



Measurement and Analysis in High Maturity Organizations: What's the Difference?

Dennis R. Goldenson
Software Engineering Institute

12th Annual PSM Users' Group Conference
Mystic, Connecticut
July 2008

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Today's Talk


 **Background: The SEI Annual Survey Series**

Purpose & scope of the 2007 survey

Results

- The respondents & their organizations
- Measurement resources & infrastructure
- Value added by measurement
- Software measures used
- Data quality & integrity
- Organizational perspectives on software measurement

Summary, lessons learned & next steps

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Understanding the State of Measurement Practice

Careful & well executed use of measurement & analysis

- Is a well accepted tenet in many fields of endeavor
- Including of course CMMI

Basic aims

- To inform management & technical decisions based on empirical evidence
- & to judge the results of those decisions once made

But, how well, and how frequently, are measurement practices put into effect in our own field?



Surveys & Benchmarking

Benchmarking: The current state

- Some professional & consulting organizations maintain repositories they use for establishing benchmarks & facilitating benchmarking activities
- However, their measures & measurement definitions differ in many ways
- In that sense, one cannot yet speak confidently about "industry standards"

The state of the practice surveys

- Aim to provide data that's not yet widely available
 - Updates of trends in typical use of measurement in software & systems engineering
 - To help projects & organizations judge their progress relative to others
- But there *also* will be a continuing need to track qualitative as well as quantitative descriptions about the quality & frequency use of measurement in our field



The SEI Series

First one completed in 2006

2007 survey discussed in depth here

The 2008 survey:

- Discussed briefly earlier this week
 - In the panel on Advanced Measurement Analysis Techniques
 - Fuller, more detailed description of the study design & initial results forthcoming
 - Come to Denver in November for the CMMI Technology Conference
- Parallel samples
 - A short set of questions for tracking the diffusion of measurement over time through the broader software & systems engineering community
 - With a focus on issues faced with respect to the adoption & use of high maturity measurement & analysis practices
 - Done in concert with new series of SEI sponsored workshops on high maturity measurement and analysis



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2nd Annual SEI Measurement Practice Survey

New in 2007

- Screening question to identify respondents whose organizations develop software but rarely if ever do measurement
- Questions about
 - Resources & infrastructure devoted to measurement
 - Practices to ensure data quality & integrity
 - Value added by doing measurement
 - The kinds of measures used by the responding organizations

Among other things, these questions allow us to make some useful comparisons by CMMI maturity level



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Trends over Time

Similar results in 2006 & 2007

- Moderately strong relationships exist when comparing the replies of respondents based on:
 - Management versus staff roles
 - Industry *versus* government organizations
 - The United States *versus* other countries
 - Organization size

But that's a topic for another time



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CMMI Measurement Capabilities & Performance Outcomes

Today's focus

- Provide evidence about the circumstances under which measurement capabilities and performance outcomes are likely to vary
- As a consequence of achieving higher levels of CMMI maturity

Most differences *are* consistent with expectations based on CMMI

- Which provides confidence in the validity of the model structure & content

However, the results also highlight areas where sometimes considerable room for improvement remains

- Even at maturity levels 4 and 5
- For example
 - A rather strong overall relationship between maturity level & use of measures about quality attributes
 - Little attention to quality attributes at the lower maturity levels
 - Yet, almost half of maturity level 4 & 5 respondents' organizations track quality attributes only occasionally at best



The Sample

Random sample of SEI customers

- 944 valid email invitations to participate

Data collected 20 February through 10 April 2007

- Two reminders

Response rate

- 41% completed all or part of the questionnaire
- N = 384
- Individual questions answered by 75-97% of respondents
 - ~29 – 39% of the sample invitees



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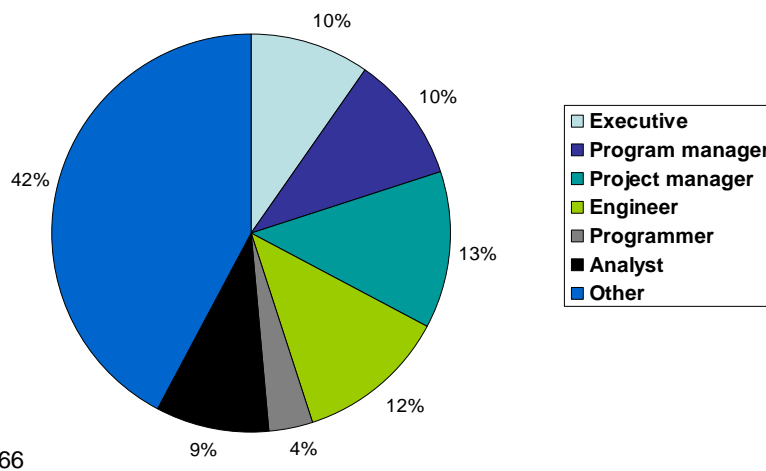
The respondents & their organizations

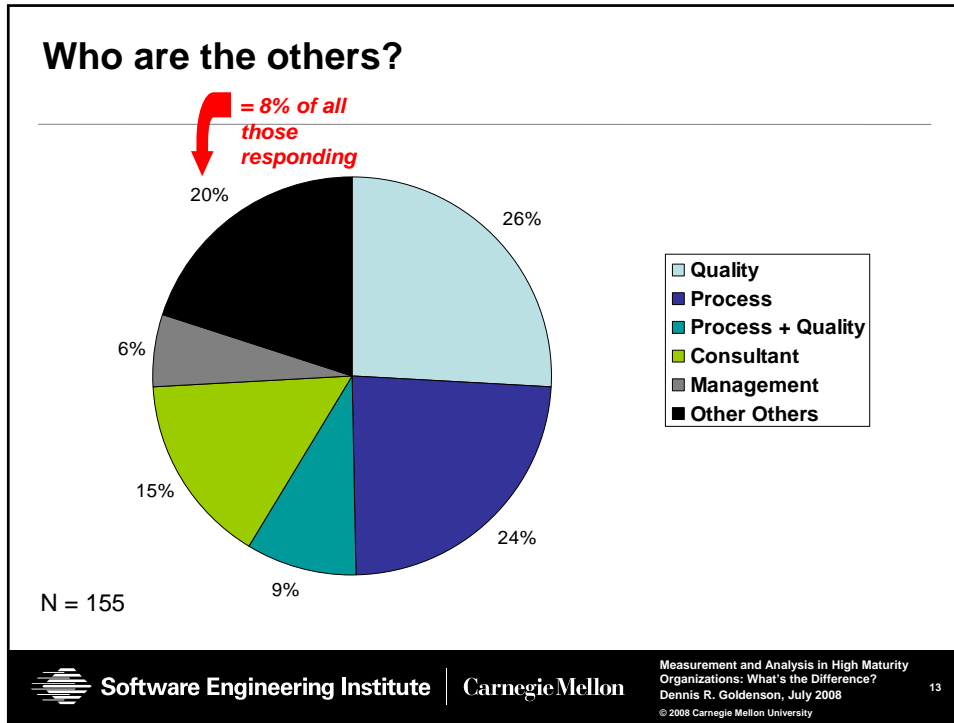
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Role in the Organization





