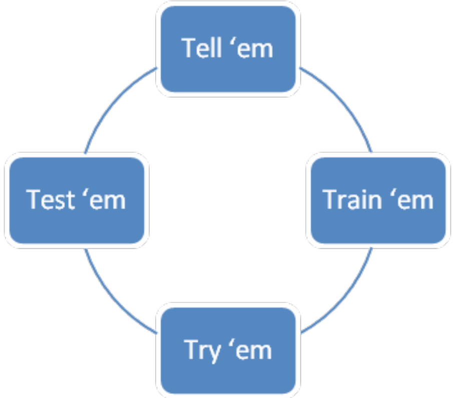
O'Neill, Don; *National Software Quality Experiment: Results 1992 – 1999*: Software Technology Conference, Salt Lake City, 1995, 1996, 2000

An example: These three Projects produced the same product using the same technology, but one used inspections, the others did not

Project	Cost	Person Months	Inspections	Variation
Project A	$25K	1	Spent 1 person month in reviews	
Project B	$100K	4	Did not conduct (4 months repair time)	400 %
Project C	$200K	8	Worst case with data (8 months repair)	800 %

Summary of Defect-Related Data

“You don’t know the status of your project (D, I)until you know the fidelity of your process (K, W).”



Assertion – *In the absence of defect data*:

- Productivity metrics are misleading
- Quality metrics are inadequate
- Value is impossible to ascertain

Opportunity – *Reduce development and support costs*

- Industry data has demonstrated a ROI for peer reviews of 2:1 to 3:1
- 30 – 60 percent of all development work is rework from changing or misunderstood requirements
- Instead of removing defects early in product development, organizations often rely on more testing to improve the quality of their products. It’s the other 50 percent of defects from requirements and design that aren’t found by testing, and which are the most expensive to resolve.

Fidelity – *Quantifying how often we do what we say . . .*

- We have a policy for product development, how often do we follow it?
- We have a process for product development, how often do we use it?
- We have criteria for tailoring our work, how often do we apply it?
- During a crisis, do we rely on process or abandon it?
- Is it useful or possible to benchmark with other organizations

if we characterize our own capability?

“7” Types of Waste – Toyota

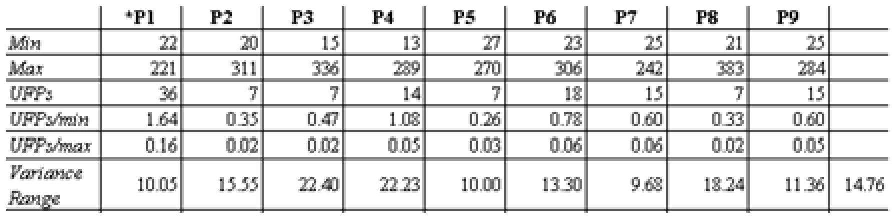
1.Overproduction
2.Inventory
3.Wait Time
4.Transportation
5.Processing
6.Motion
7.Defects
8.Underutilized People

Ref: *Fidelity & Defect Metrics;* Information Technology Measurement and Governance – International Strategies; Ottawa, Canada, May 1, 2013; Joe Schofield

Inappropriate size measures will distort your data: lines of code, story points, page size

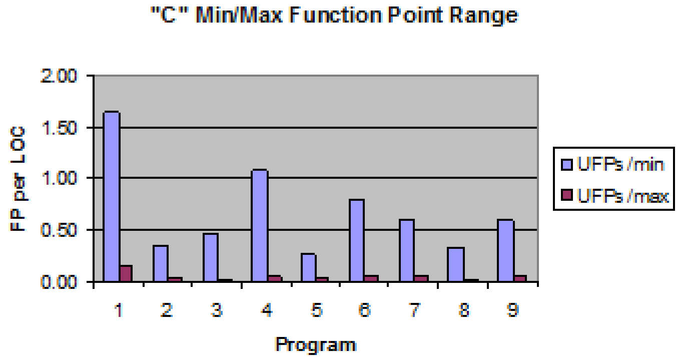
Min and max values for "C" code

compared to Function Point size over 9 programs (n = 49)



	*P1	P2	P3	P4	P5	P6	P7	P8	P9	
Min	22	20	15	13	27	23	25	21	25	
Max	221	311	336	289	270	306	242	383	284	
UFPs	36	7	7	14	7	18	15	7	15	
UFPs/min	1.64	0.35	0.47	1.08	0.26	0.78	0.60	0.33	0.60	
UFPs/max	0.16	0.02	0.02	0.05	0.03	0.06	0.06	0.02	0.05	
Variance Range	10.05	15.55	22.40	22.23	10.00	13.30	9.68	18.24	11.36	14.76

Largest min to max variance is > 22, smallest is almost 10, average is almost 15.



