Carnegie Mellon
Software Engineering Institute

Pittsburgh, PA 15213-3890

Interpretive Guidance: What We've Learned

Software Engineering Process Group Conference

March 10, 2004

Sponsored by the U.S. Department of Defense

Topics

Project Overview and Status

Detailed Interviews

Preliminary Report

Summary of Issues Collected

Questions

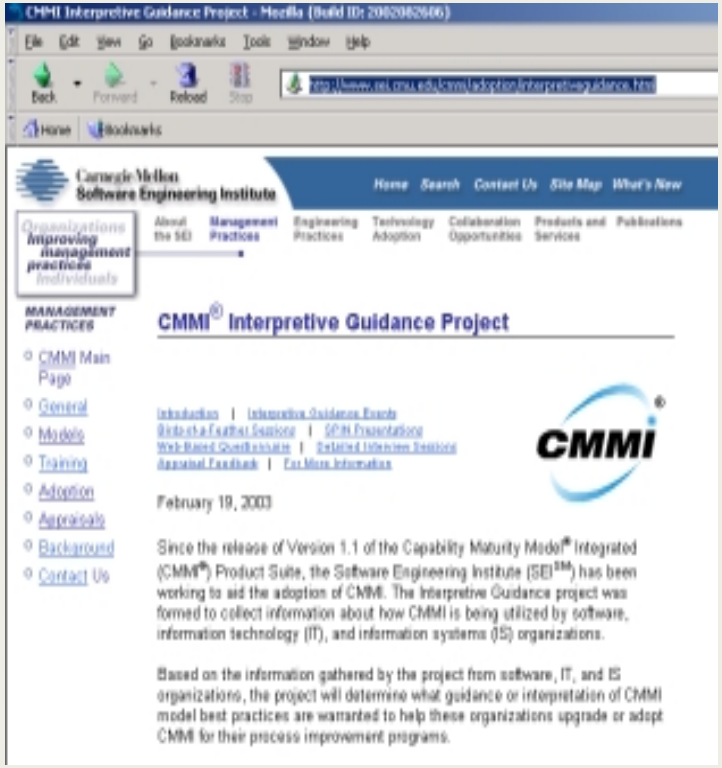
Interpretive Guidance Objectives

To understand and address the issues that software organizations have when using CMMI

To allow current SW-CMM users to more easily upgrade to CMMI

To eliminate as many perceived barriers to CMMI adoption as possible

To make CMMI adoption easy



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Phase I Accomplishments

Collected comments from Birds-of-a-Feather sessions in conjunction with conferences and SPIN meetings

Formed expert group

Received responses from Web-based questionnaire

Received limited feedback from SCAMPI appraisals

Performed preliminary analysis of issues

Released Interpretive Guidance Preliminary Report (available at http://www.sei.cmu.edu/cmmi/)

Phase II

The purpose of Phase II is to analyze issues to determine:

- if interpretive guidance is needed
- where interpretive guidance is appropriate
- what form interpretive guidance will take

At a minimum we will:

- perform detailed analysis of the issues
- conduct detailed interviews to further investigate issues
- share detailed analysis with groups at the SEI to understand how their activities relate to identified issues
- present preliminary data at conferences and SPIN meetings to validate the data and analysis
- produce a final report to document our findings and conclusions

Detailed Analysis

Categorize the data.

Identify “low hanging fruit.”

Identify issues that will be addressed by the Interpretive Guidance project.

Generate change requests for the CMMI Version 1.2 revision effort.

Identify issues that can be addressed by other groups at the SEI.

Detailed Interviews

Follow-up to the Interpretive Guidance Web-Based Questionnaire

- Clarify and elaborate on issues identified in the questionnaire.
- Identify potential interpretive guidance artifacts or other solutions for the community.

Detailed Interview Candidates

Identified 21 organizations as candidates; selected the following 10 organizations:

- Automatic Data Processing
- Bank of America
- Electronic Data Systems
- Robert Bosch
- Gartner Group
- John Hancock Financial Services
- Lockheed Martin M&DS
- Northrop Grumman IT
- McKesson Corporation
- Raytheon Space and Airborne

Detailed Interview Questions

Tell us what works for you in CMMI.

Tell us what does NOT work for you in CMMI.

Let us know about obstacles you or your organization have encountered.

Show us how you and the organization have/will dealt/deal with these obstacles.

Can you provide examples of what you have done?

- Templates, Interpretation Notes, Policy Guidelines
- Procedure Notes, Training materials

Example Issues from Detailed Interviews

Project Planning and Generic Practice 2.2 -- Typical work products should be added, as it is convoluted as to what artifacts are necessary. We had a proposal that showed a plan to do plan for the program. That was not sufficient. So why isn't a proposal sufficient? Eventually it was accepted after explanation. You need a typical work product explicitly, such as a proposal development process.

Can you rewrite the MA PA? Rewrite context that captures/promotes the business environment so we understand what the objectives are that customers want upfront. We don't see much of that in MA. For those down in the trenches, what objectives do we associate? Objectives of the business? program? We approached it as objectives of the business.

Don't find value-added in having 57 measures. It's too many.

Preliminary Report

Describes the data-collection activities from both BoF sessions and Web-based questionnaire efforts

Includes summaries of the data collected through August 2003

Events with BoF Sessions

CMMI Users Group
ICSPI Conference
New York City SPIN
QAAM/QAI Conference on Managing Software Excellence
PROFES 2002
Acquisition of SW-Intensive Systems
SEPG 2003
Southern California SPIN meeting
San Diego SPIN meeting
bITa Europe Conference
NDIA Transition Workshop
STC 2003
European SEPG Conference
Practical Software Measurement

Web-Based Questionnaire

Invited participation of ~7,000 people

- Over 4,000 people had direct internet access.
- Over 3,000 others were notified that the questionnaire was available.
- We also placed an announcement on the SEI Web site.