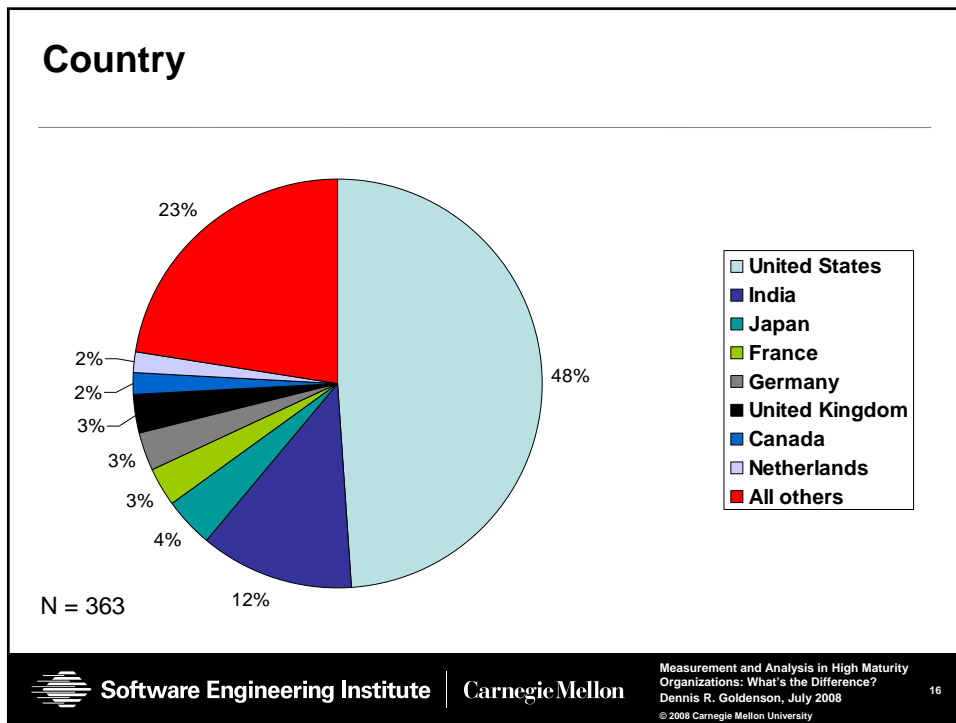
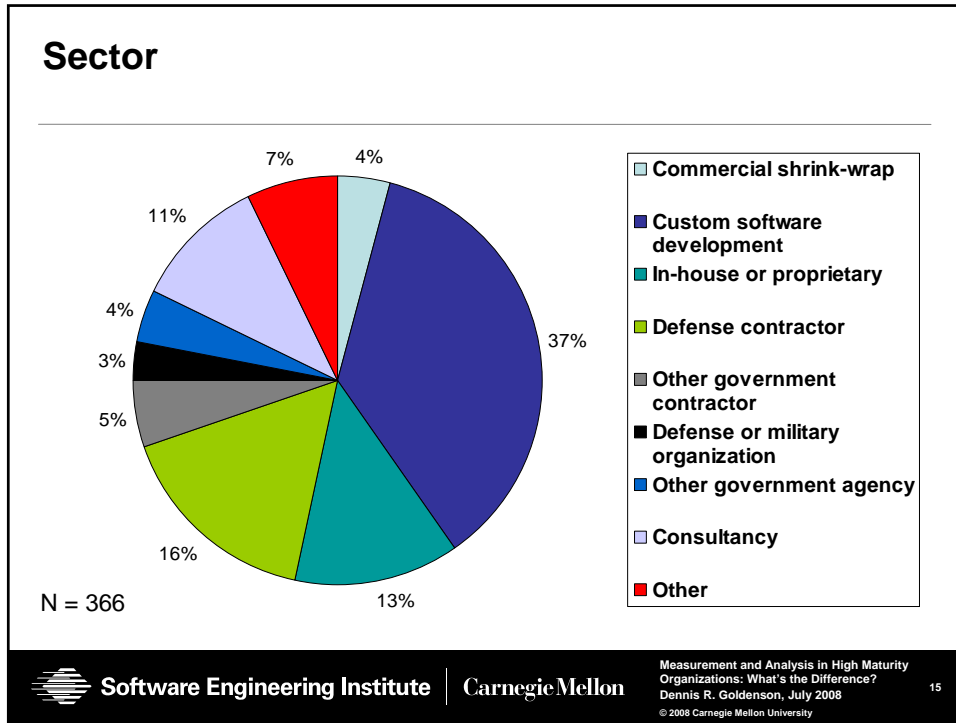
And who are the other others?

