Understanding CMMI Measurement Capabilities & Impact on Performance: Results from the 2007 SEI State of the Measurement Practice Survey

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Today's Talk

Purpose & scope of the 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

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 speak confidently about “industry standards”
- Which is why the SEI has launched the Performance Benchmarking Consortium {as described at last year’s CMMI Technology Conference}

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 of use of measurement in our field

2nd Annual SEI Measurement Practice Survey

New this year

- 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

Trends over Time

1st survey described at last year's CMMI technology Conference

Similar results this year

- 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

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 exists 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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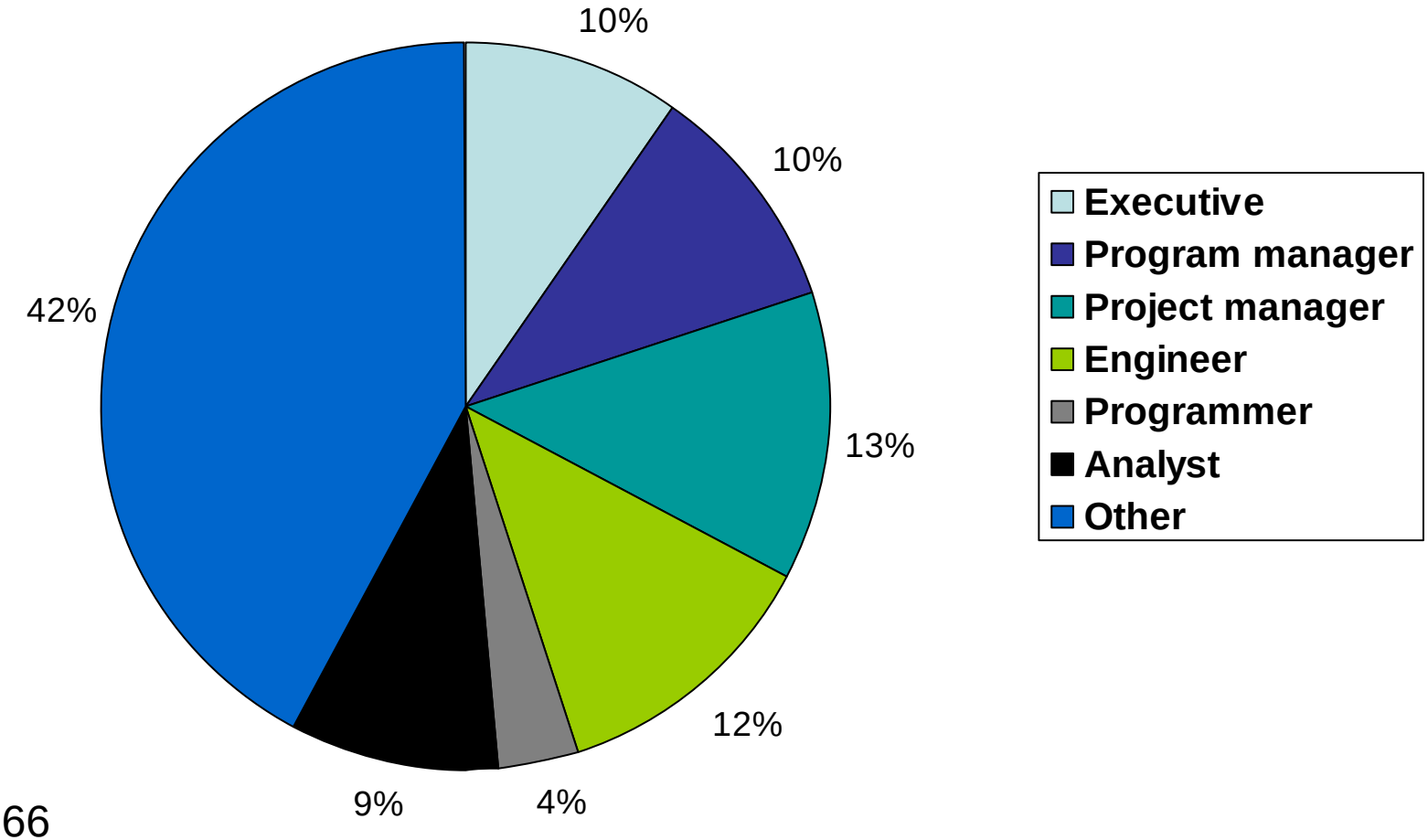
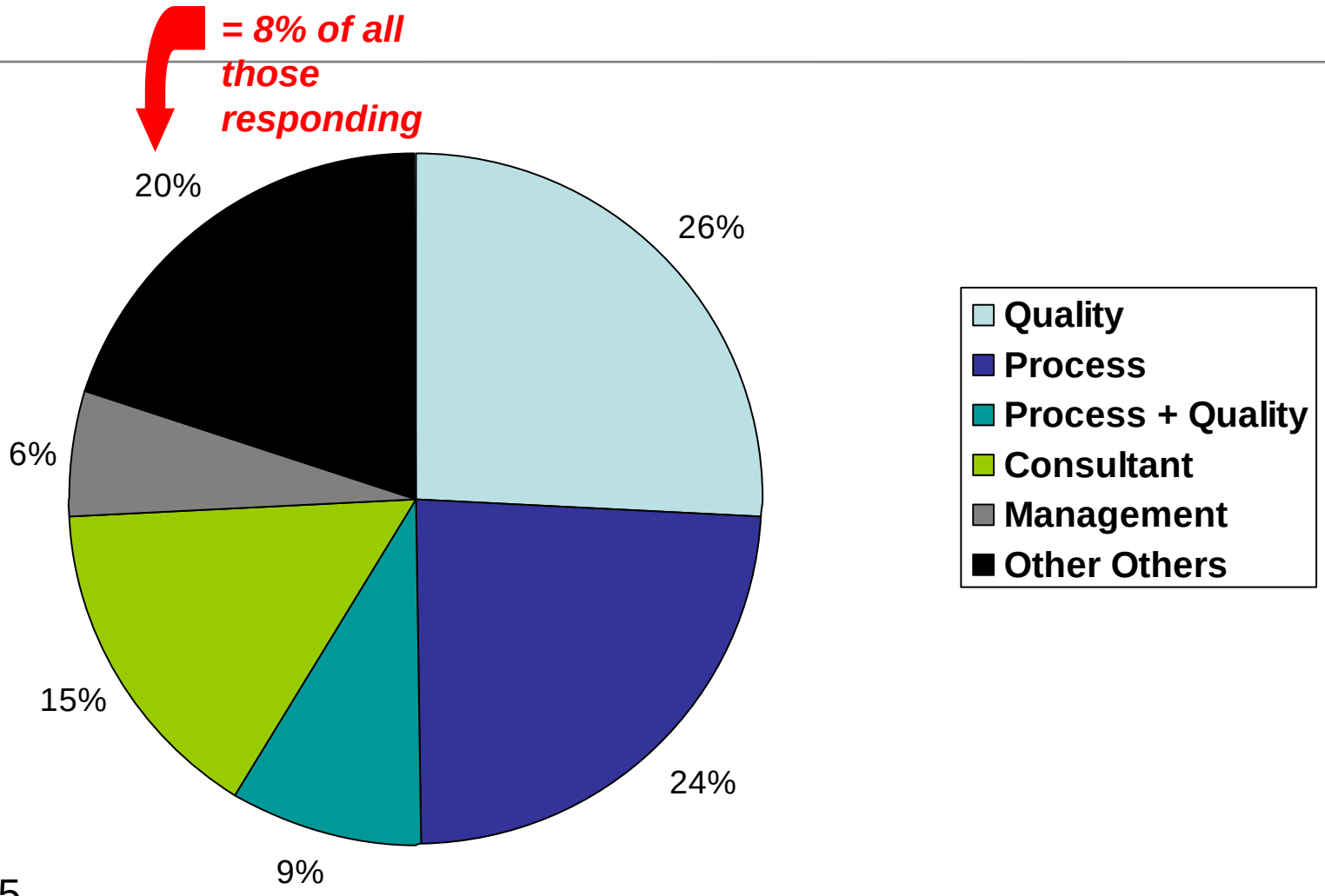
Role in the Organization



N = 366

Who are the others?



N = 155

And who are the other others?

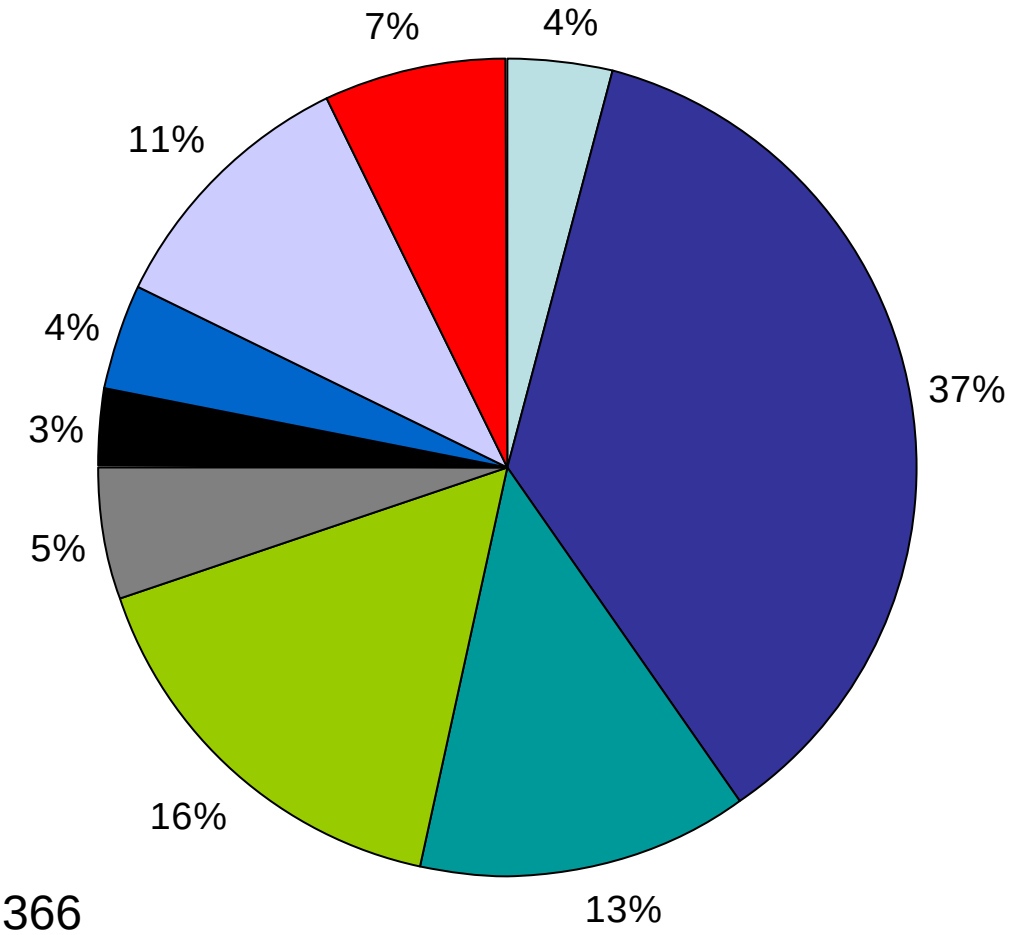
Process + Measurement	3	
Measurement Specialist	1	
Process + Quality + Measurement + Training	1	6
Quality + Process + Measurement	1	
Training	6	
Architect	4	
Security	2	
Testing	2	