The number of individuals responding to the sections of the questionnaire were

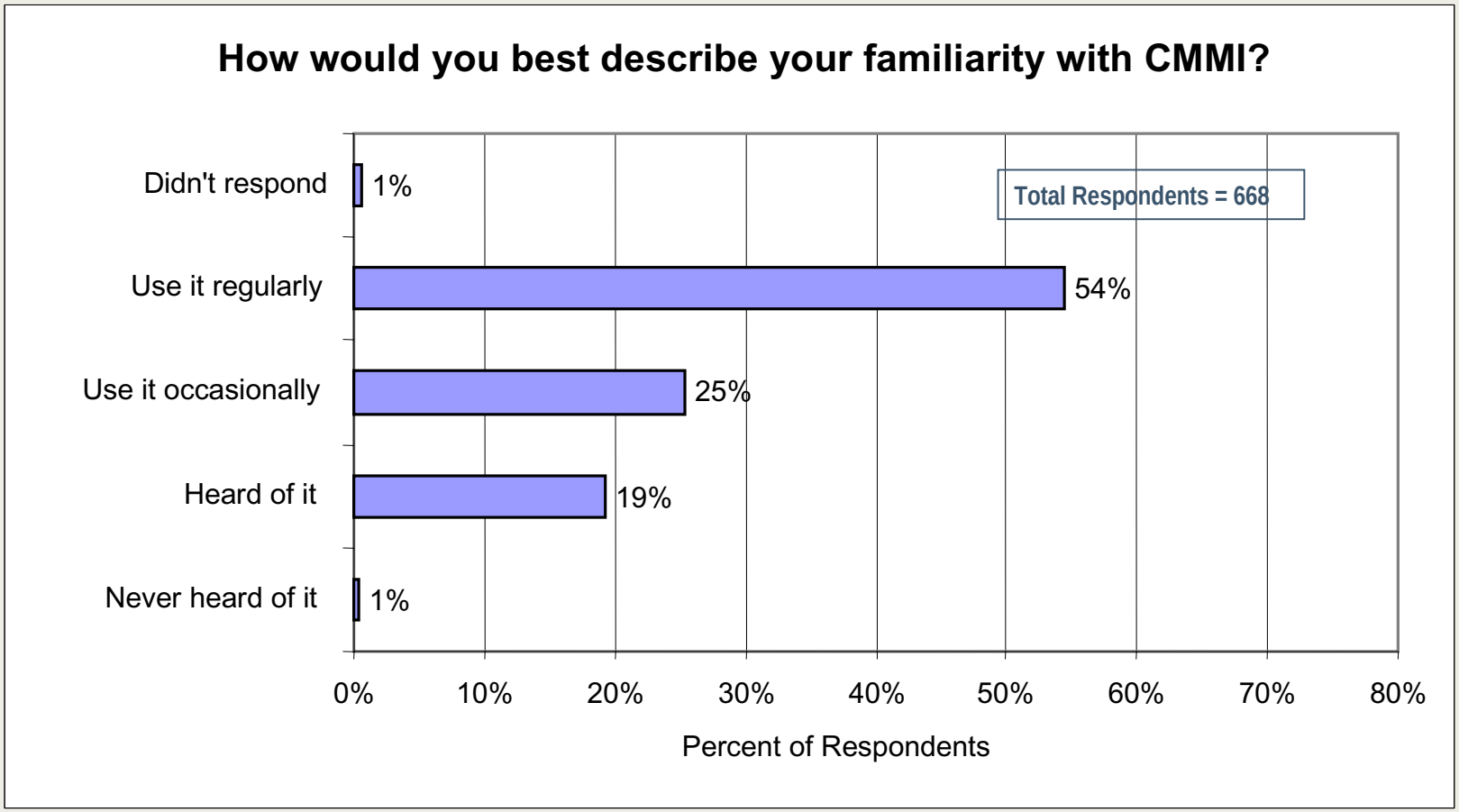
- Background and Context (required section) - 668
- Global Issues - 587
- Generic Goals and Generic Practices - 339
- Specific Process Areas - 182