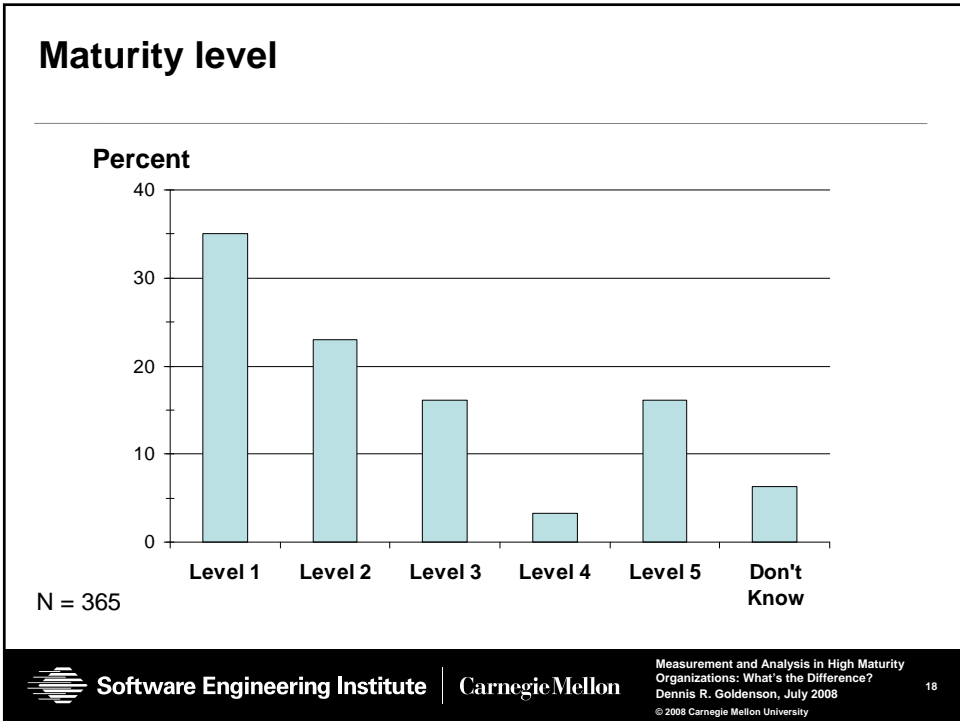
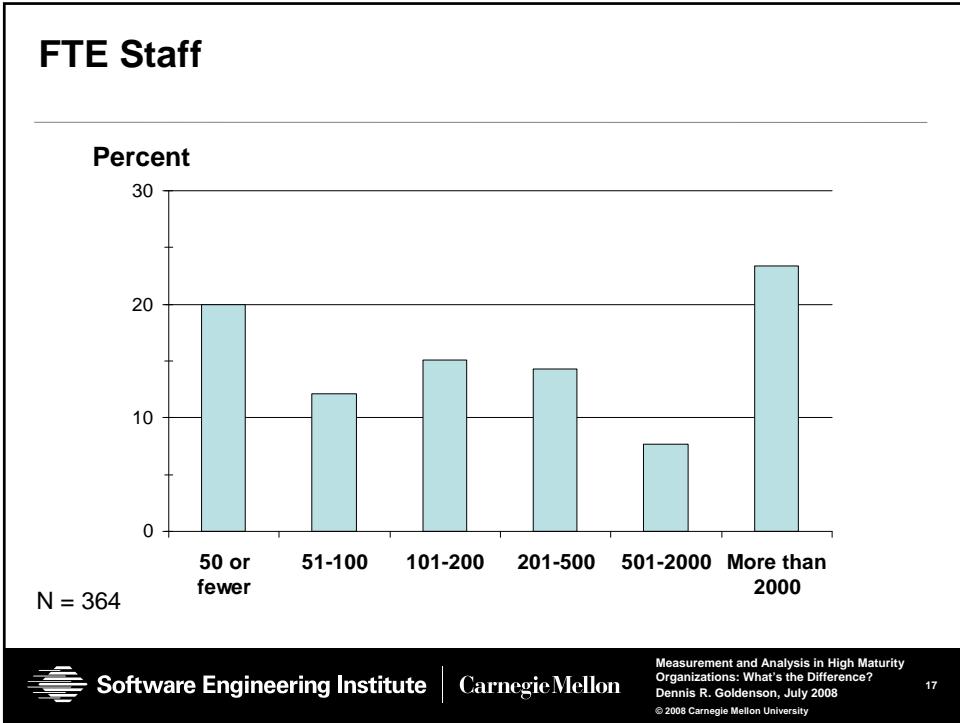
Process + Measurement	3	} 6	One each:
Measurement Specialist	1		
Process + Quality + Measurement + Training	1		
Quality + Process + Measurement	1		
Training	6		• Administrative support
Architect	4		• Coach
Security	2		• Consultant + researcher
Testing	2		• Engineering Manager + Process
			• Process + Project engineer
			• Program / team lead
			• Program manager + Quality + Process
			• Project manager + Quality
			• Project manager + Engineer
			• Not specified