N = 31

One each:

- Administrative support
- Coach
- Consultant + researcher
- Engineering Manager + Process
- Process + Project engineer
- Program / team lead
- Program manager + Quality + Process
- Project manager + Quality
- Project manager + Engineer
- Not specified

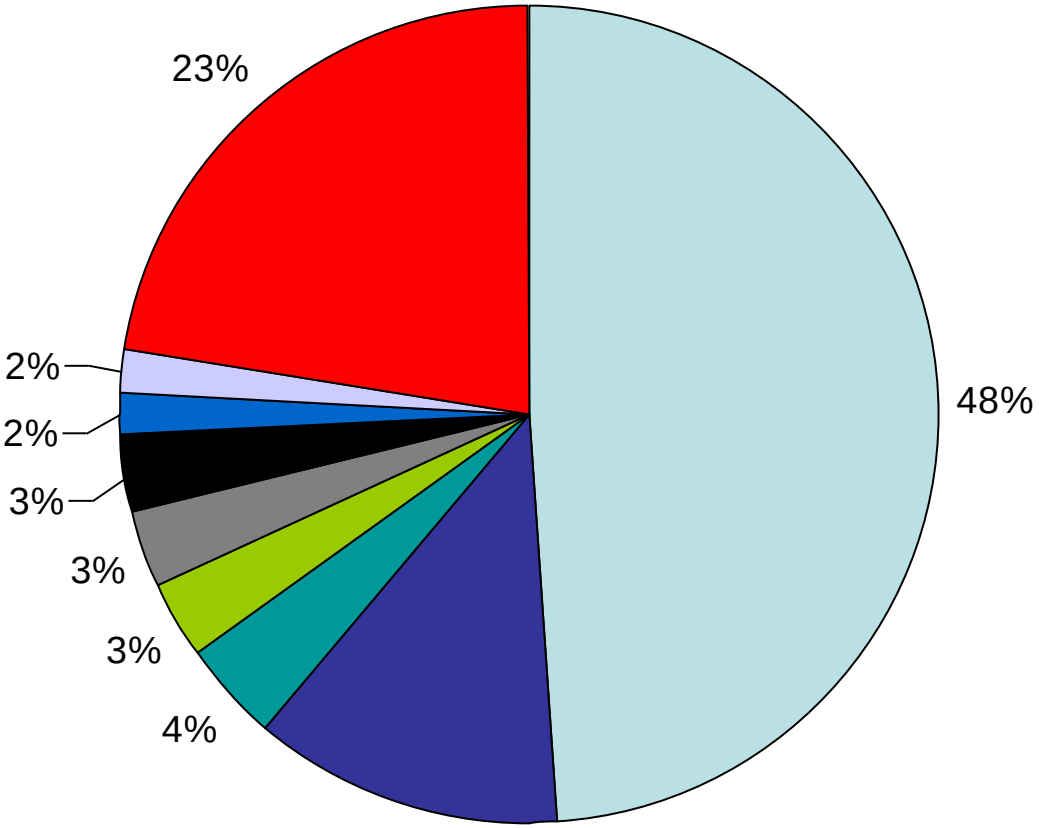
Sector



N = 366

- Commercial shrink-wrap
- Custom software development
- In-house or proprietary
- Defense contractor
- Other government contractor
- Defense or military organization
- Other government agency
- Consultancy
- Other