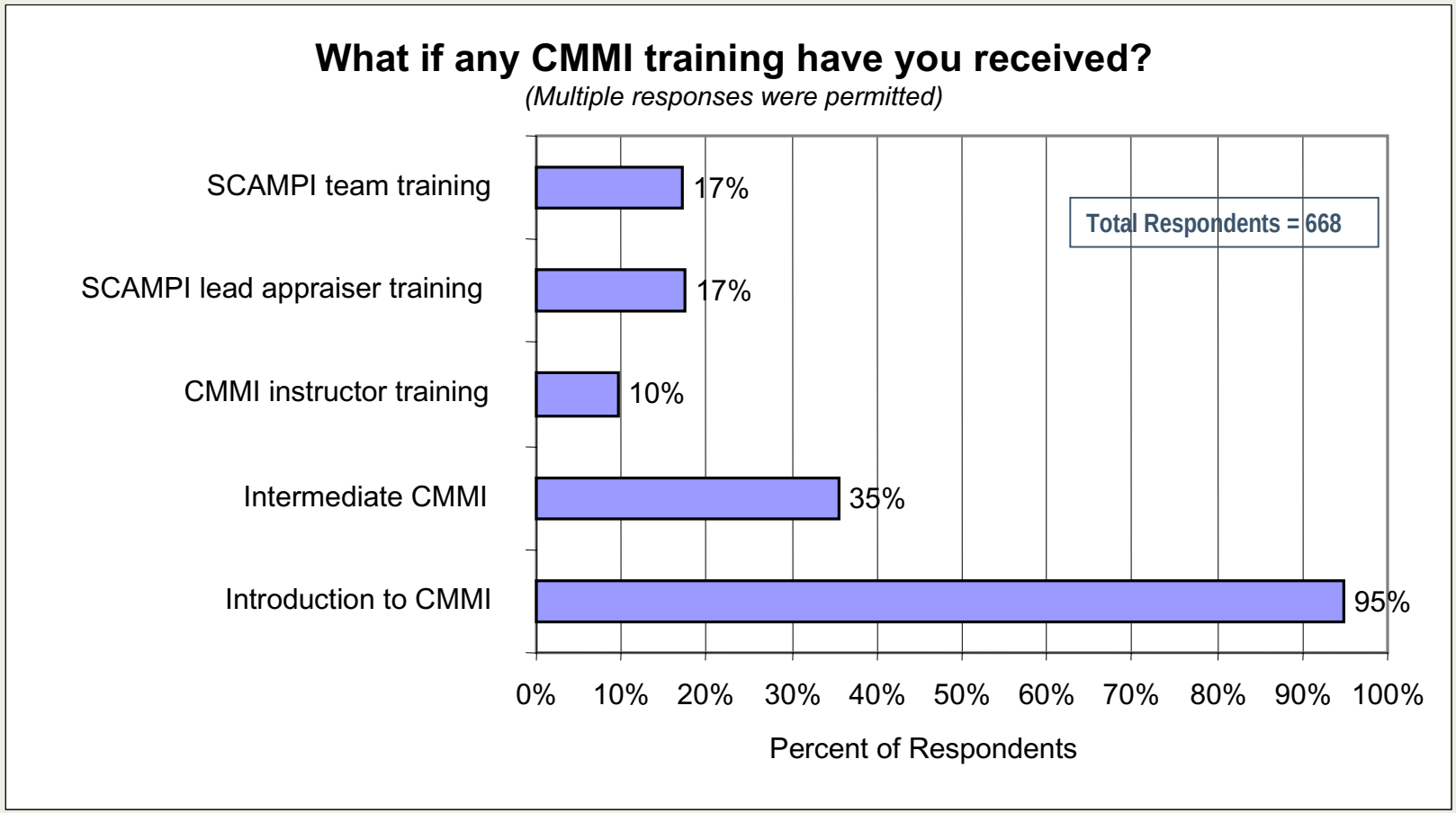
Background

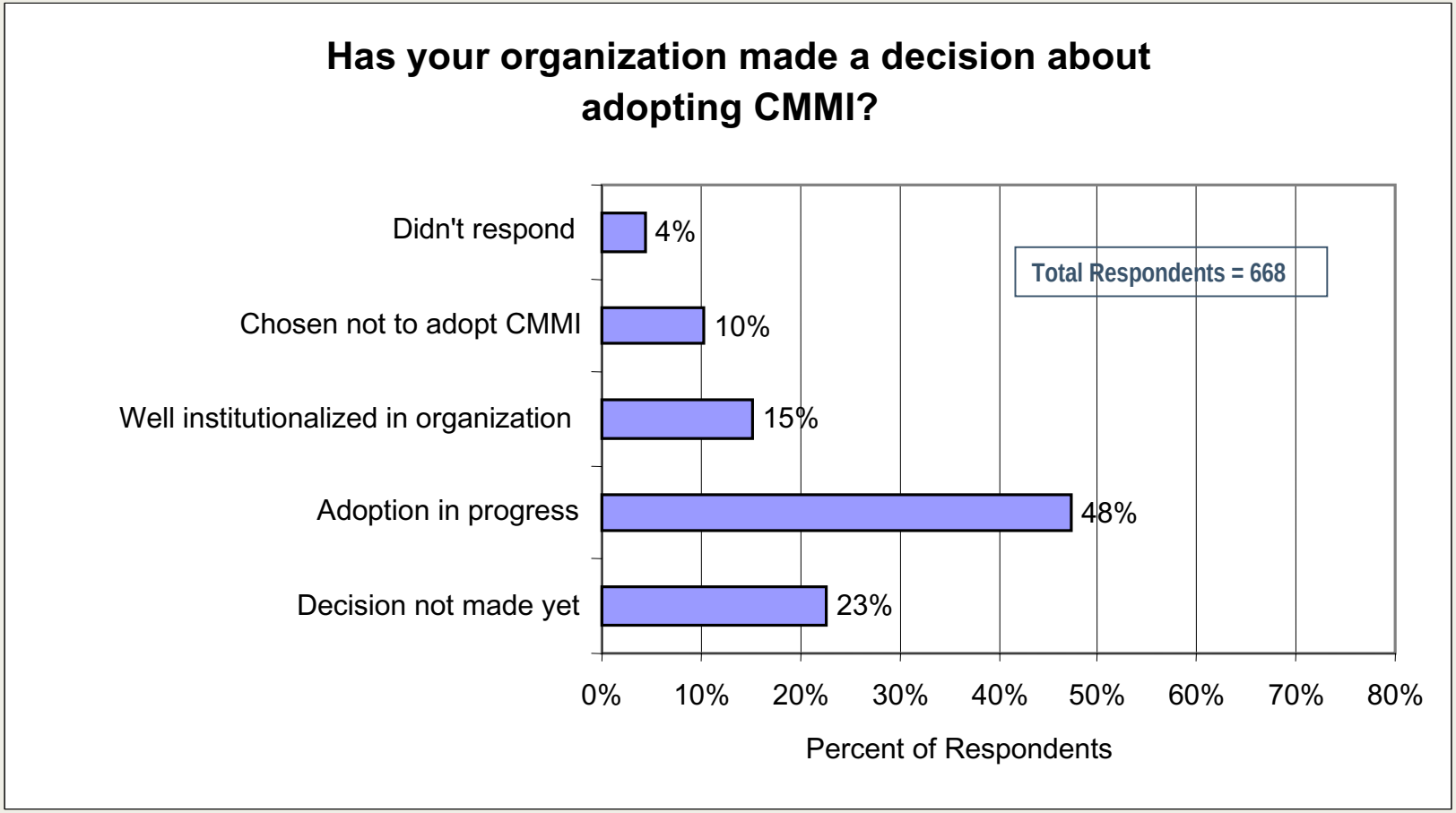
Nine questions were asked to understand the background of the respondent.