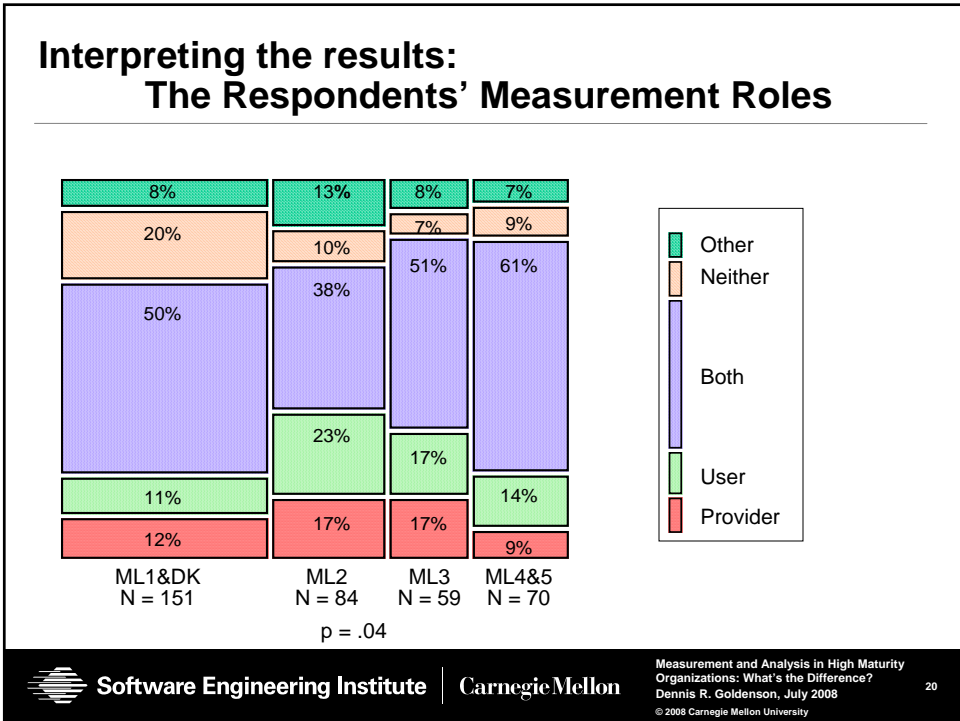
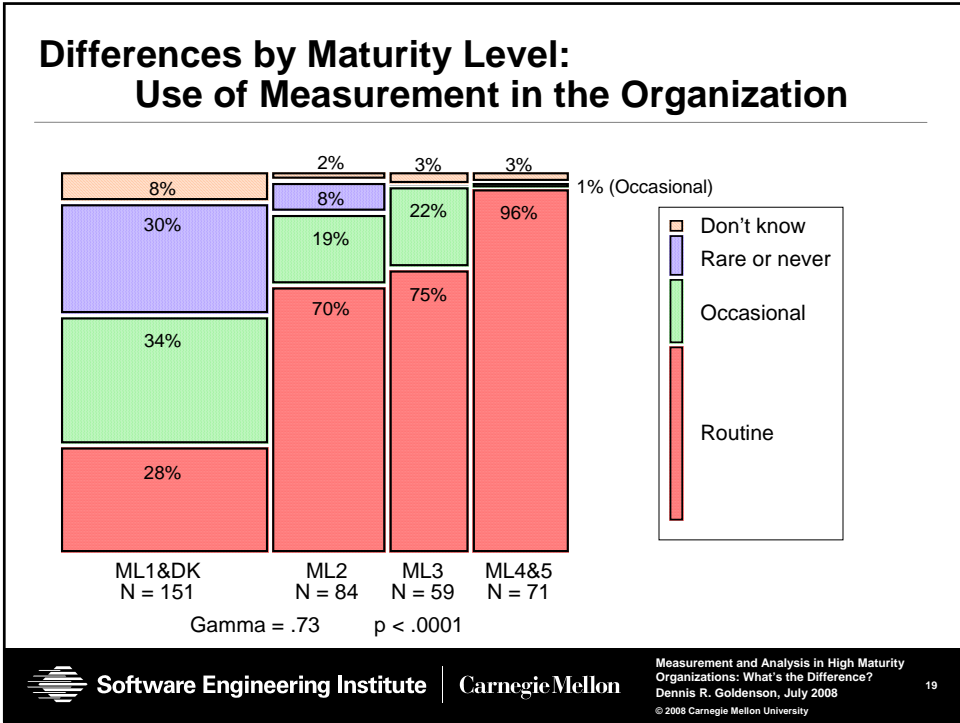
N = 31

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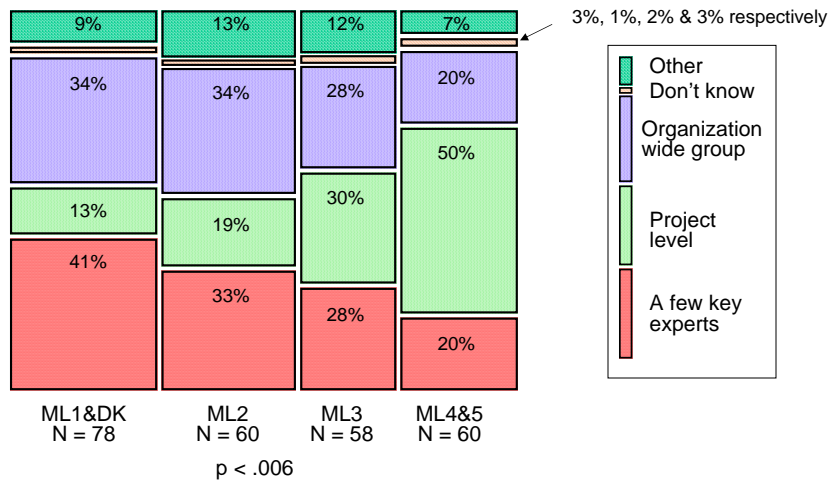


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How Measurement Work is Staffed