Deeper Reading: *The Statistically Unreliable Nature of Lines of Code*; CrossTalk; April, 2005 - NIST Citation

Inappropriate size measures will distort your data: lines of code, story points, page size

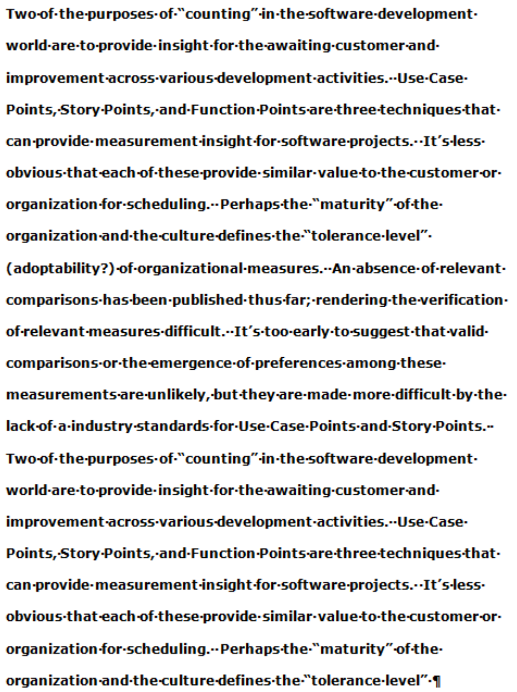
Characteristic	Function Points	Use Case Points	Story Points
Useful at the project level for estimating or planning	With historical FP data	With historical UCP data	With historical SP data
ISO / Standards based	ISO 20926	no	no
Captures customer view	Expected	Expected	Definitely
Useful for benchmarking outside the company	Could be	Could be	Less so
Easy to calculate	Less so	More so	Yes
Easy to validate for repeatability / consistency	More so	More so	Less so
Objectivity	More so	More so	Less so (team / team member variability)
Technologically independent	Yes	Yes	Maybe
Functional measurement to customer	Yes	Yes	Not exclusively (may include refactoring, design, and other work)

Deeper Reading *Function Points, Use Case Points, Story Points: Observations from a Case Study*; CrossTalk; May / June, 2013

Inappropriate size measures will distort your data: lines of code, story points, page size

	Margins	Font	Font Size	Spacing	Bolding	Char. Per page	% Content Loss
Initial settings	.3 top & bottom; . 4 sides	Times New Roman	10	Single	none	7584	0
	1”					5450	28
		Verdana				5686	25
			12			5177	32
				Double		4353	43
					ON	7185	5
Initial settings	1”	Verdana	12	Double	ON	1403	83

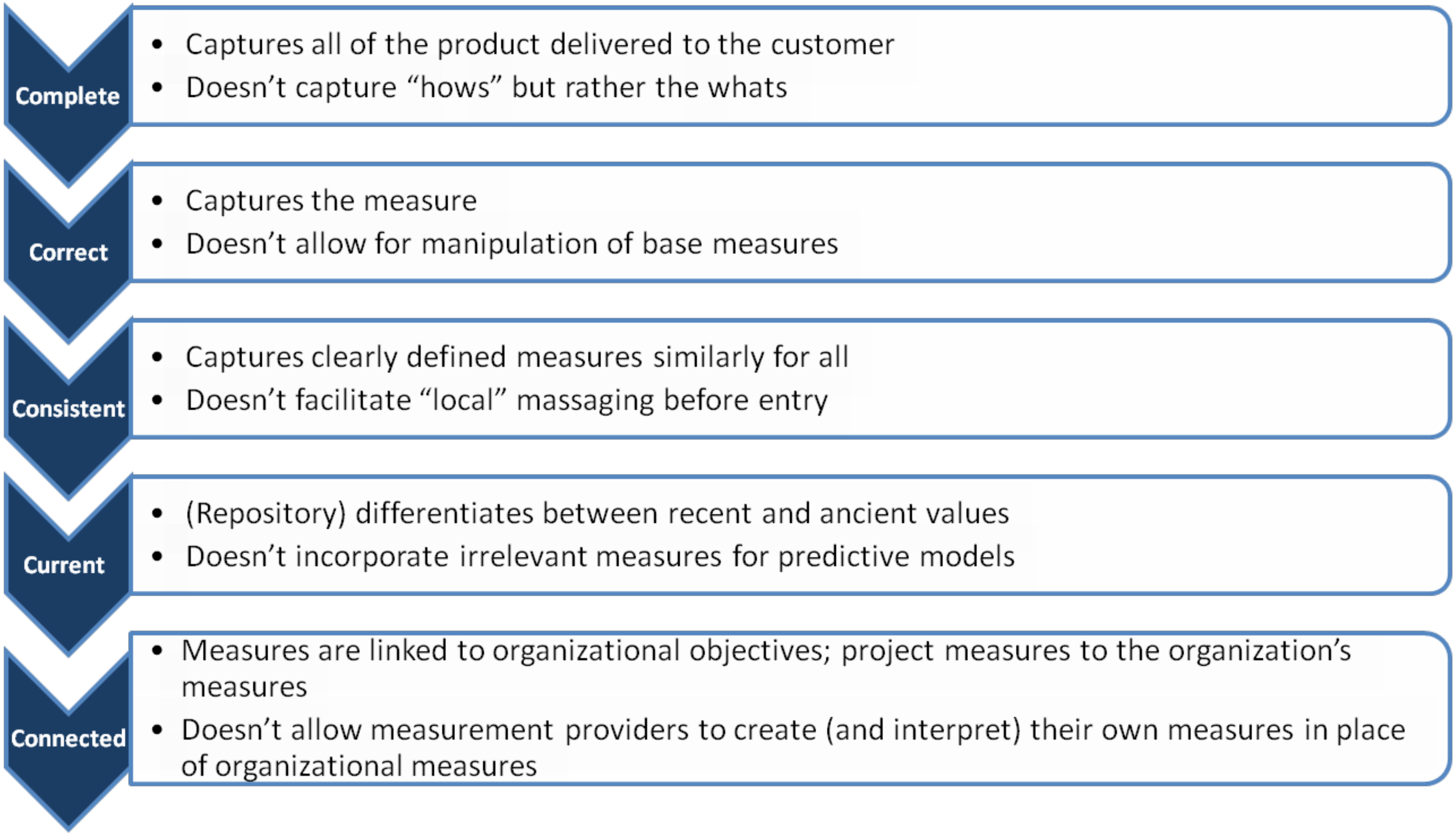
- Read “% Content Loss” (last column) as *variation*!
- Cumulative difference of one page to almost six
- Consider still larger font, font size, spacing, charts, diagrams, pictures, etc.
- **Impact on PMC SP1.1** – Monitor actual values of project planning parameters against the project plan.