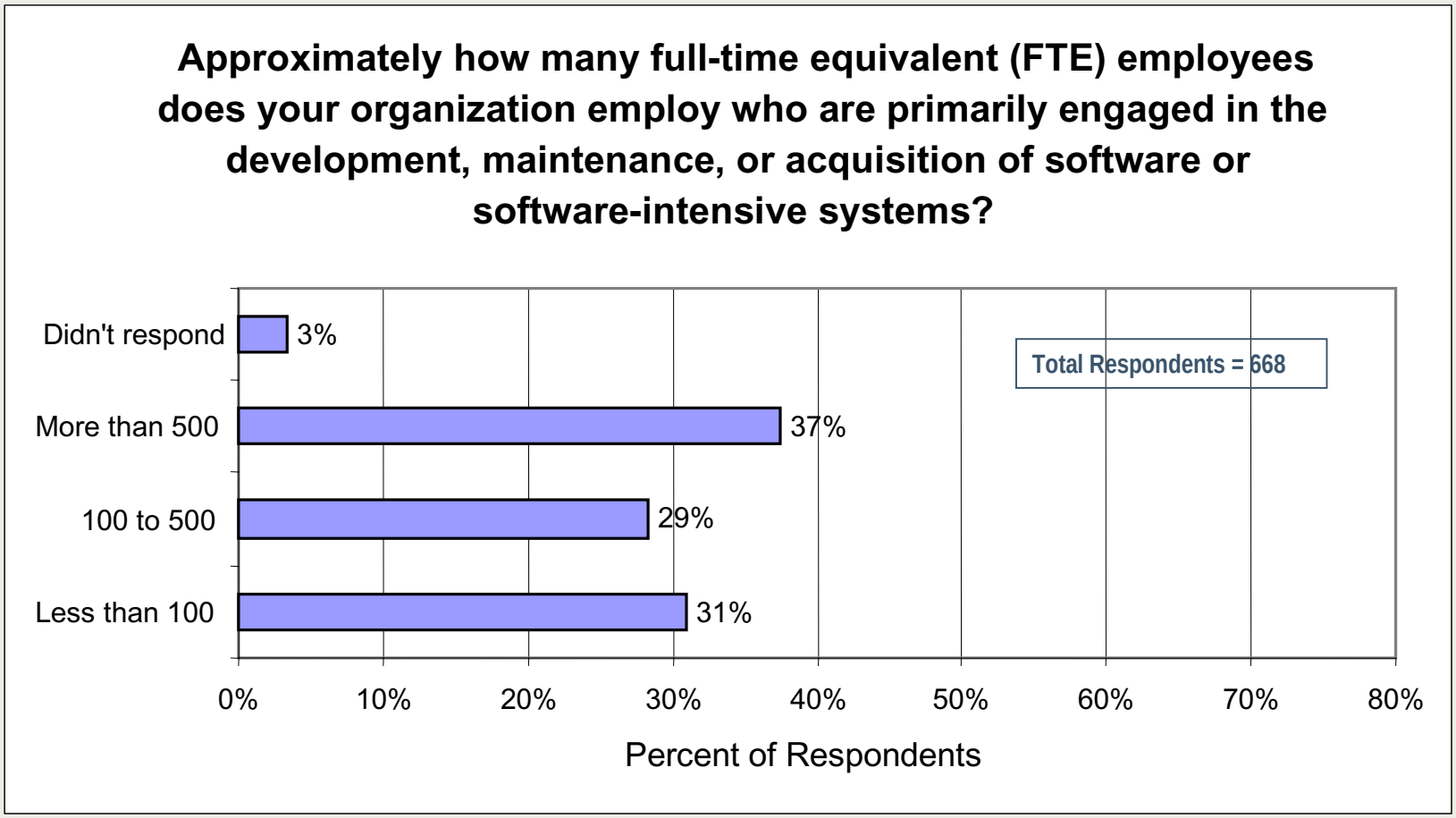
Some questions were specific to the person filling out the questionnaire.

Other questions were providing background information about the organization.