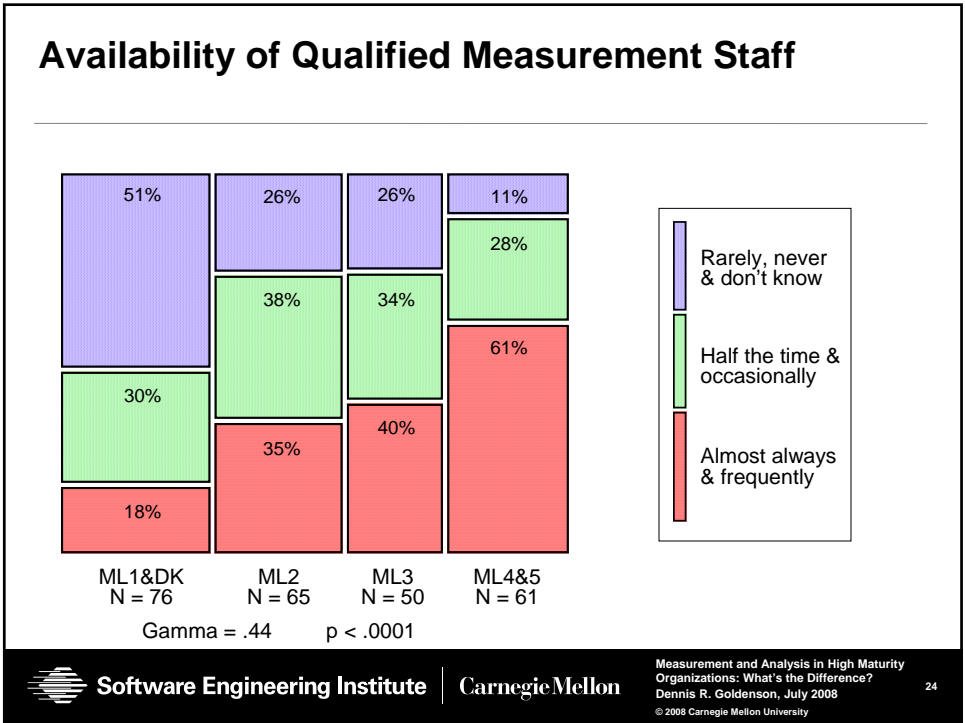
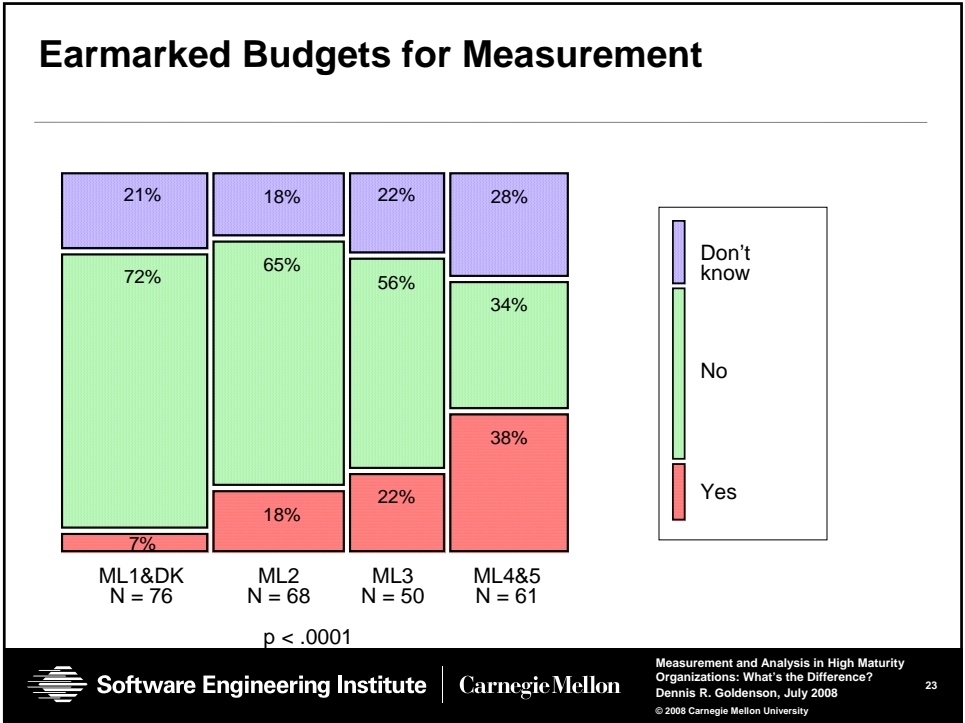


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Similar Results

For:

- Automated measurement support for data collection, data management, data analysis & reporting
- Use of commercial measurement packages & tools
- Existence of common, integrated organizational measurement repositories
- Availability of measurement related training

Proportions sometimes vary across the distributions.

But there are consistent differences by maturity level.



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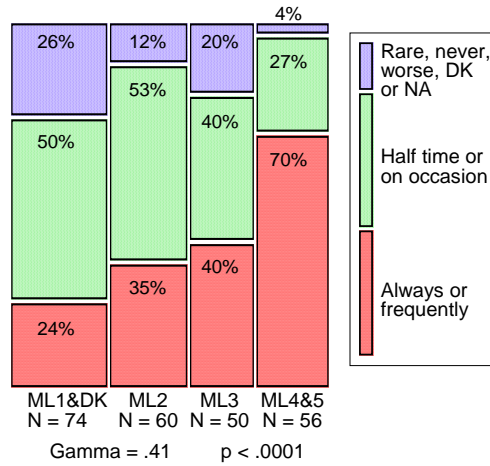
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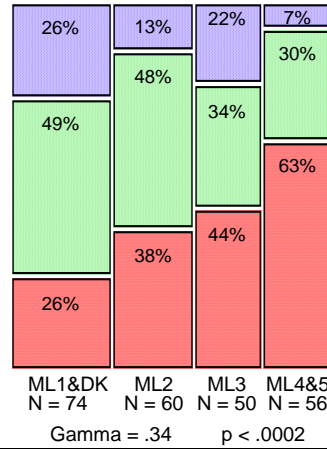


Effects of Measurement on the Organizations₁

Better Project Performance



Better Product Quality



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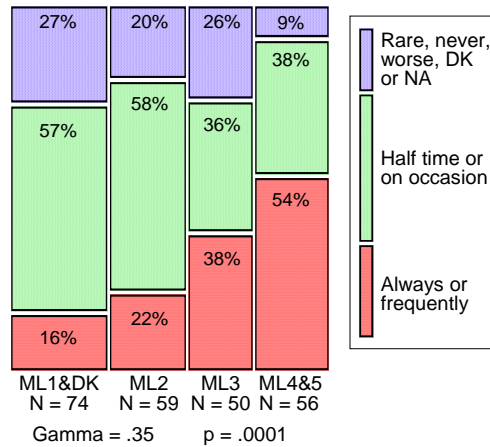
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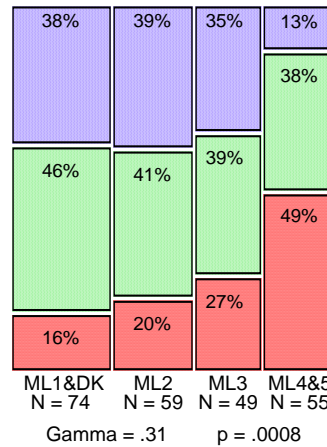
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Effects of Measurement on the Organizations₂

Better Tactical Decisions



Better Strategic Decisions



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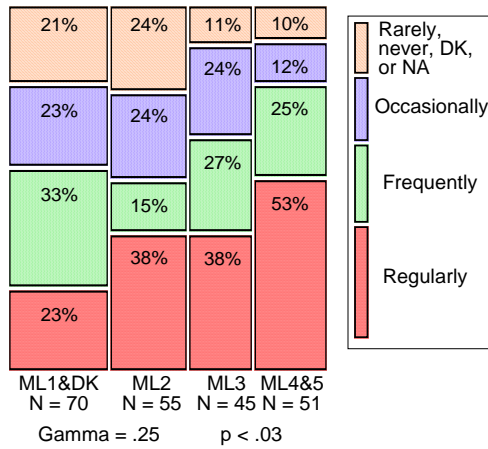