Two of the purposes of “counting” in the software development world are to provide insight for the awaiting customer and improvement across various development activities. Use Case Points, Story Points, and Function Points are three techniques that can provide measurement insight for software projects. It’s less obvious that each of these provide similar value to the customer or organization for scheduling. Perhaps the “maturity” of the organization and the culture defines the “tolerance level” (adoptability?) of organizational measures. An absence of relevant comparisons has been published thus far; rendering the verification of relevant measures difficult. It’s too early to suggest that valid comparisons or the emergence of preferences among these measurements are unlikely, but they are made more difficult by the lack of a industry standards for Use Case Points and Story Points. Two of the purposes of “counting” in the software development world are to provide insight for the awaiting customer and improvement across various development activities. Use Case Points, Story Points, and Function Points are three techniques that can provide measurement insight for software projects. It’s less obvious that each of these provide similar value to the customer or organization for scheduling. Perhaps the “maturity” of the organization and the culture defines the “tolerance level” ¶

Deeper Reading *Size - The Forgotten Measure;* SEPG North America; Albuquerque, N. M.; March 15, 2012

5 C's of Sizing Measures



Complete

- Captures all of the product delivered to the customer
- Doesn't capture "hows" but rather the whats

Correct

- Captures the measure
- Doesn't allow for manipulation of base measures

Consistent

- Captures clearly defined measures similarly for all
- Doesn't facilitate "local" massaging before entry

Current

- (Repository) differentiates between recent and ancient values
- Doesn't incorporate irrelevant measures for predictive models

Connected

- Measures are linked to organizational objectives; project measures to the organization's measures
- Doesn't allow measurement providers to create (and interpret) their own measures in place of organizational measures

Deeper Reading: : *Size - The Forgotten Measure;* SEPG North America; Albuquerque, N. M.; March 15, 2012

Takeaways

- You won’t understand your benchmark data until you understand your process fidelity
- Inappropriate size measures will distort your data: story points, lines of code, page size
- The absence of quality-related data will distort your benchmark results
- Allowing teams to retain their own measures and report them as needed to a measurement group will add a layer of inconsistency to your data
- Benchmark to improve, not to impress

Questions

Further Readings

Joe Schofield is the President of the International Function Point Users Group. He retired from Sandia National Laboratories as a Distinguished Member of the Technical Staff after a 31-year career. During twelve of those years he served as the SEPG Chair for an organization of about 400 personnel which was awarded a SW-CMM® Level 3 in 2005. He continued as the migration lead to CMMI® Level 4 until his departure.

Joe has facilitated over 100 teams in the areas of software specification, team building and organizational planning by using lean six sigma and business process reengineering. Joe has taught graduate courses since 1990. He was a licensed girl’s mid-school basketball coach for 21 seasons--the last five undefeated, over a span of 50 games.

http://joejr.com/presentd.htm (~55)

http://joejr.com/publishd.htm (~36)

He has over 80 published books, papers, conference presentations and keynotes—including contributions to the books *The IFPUG Guide to IT and Software Measurement (2012), IT Measurement, Certified Function Point Specialist Exam Guide, and The Economics of Software Quality.* He is a CMMI Institute-certified Instructor for the Introduction to the CMMI® and two other CMMI Institute courses, Certified Software Quality Analyst, Certified Function Point Specialist, and a Certified Software Measurement Specialist.

Joe is a frequent presenter in the Software Best Practices Webinar Series sponsored by Computer Aid, Inc. Joe completed his Master’s degree in MIS at the University of Arizona in 1980. By "others" he is known as a husband, father, and grandfather.