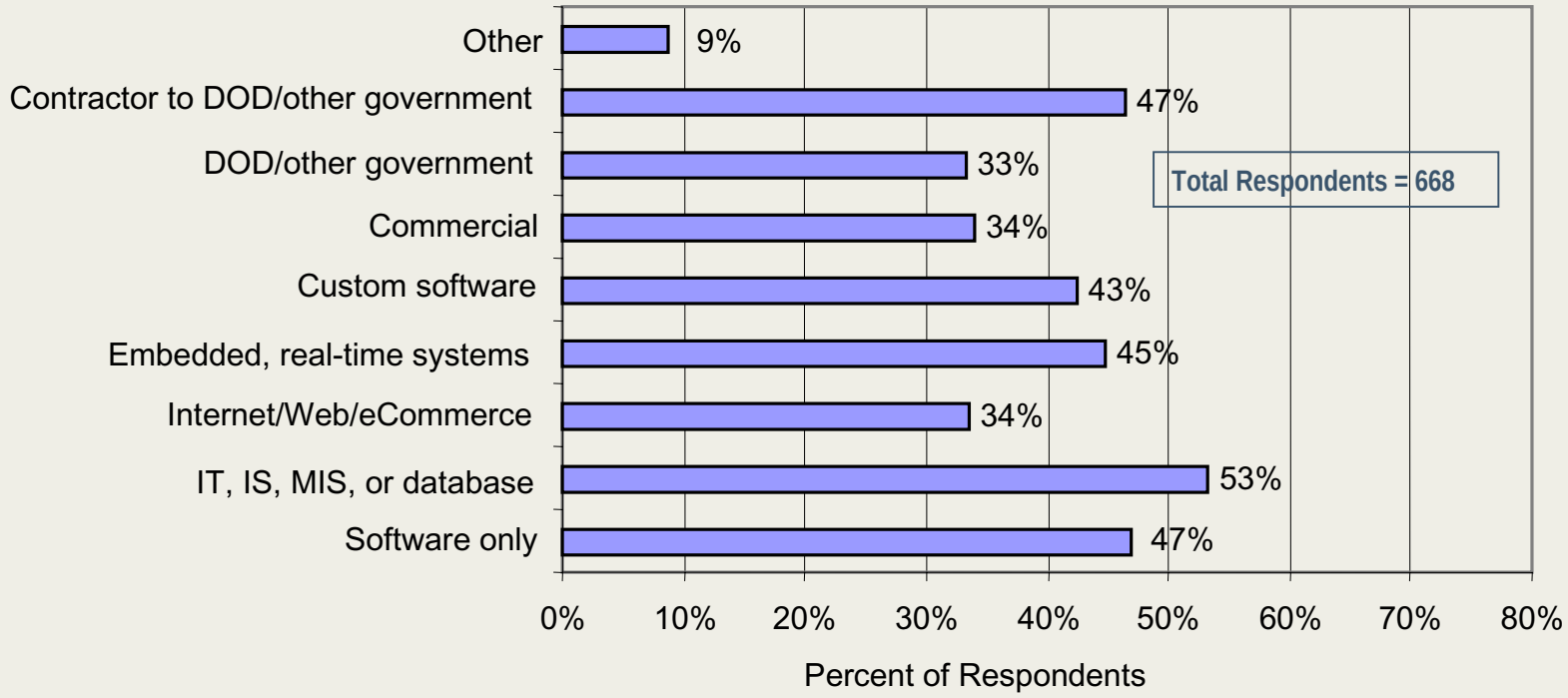


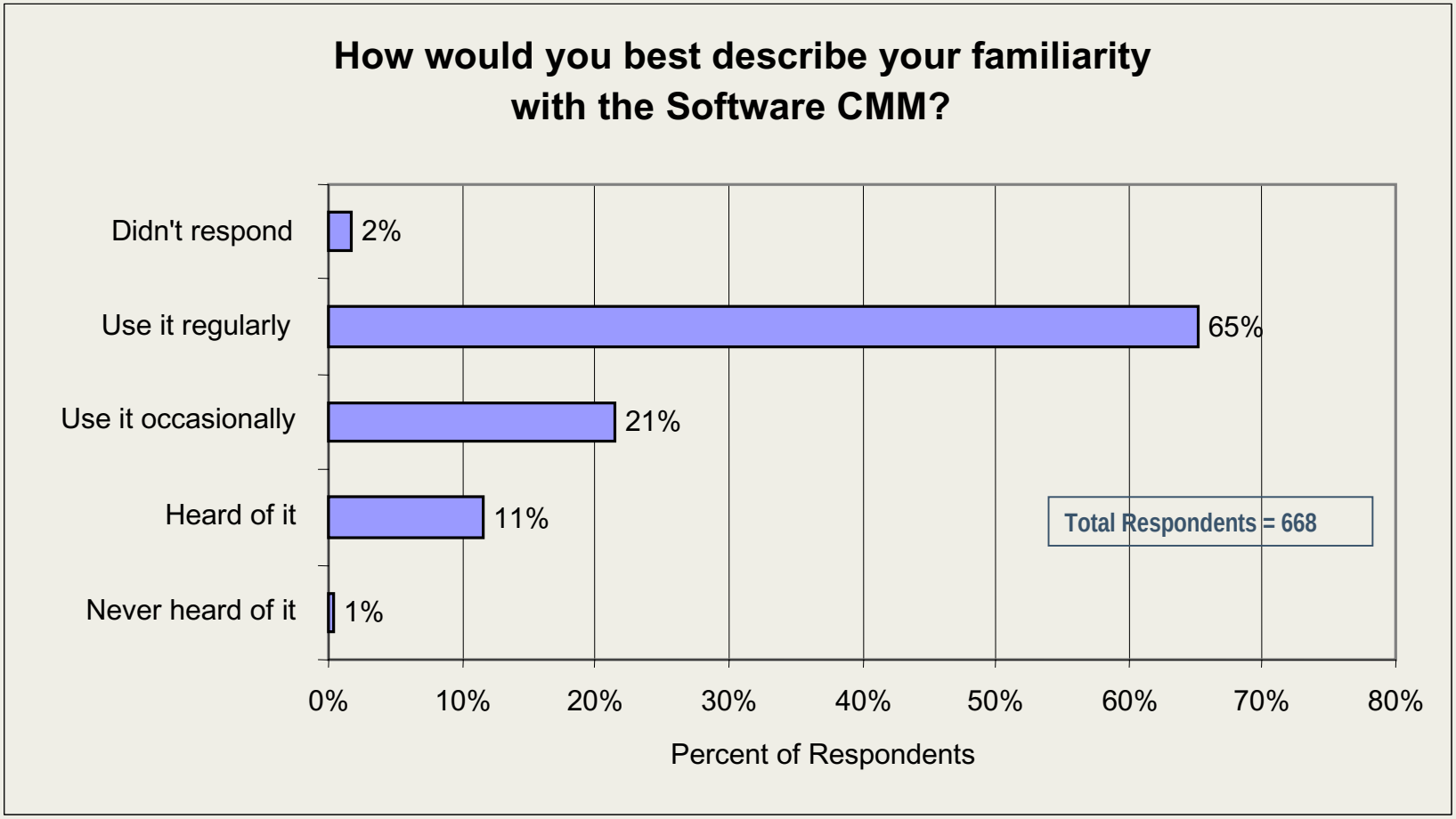




How would you best describe your software related experience? In what application domains or business areas have your worked?

(Multiple responses were permitted)