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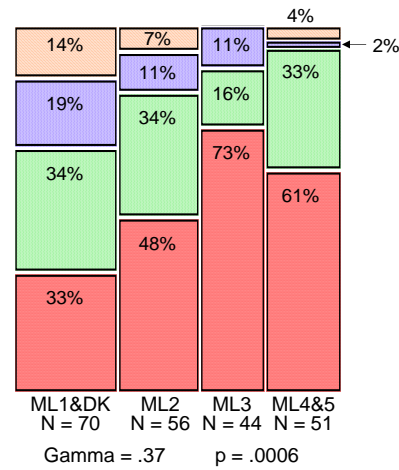
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Project & Organizational Measurement Results Reported₁

Cost Performance



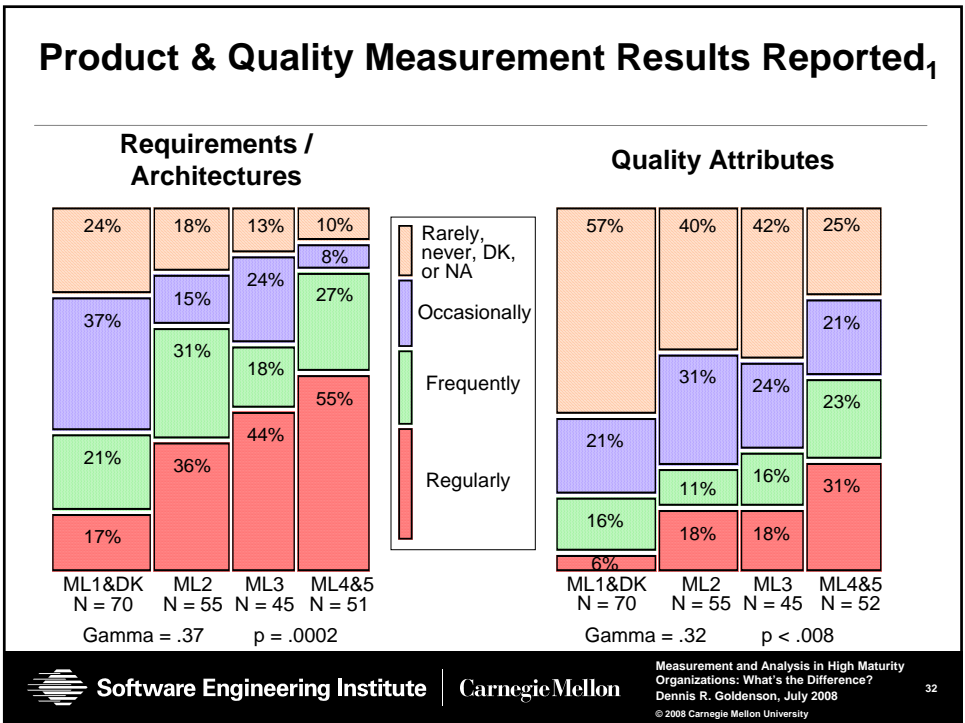
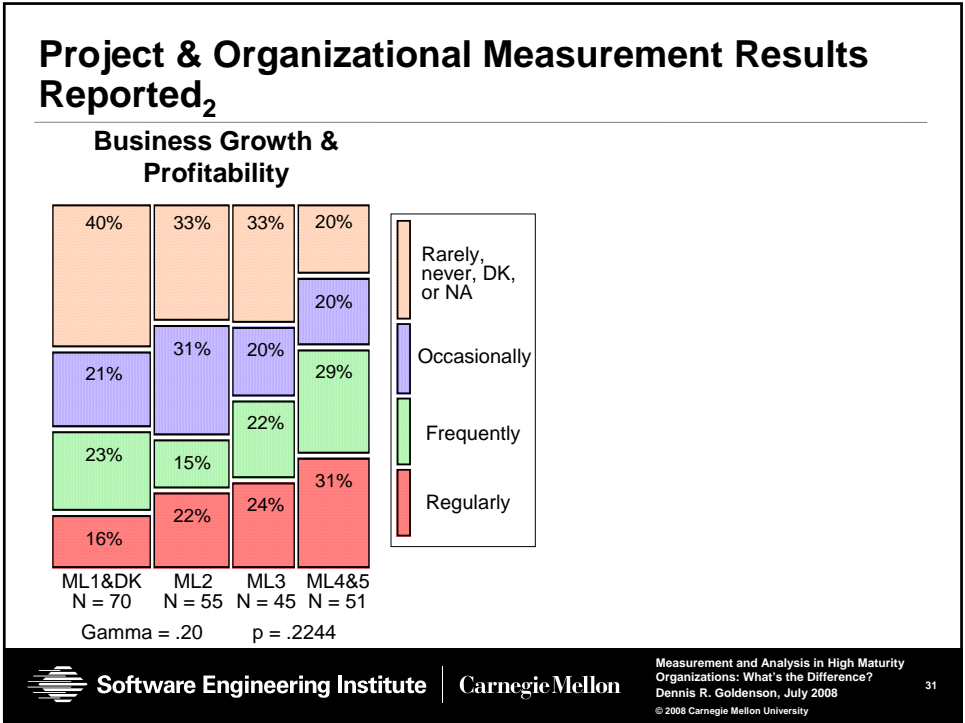
Schedule Performance