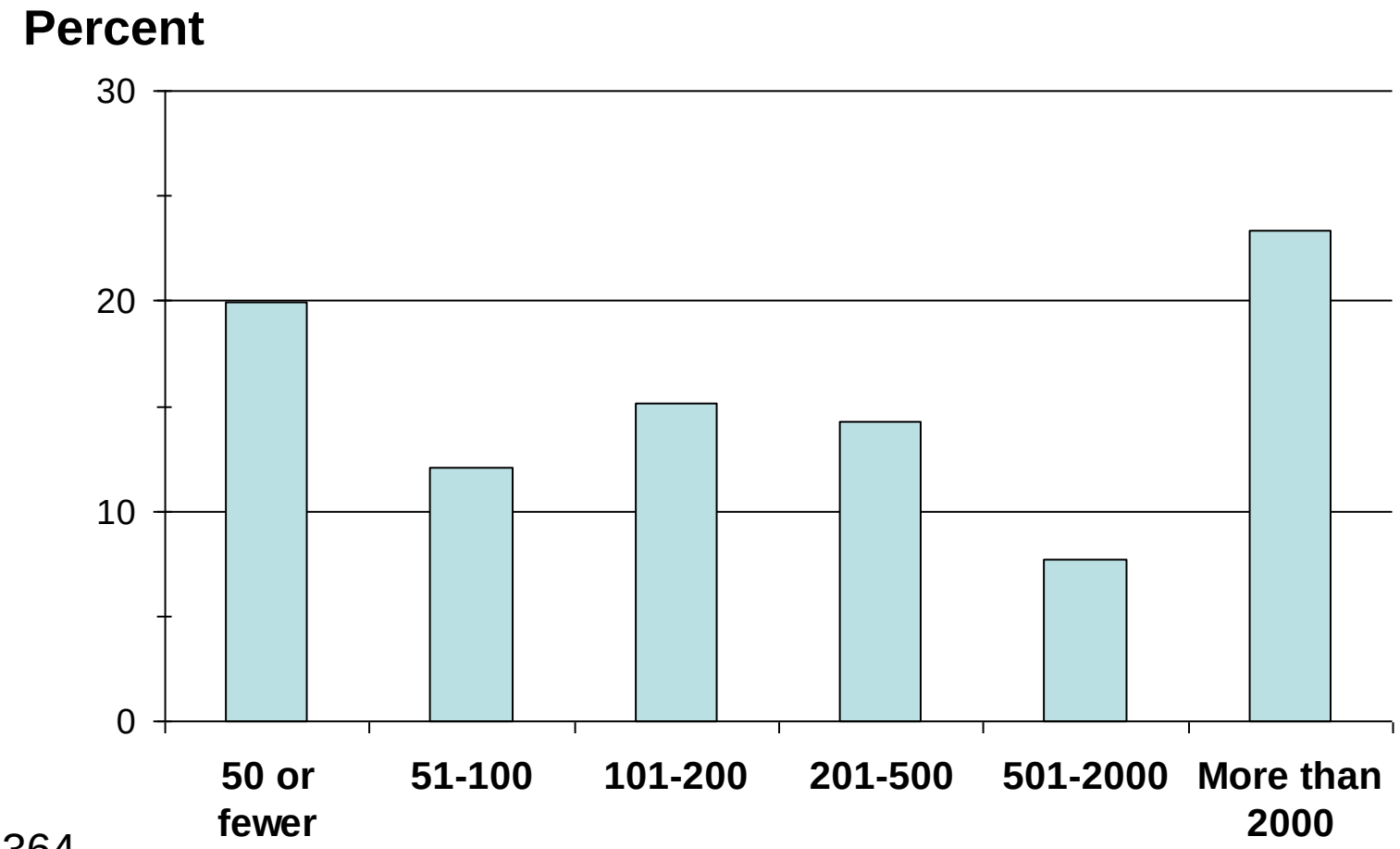
Country



N = 363

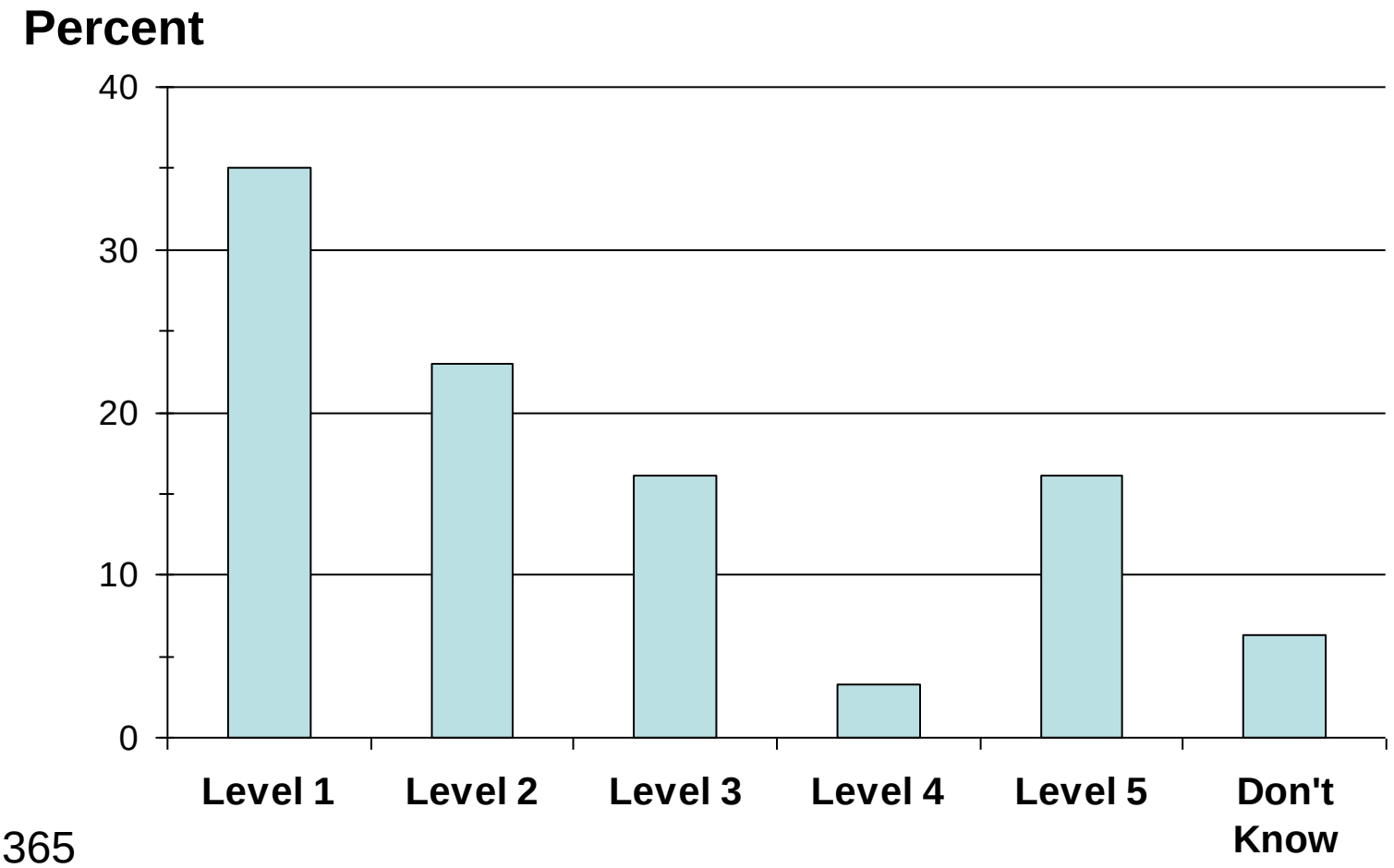
United States
India
Japan
France
Germany
United Kingdom
Canada
Netherlands
All others