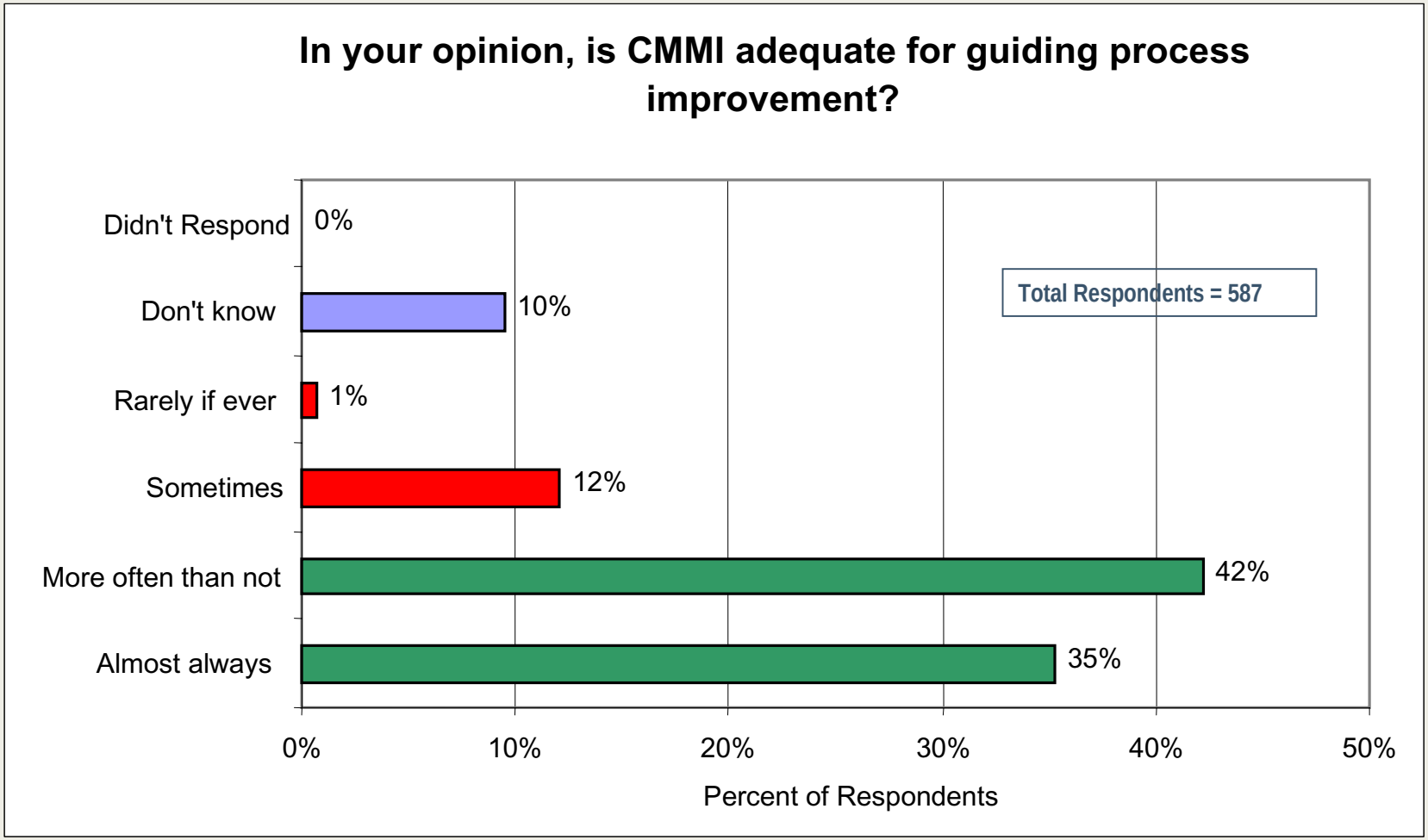


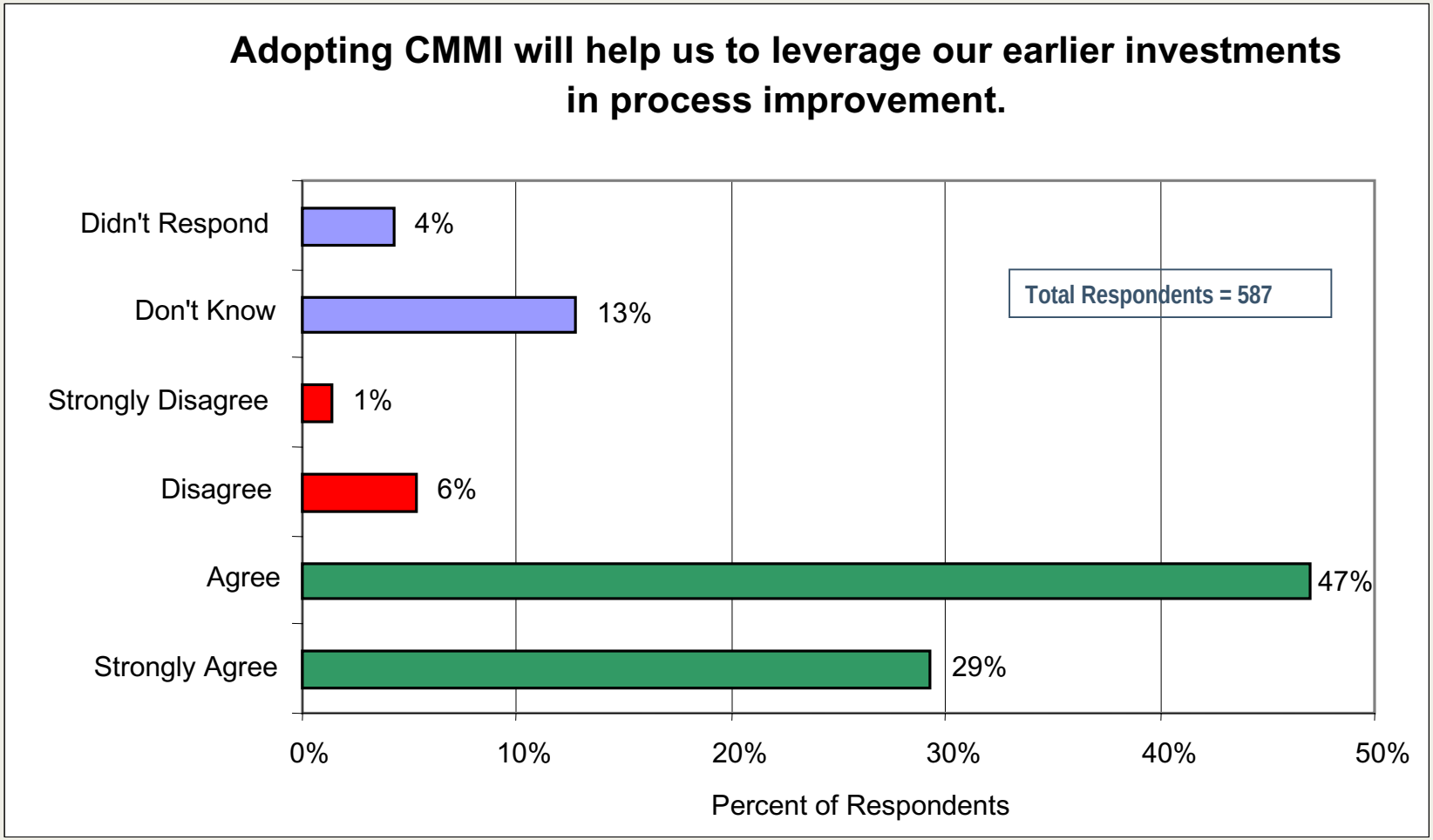