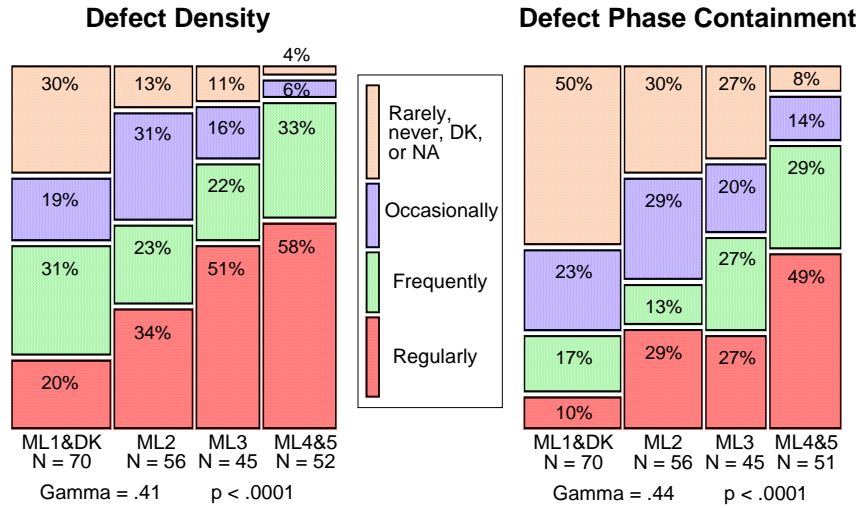
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Product & Quality Measurement Results Reported₂



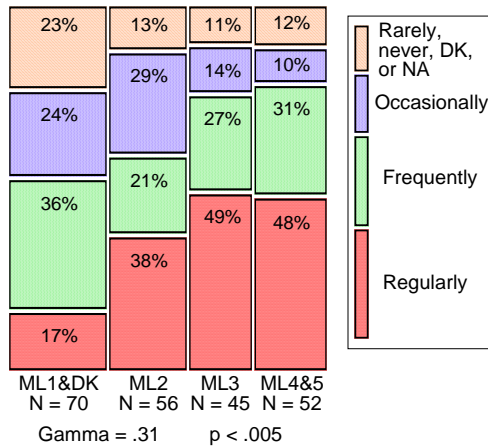
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Product & Quality Measurement Results Reported₃

Customer Satisfaction



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Similar Results

For:

- Adherence to work processes
- Effort applied to task
- Estimation accuracy
- Cycle time

Proportions sometimes vary across the distributions.

But there are consistent differences by maturity level.




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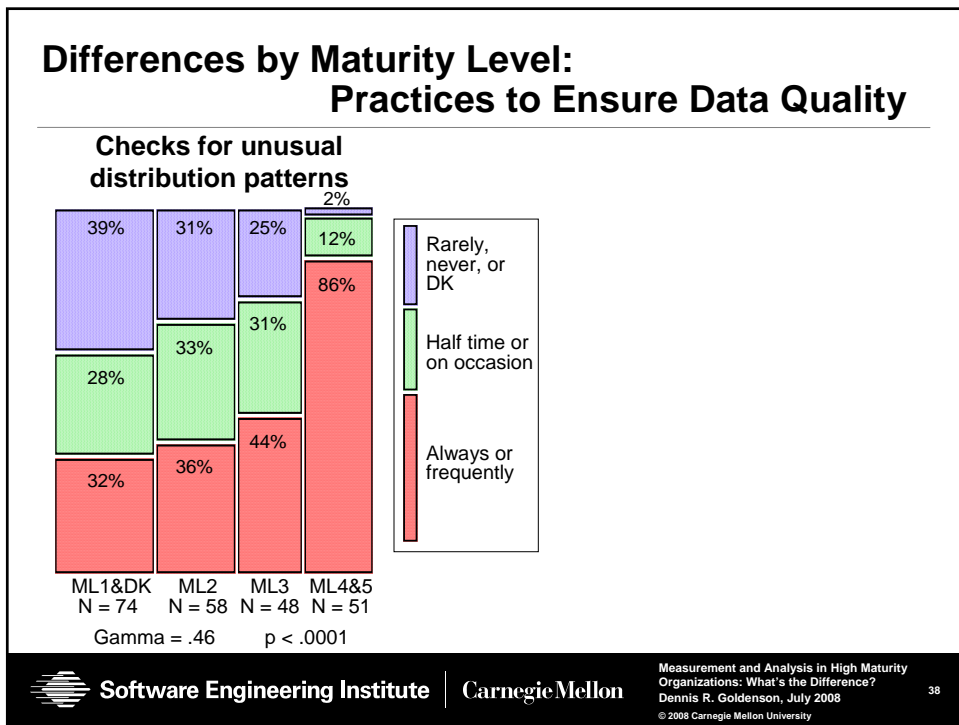
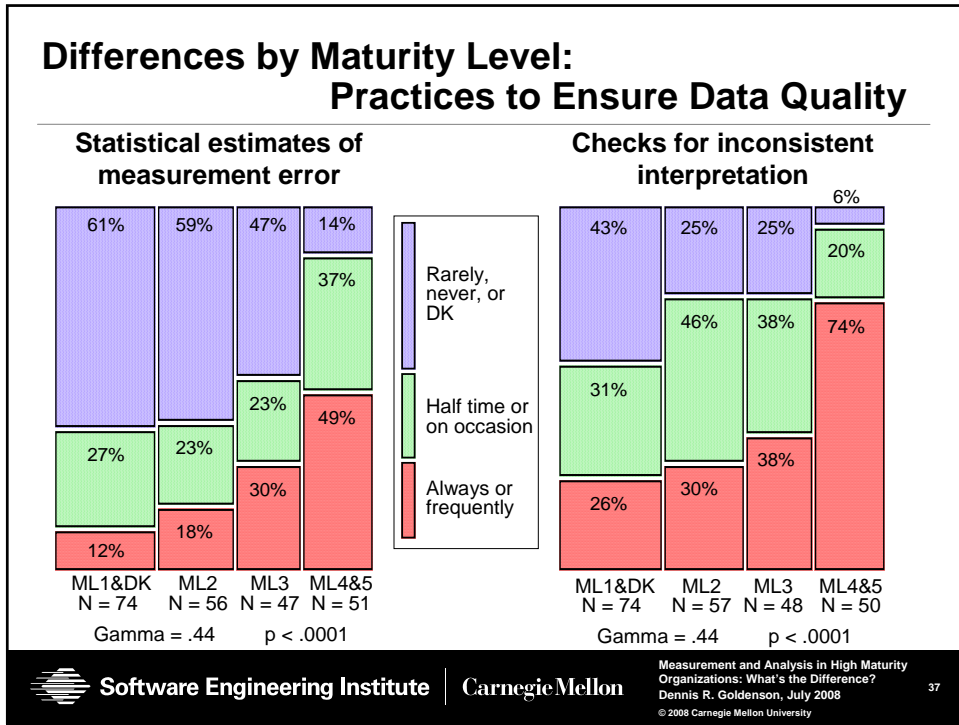
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Similar Results