FTE Staff



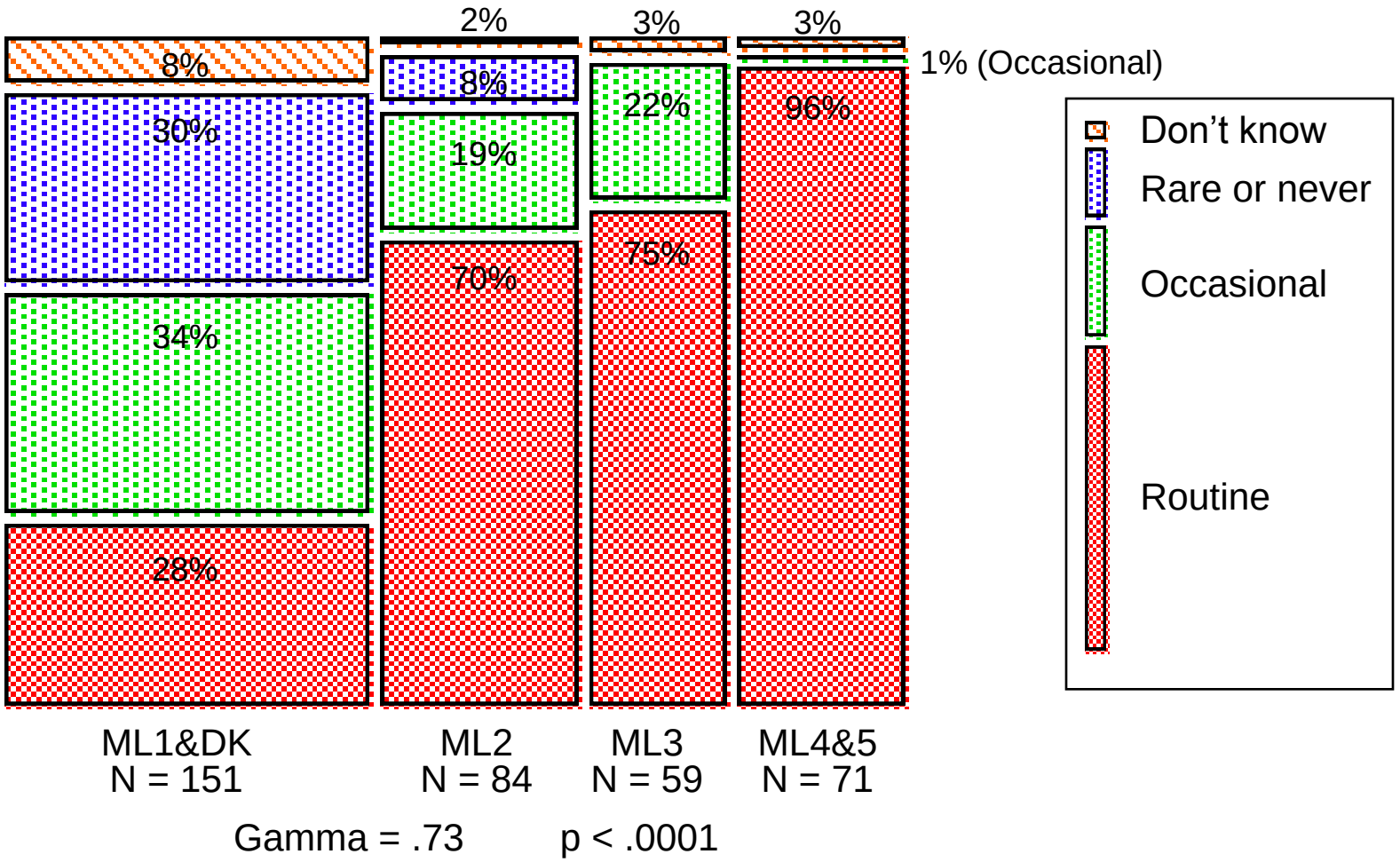
N = 364

Maturity level

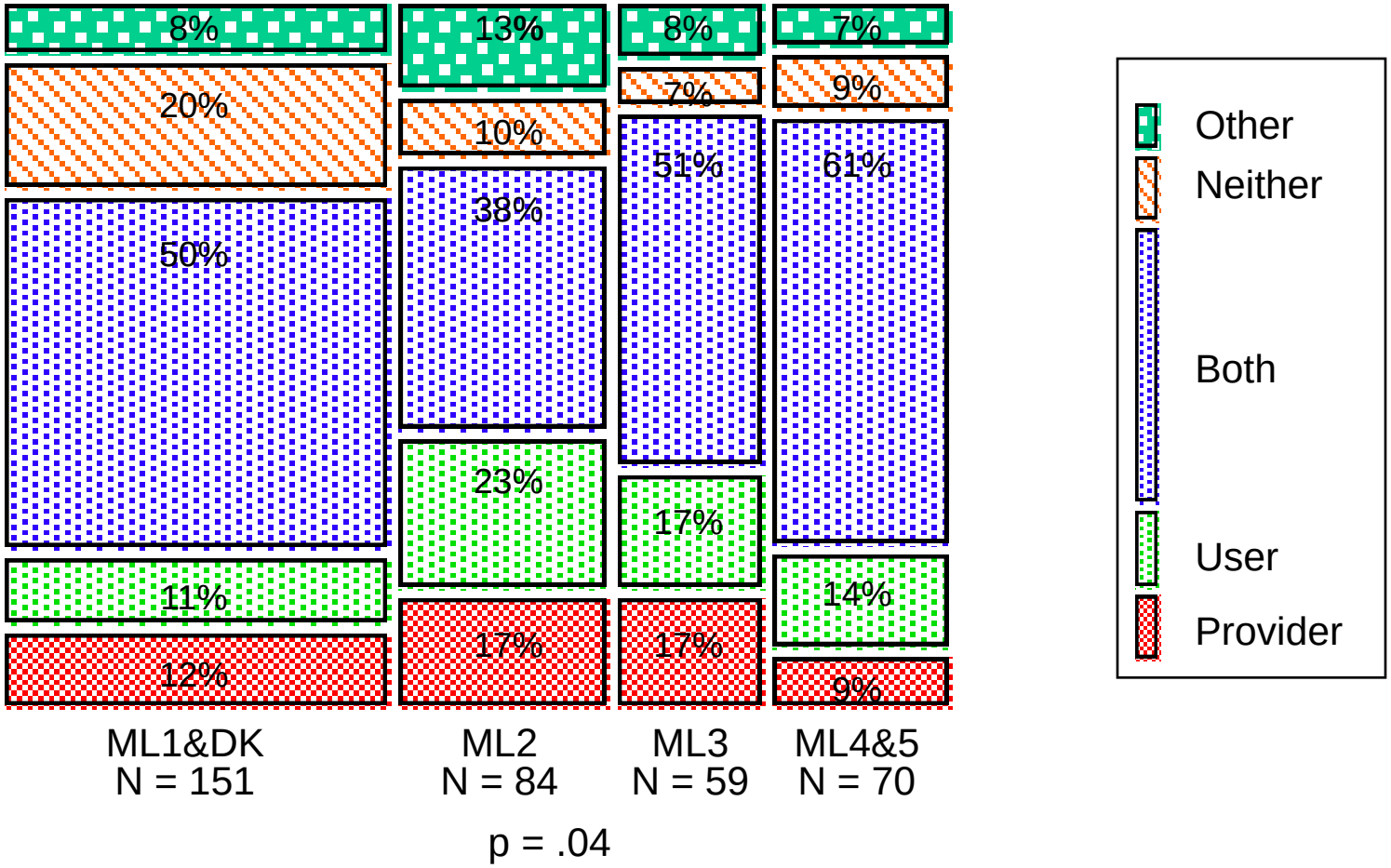


N = 365

Differences by Maturity Level: Use of Measurement in the Organization



Interpreting the results: The Respondents' Measurement Roles



Today's Talk

Purpose & scope of the survey

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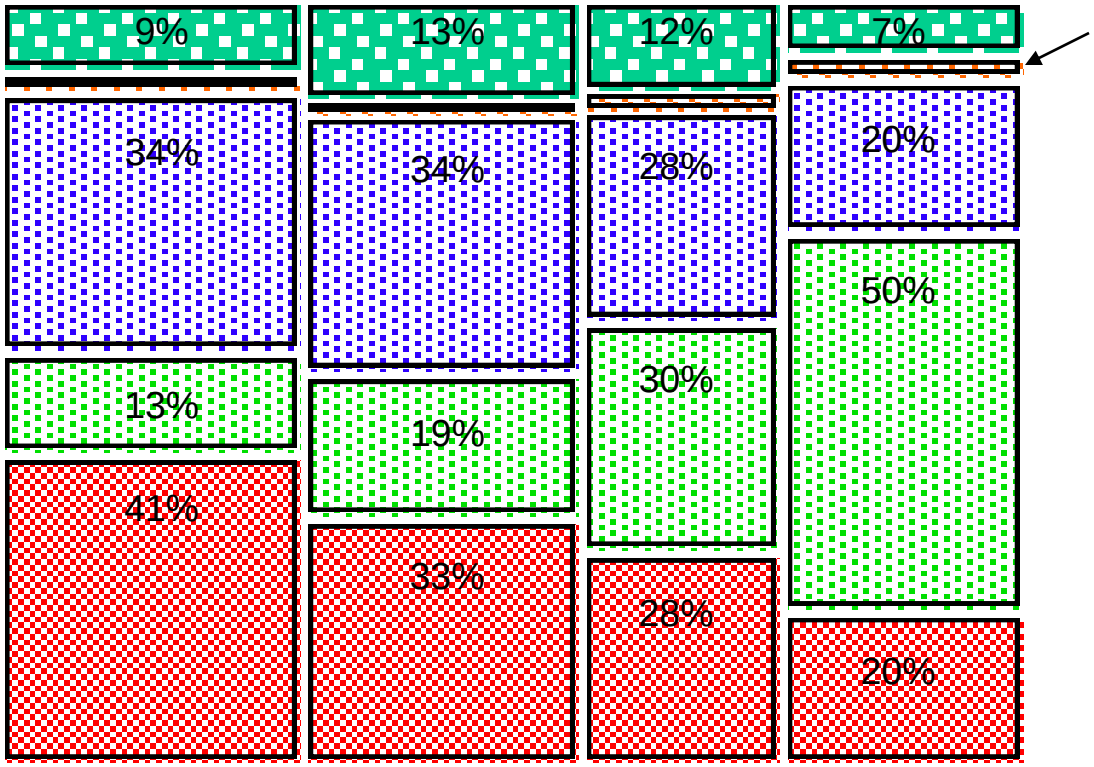
- Organizational perspectives on software measurement