Global

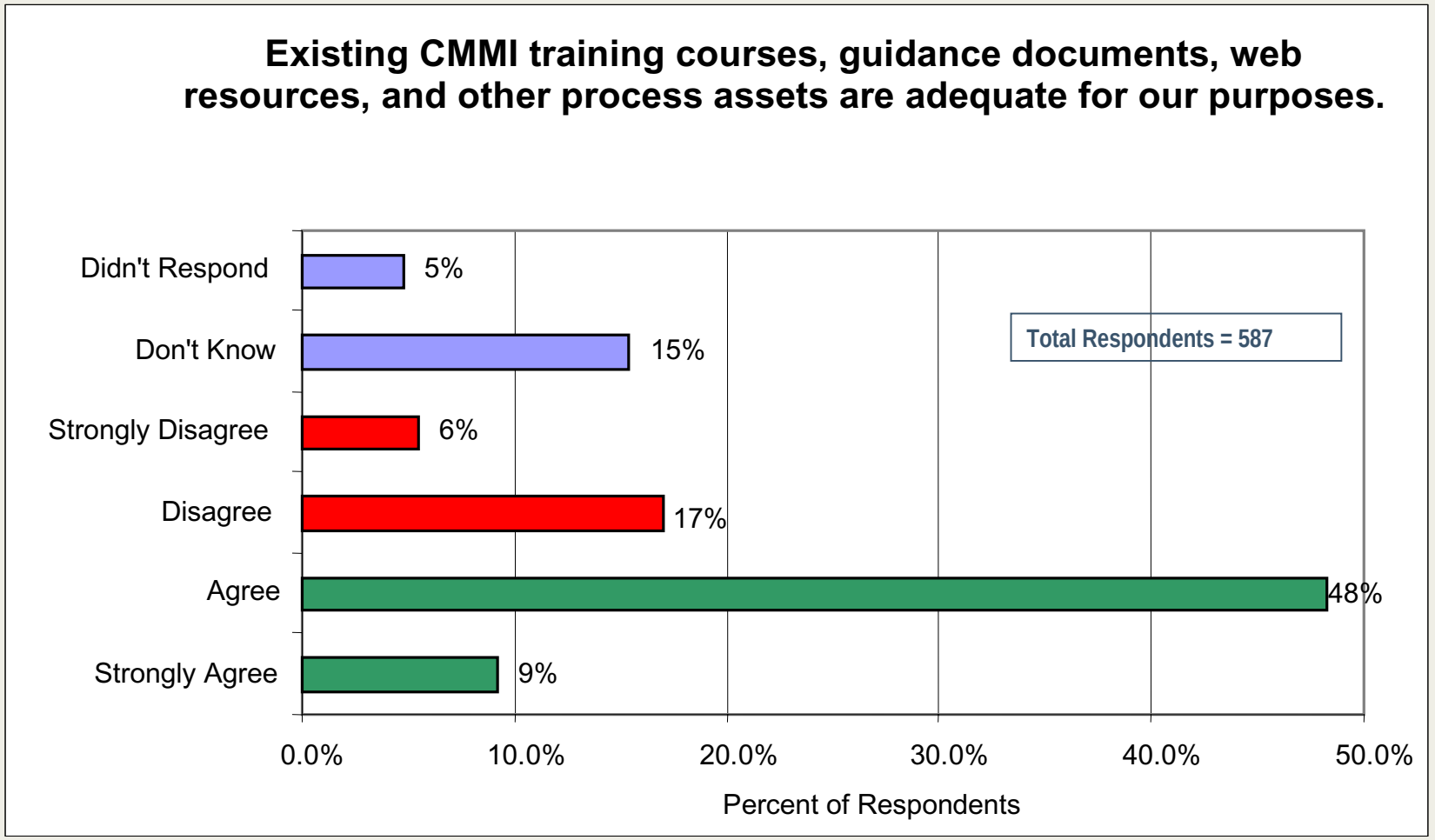
Thirteen questions were asked.