For:

- Out of range & illegal values ... Number & distribution of missing data
- Missing data not treated as zero ... Precision & accuracy tests
- Other aspects of alignment & coordination of measurement activities
 - Understandable & consistent measurement definitions
 - Understandable & interpretable measurement results
 - Use of “standard” measurement methods
 - Measurable product & service criteria
 - Measurement used to understand product & service quality
 - Documented data collection process
 - Documented process for reporting results
 - Corrective action taken when thresholds exceeded
 - Understands purposes of the data collected/reported

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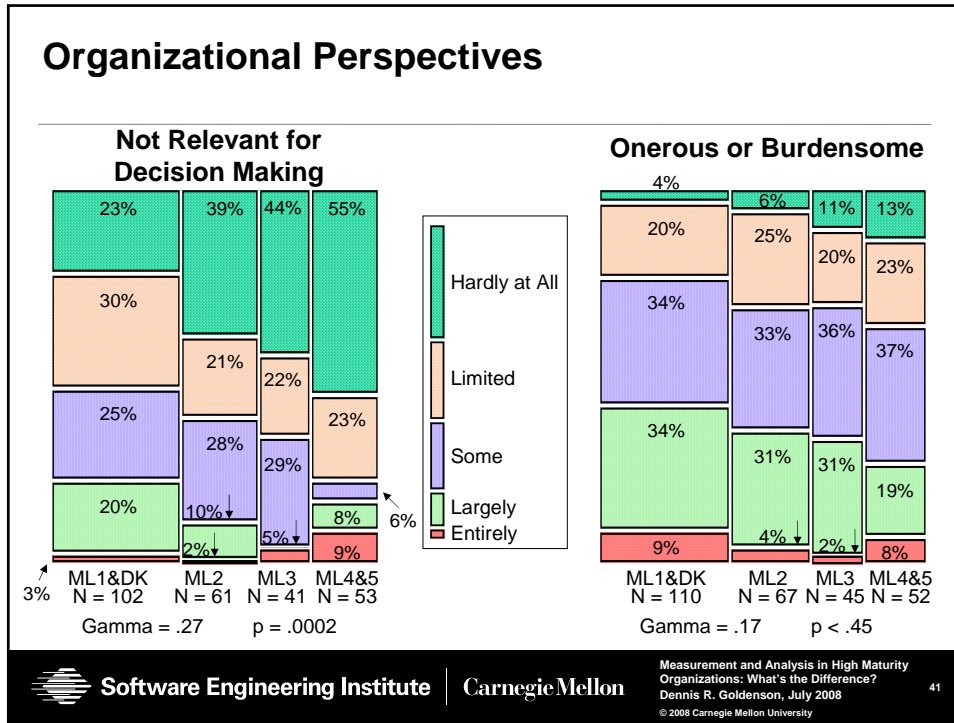
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Similar Results

For:

- Stated negatively
 - Inappropriate collection & use of data
 - Resistance to “extra” work
- Stated positively
 - Understandable & interpretable results
 - Data collected are regularly analyzed
 - Measurement an integral part of the business
 - Objective results highly valued

Once again:

- Proportions sometimes vary across the distributions.
- But there are consistent differences by maturity level.

Yet resistance to measurement still exists in our field.

- Even in high maturity organizations

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Summary of Results

Characteristic differences associated with CMMI Maturity level achieved

- Measurement capability & performance outcomes
- Common stair step pattern up the maturity levels
- Some quite substantial

Still, some of the results imply room for improvement

- Sometimes substantial room

Even in higher maturity organizations

- Although the expectations for quality & "goodness" may well be higher there too
- Jim Herbsleb & I saw a similar pattern years ago
 - For process champions *versus* practitioners & managers



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Sampling Issues

Lower than desired response rate

- Lower maturity level respondents less likely to finish the questionnaire
- Some drop off in higher maturity level respondents later in questionnaire

Not surprising in a relatively long questionnaire ... but exacerbated by:

- Spoofed email invitations & reminder message errors
- Related problems with incremental saving
 - Cookie flushing & assignment of multiple URLs by COTS web survey product
 - Leading to “lost” information
- & (possibly) lack of feedback on time/length remaining

Recurring anomalous dip at maturity level 3

- May be due to bias from relatively small number of ML3 respondents
- Or learning curve effects ... or higher expectations



Measurement Issues

There *always* is noise in survey (& other measurement) data, e.g.

- Differing interpretations of intended meaning of questions
- Use of “vague quantifiers” in closed ended response categories

“Don't know” & other off scale responses

- Most common at lower maturity levels
- But they also exist at the higher maturity levels
- Perhaps because some folks in larger organizations truly don't know

Regardless, the survey results are consistent with expectations based on CMMI

- a.k.a. predictive validity



The Future

Relatively little data yet exist for meaningful comparisons among software & systems engineering projects & organizations

- Hence tendency to cover too much at once in a single sample survey

Considering variants on matrix sampling strategies for future surveys

- Answer only a subset of questions ... to avoid over-burdening the respondents

“State of the practice” can refer to very different target populations

- The SEI customer base ... the broader software & systems engineering community ... or those organizations that more routinely use measurement?
- Of course, the answer depends on the purposes of the survey



Tracking Trends in State of the Practice Still to be resolved...

Sampling criteria for valid comparisons

- Software & systems engineering organizations in general ...
- The SEI customer base ... Routine users of measurement & analysis ...
- Projects or Organizations ... Respondent roles

Questions to be tracked

- Settling on the right starter set
- Processes for modification over time

Frequency of published updates

- Yearly ... or less frequently?
- Rolling updates online? {Based on matrix sampling variants}



Next Steps

Our plans

- We will continue to track change over time & go into further depth about focused topics from the perspective of current measurement practitioners
- Surveys on Program Office acquisition capabilities also in plan

Of course, there is no shortage of additional topics for the future

- In the SEI series or in those that we hope to see done by others



Thank You for Your Attention!

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