Summary, lessons learned & next steps

How Measurement Work is Staffed



3%, 1%, 2% & 3% respectively

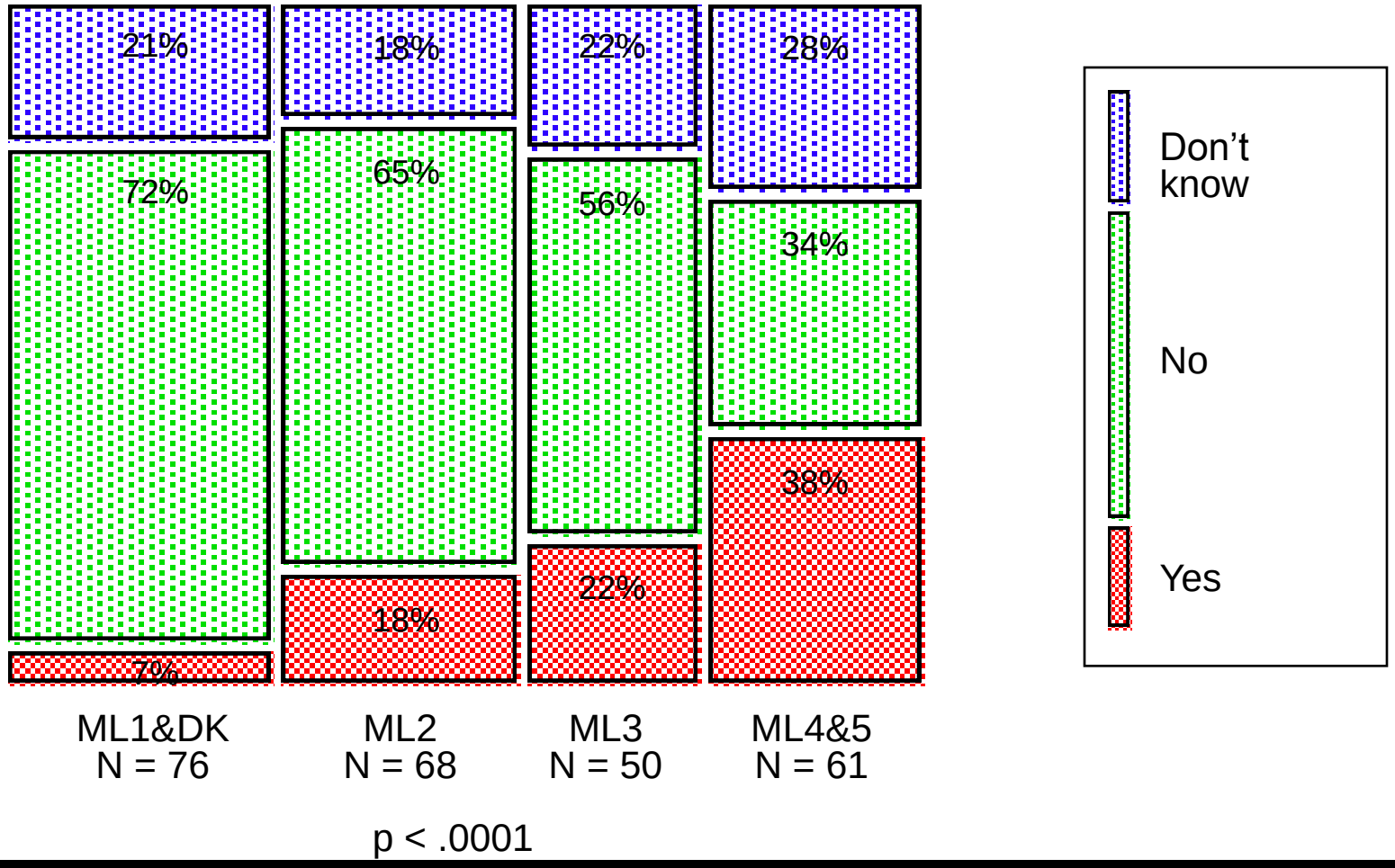
Other
Don't know

Organization wide group

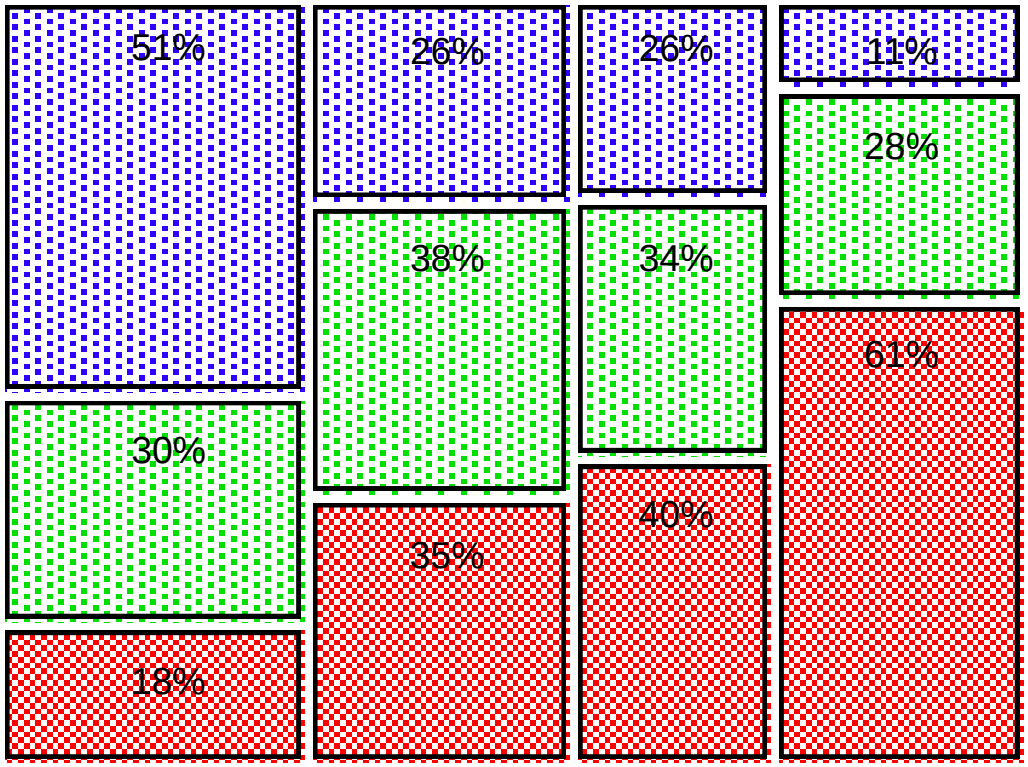
Project level

A few key experts

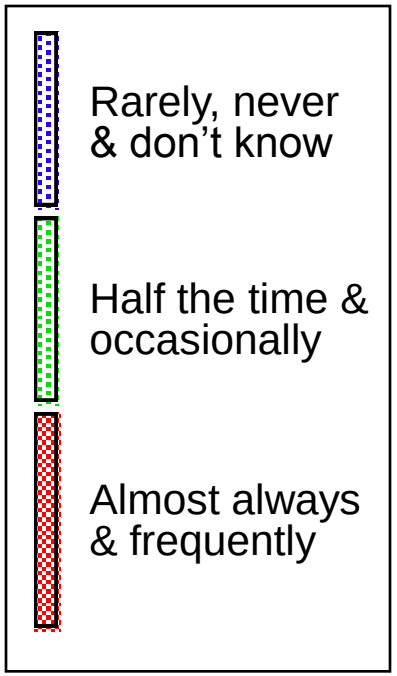
Earmarked Budgets for Measurement



Availability of Qualified Measurement Staff



Gamma = .44 p < .0001



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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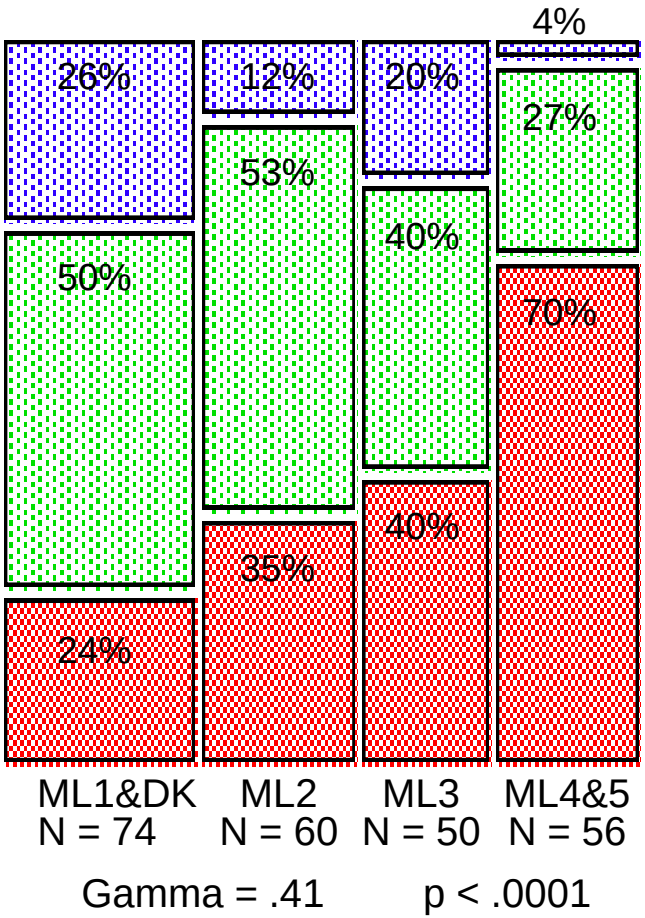
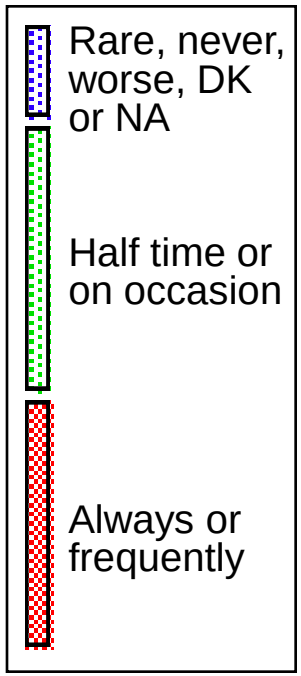
Effects of Measurement on the Organizations[1]

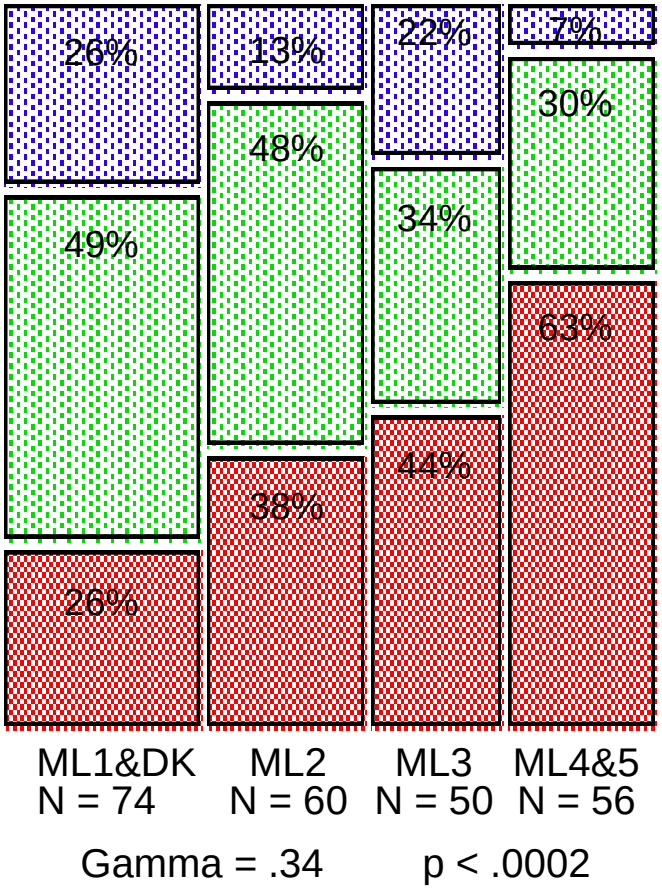
Better Project Performance



Gamma = .41 p < .0001



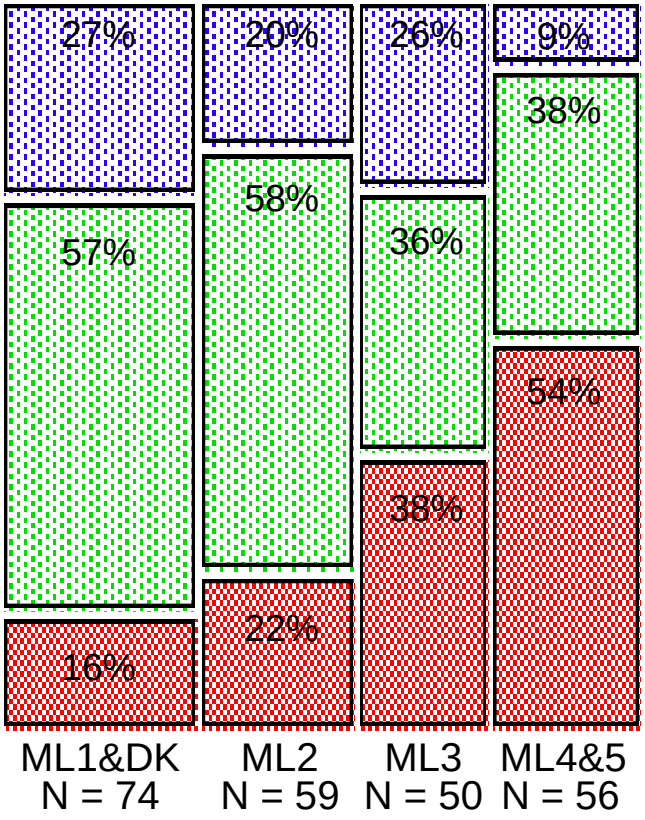
Better Product Quality



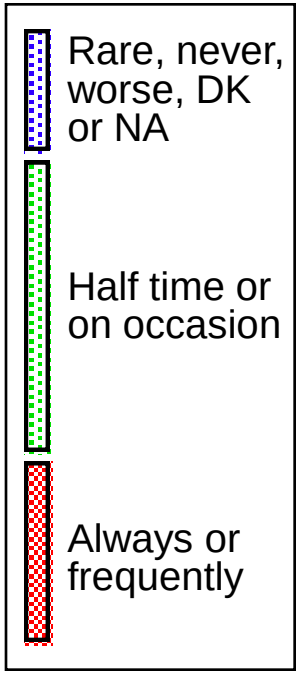
Gamma = .34 p < .0002

Effects of Measurement on the Organizations$_2$

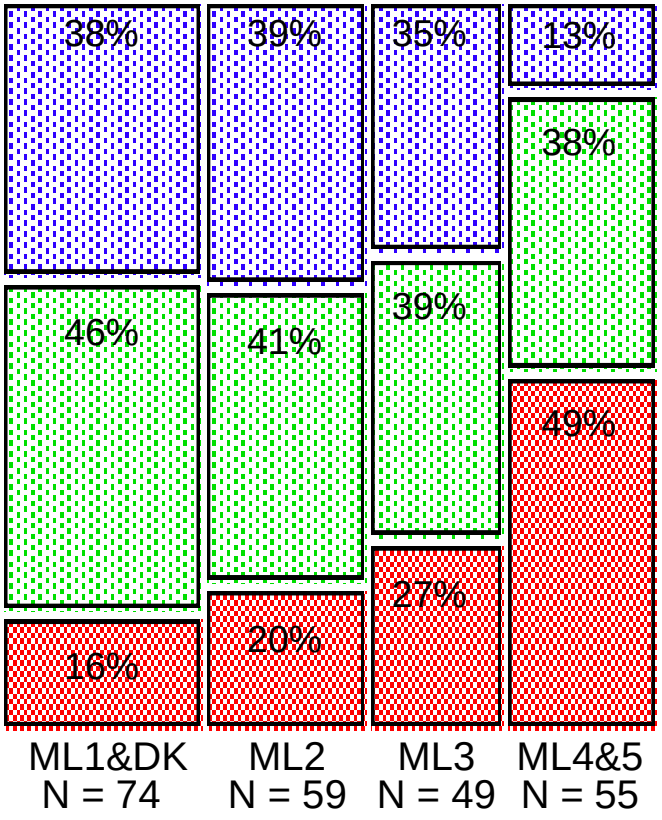
Better Tactical Decisions



Gamma = .35 p = .0001



Better Strategic Decisions



Gamma = .31 p = .0008

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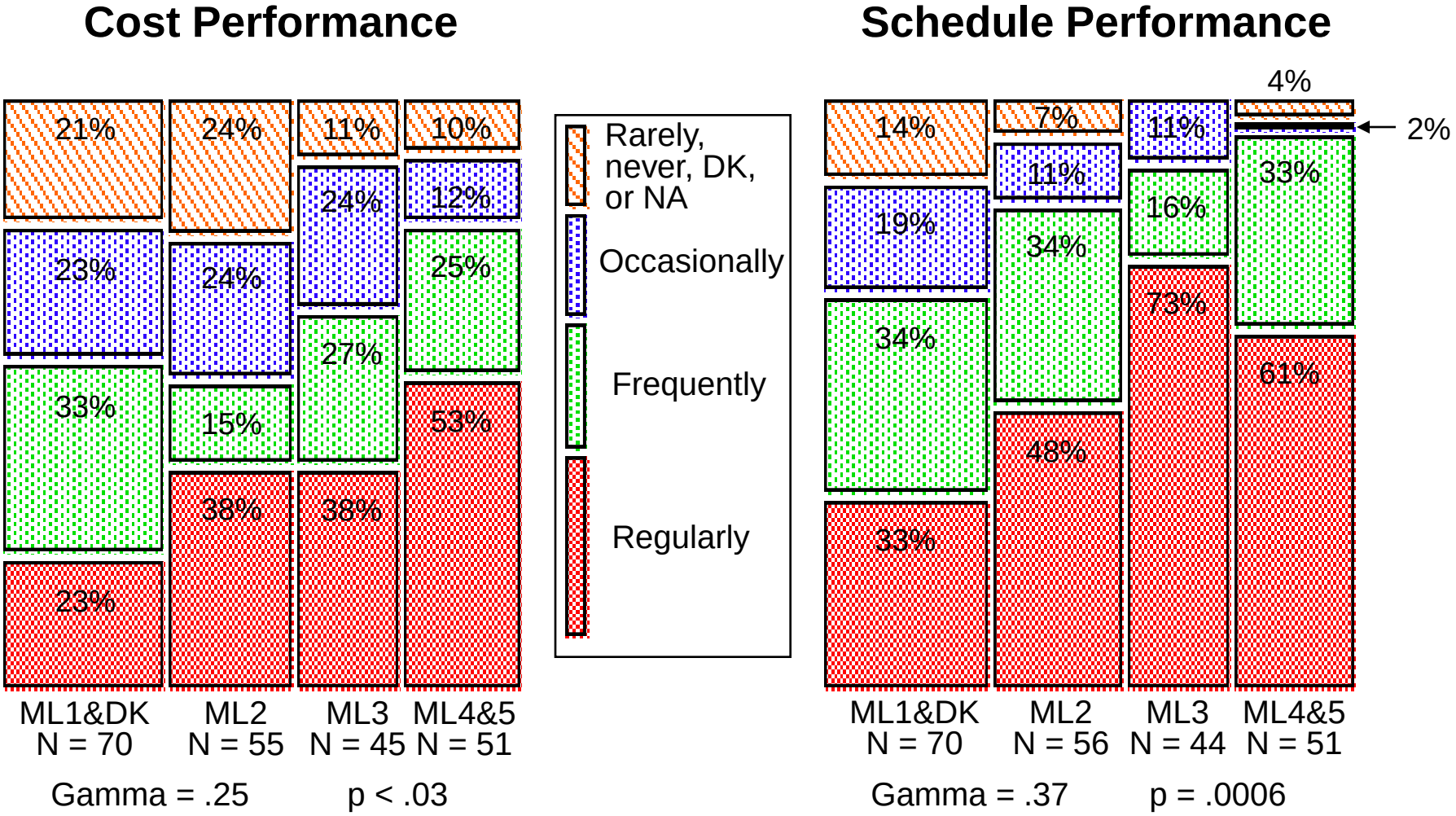
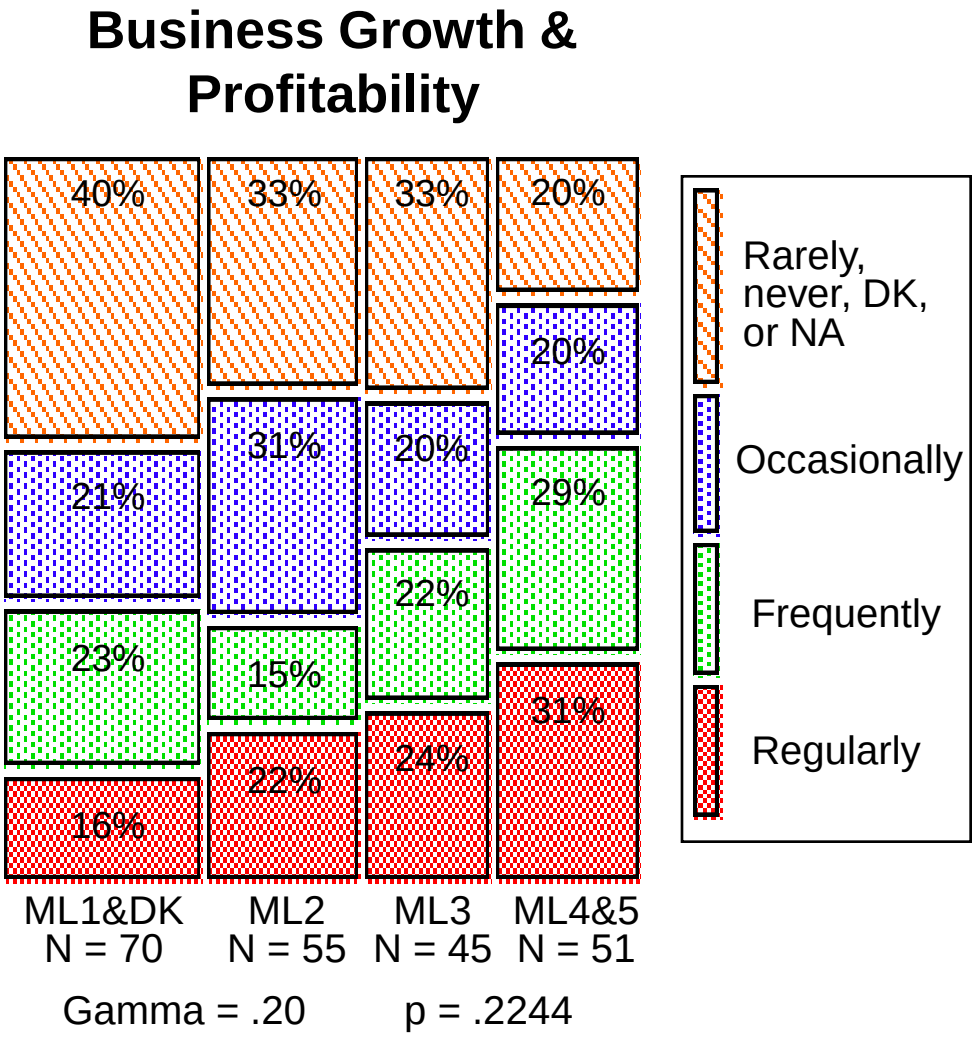
Project & Organizational Measurement Results Reported[1]

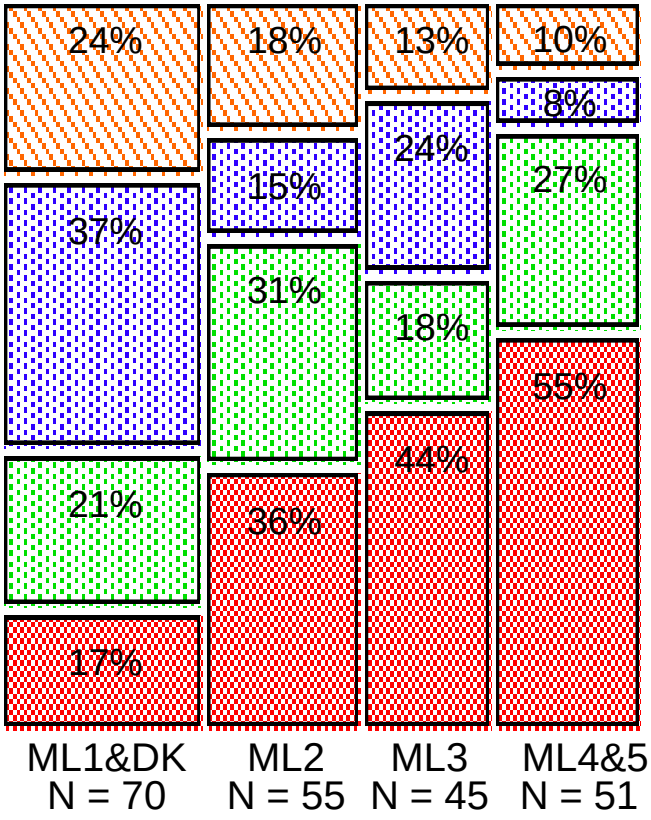


Project & Organizational Measurement Results Reported$_2$

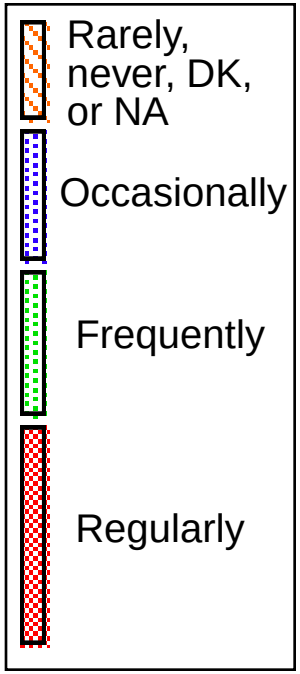


Product & Quality Measurement Results Reported[1]

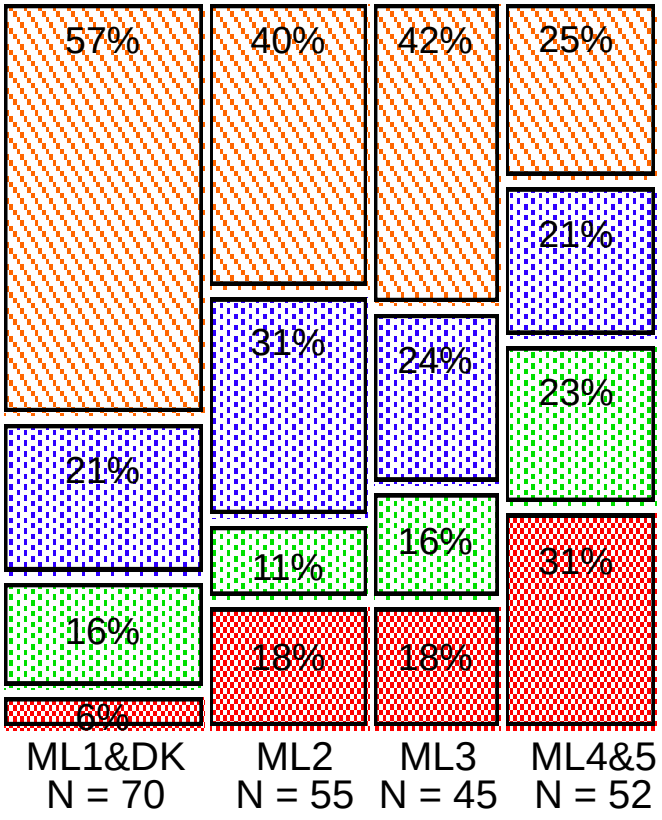
Requirements / Architectures



Gamma = .37 p = .0002



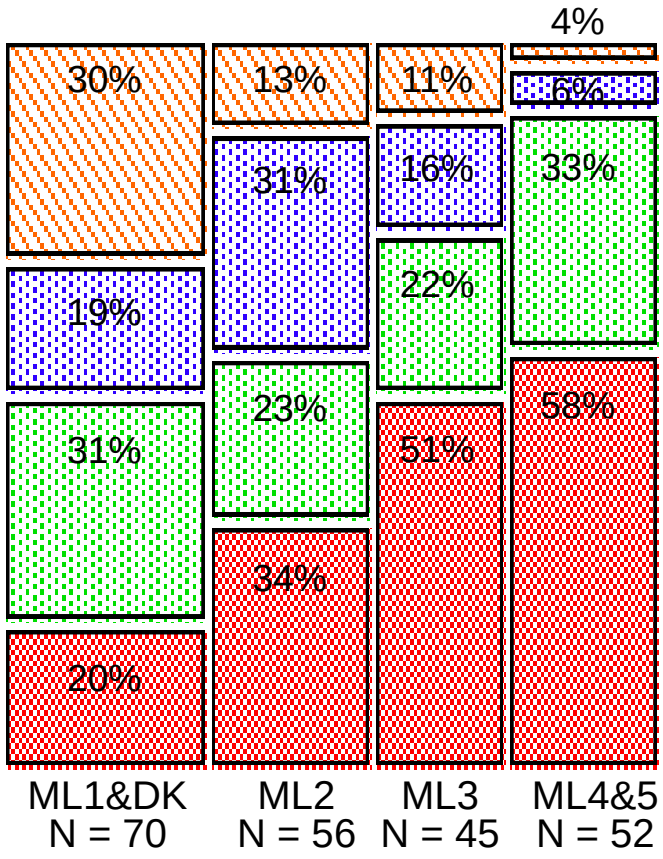
Quality Attributes



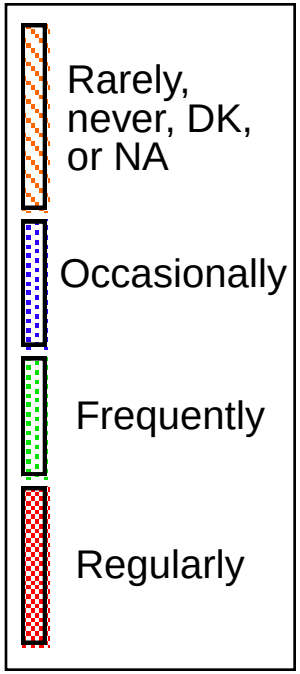
Gamma = .32 p < .008

Product & Quality Measurement Results Reported$_2$

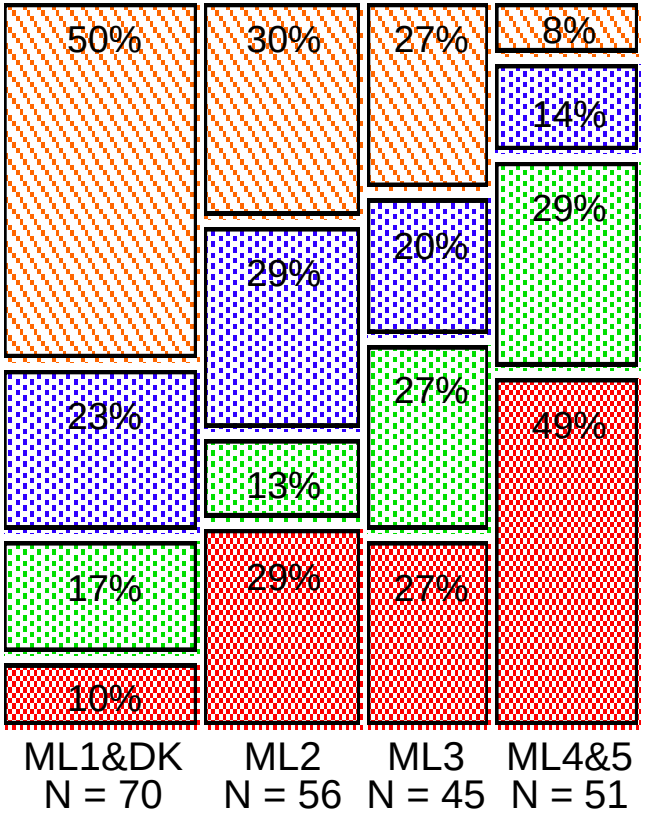
Defect Density



Gamma = .41 p < .0001



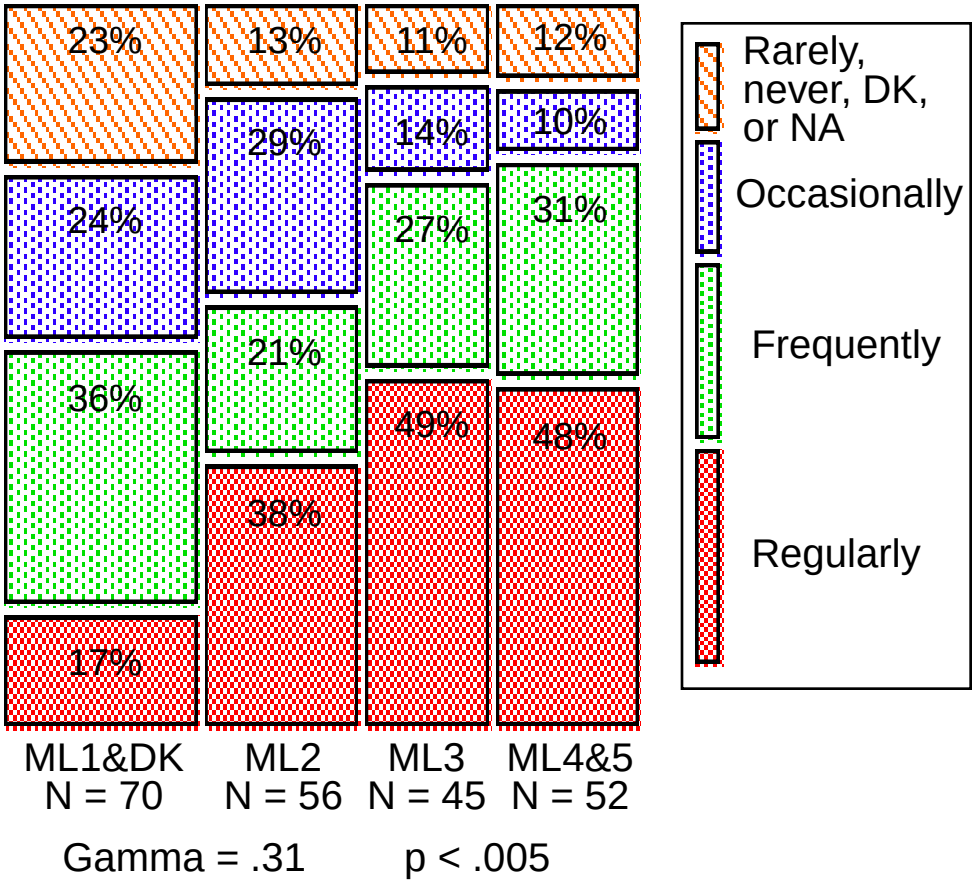
Defect Phase Containment



Gamma = .44 p < .0001

Product & Quality Measurement Results Reported$_3$

Customer Satisfaction



Gamma = .31 p < .005

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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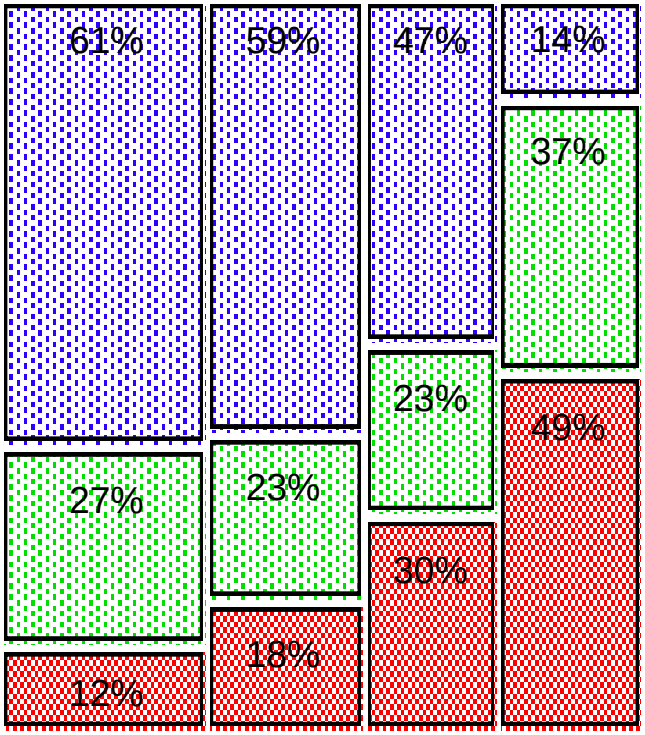
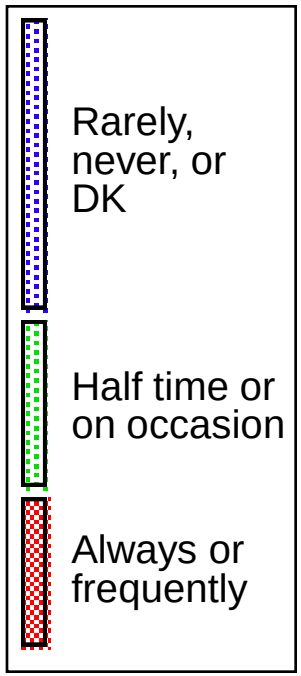
Differences by Maturity Level: Practices to Ensure Data Quality

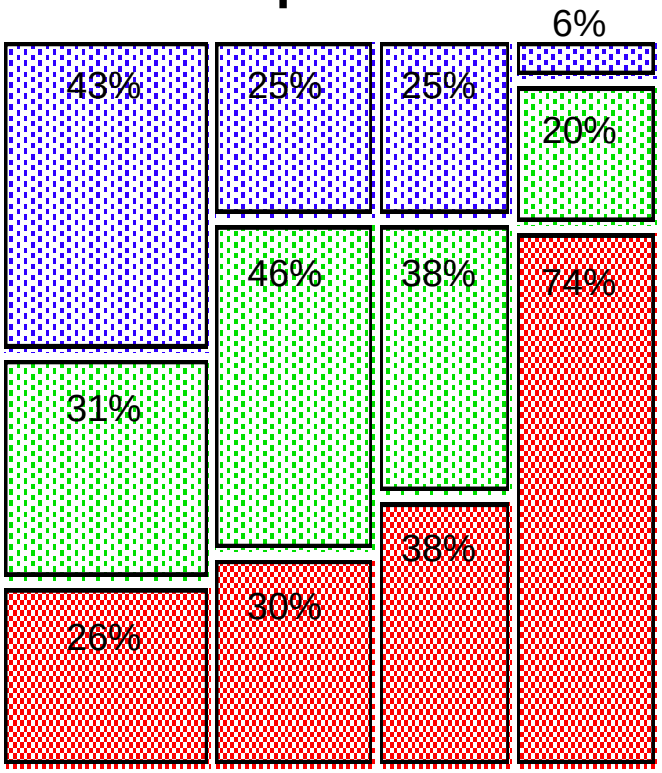
Statistical estimates of measurement error



Gamma = .44 p < .0001

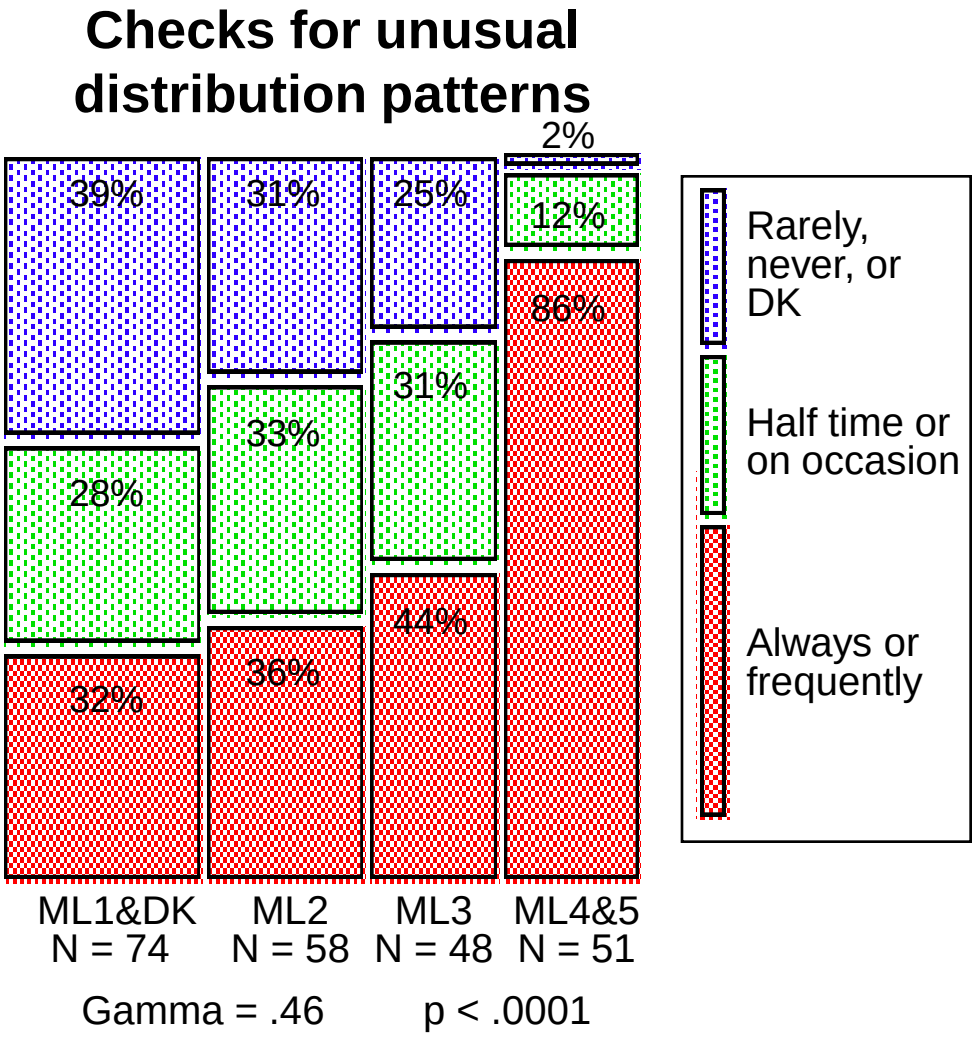


Checks for inconsistent interpretation



Gamma = .44 p < .0001

Differences by Maturity Level: Practices to Ensure Data Quality



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

Proportions sometimes vary across the distributions.

But there are consistent differences by maturity level.

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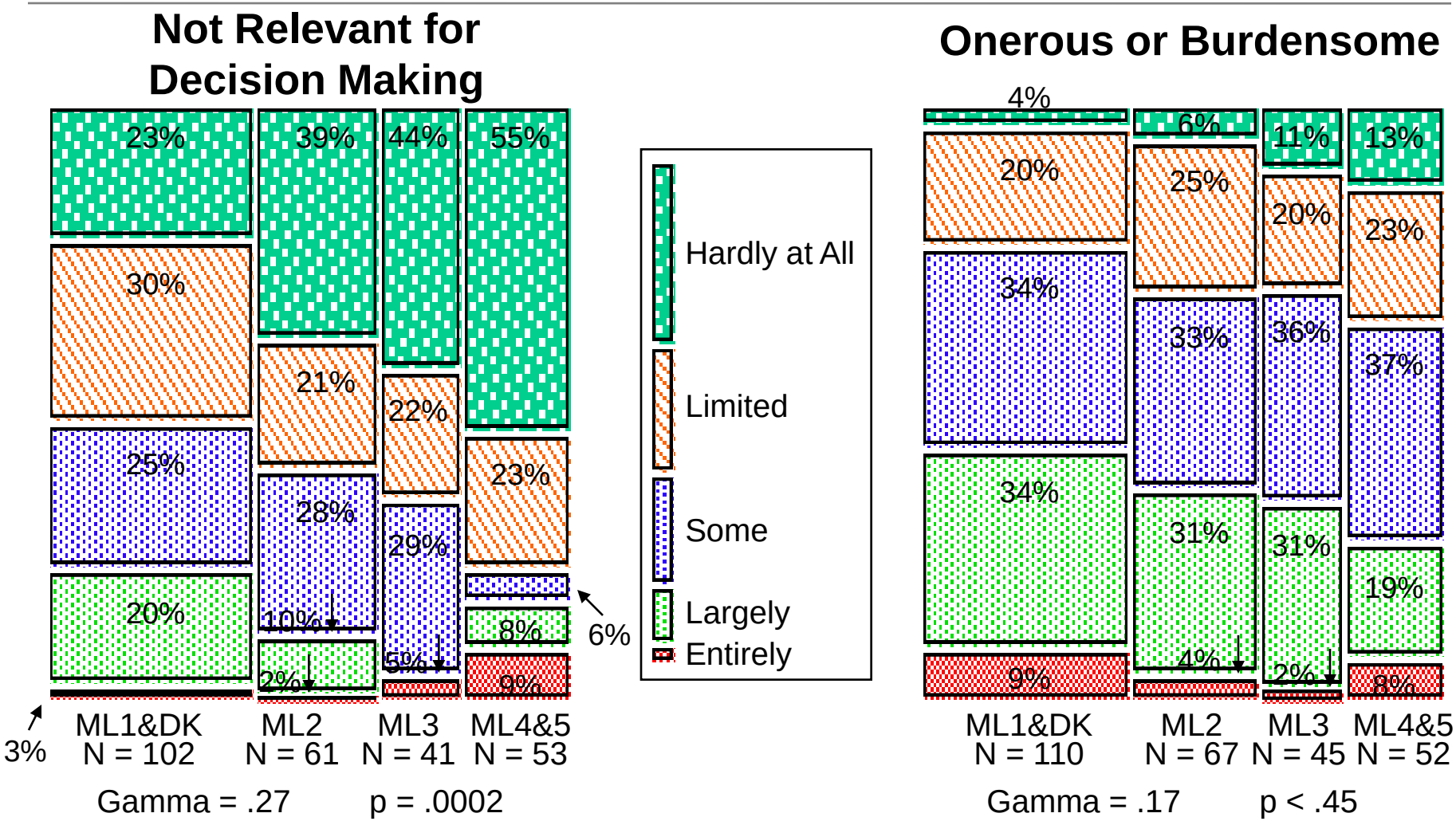
Organizational Perspectives



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

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 2008 survey

- 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

Next Steps

Our plans

- We will track change over time **&** go into further depth about focused topics from the perspective of current measurement practitioners

Considering parallel samples for 2008

- A short set of questions for tracking the diffusion of measurement through the broader software & systems engineering community
- Possible focus on issues faced with respect to the adoption & use of high maturity measurement practices

Also fielding a survey on Program Office acquisition capabilities (early 2008)

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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