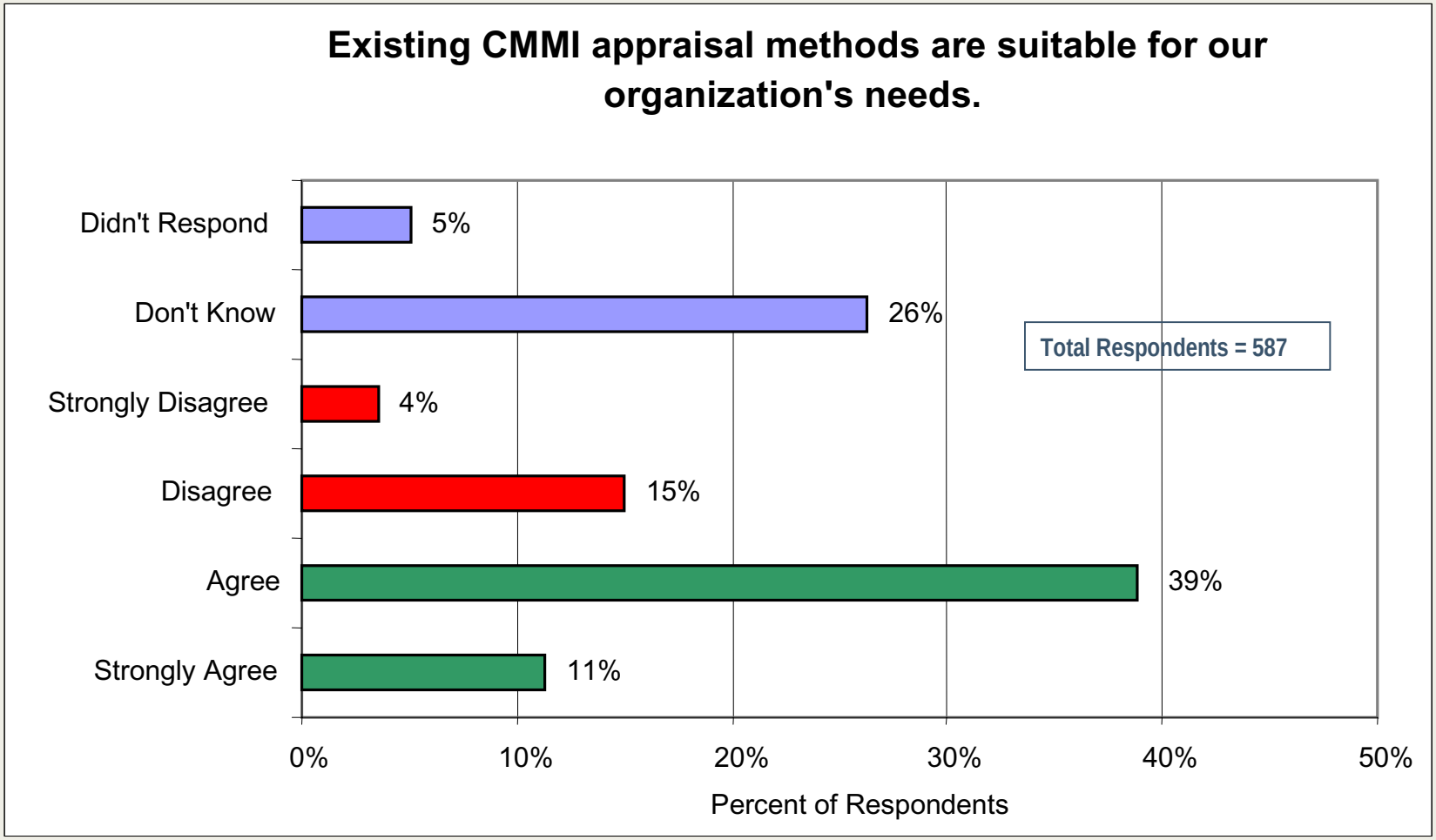
General questions that addressed CMMI adoption included

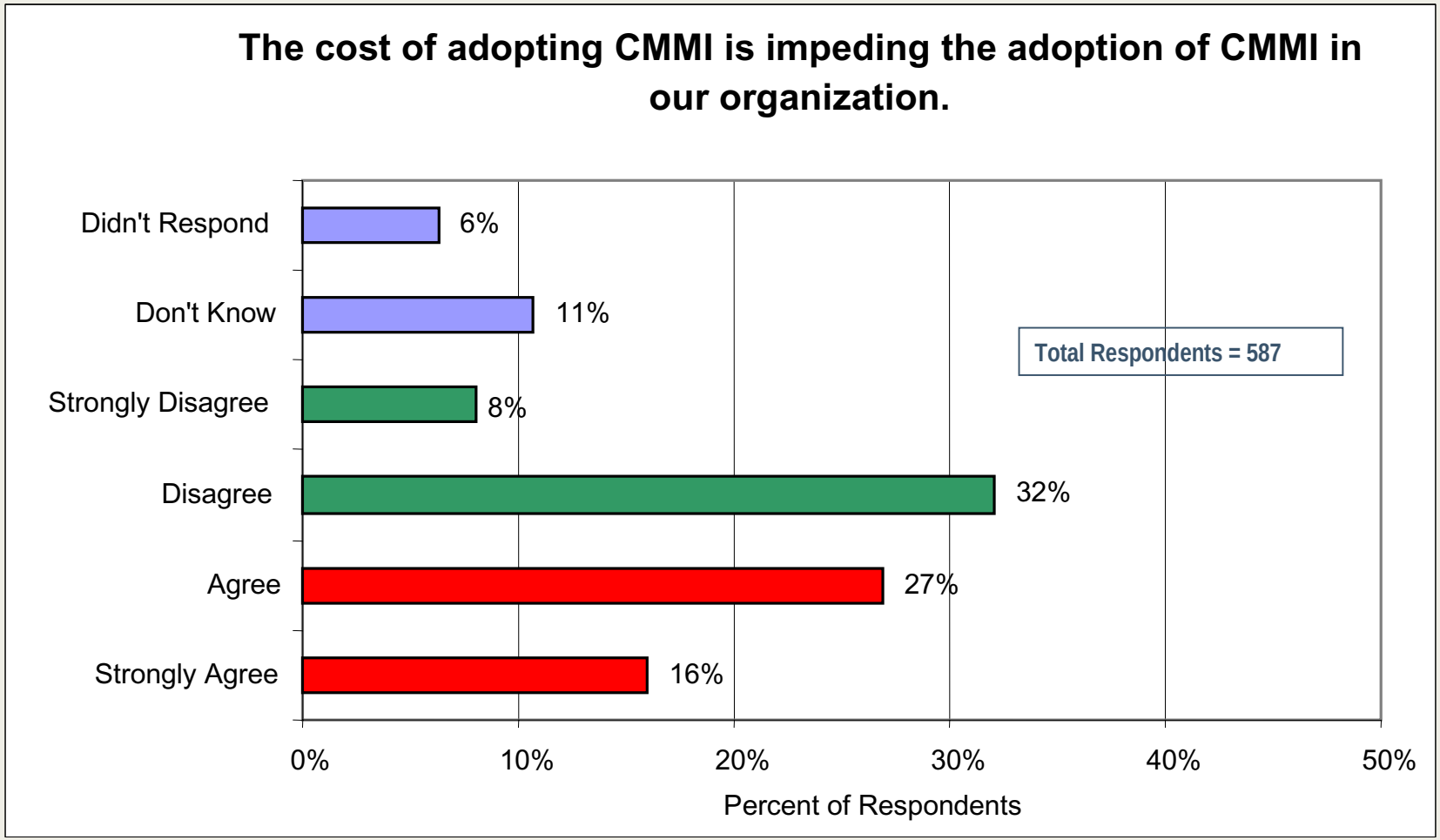
- CMMI concepts or terminology
- model representations
- costs
- ROI

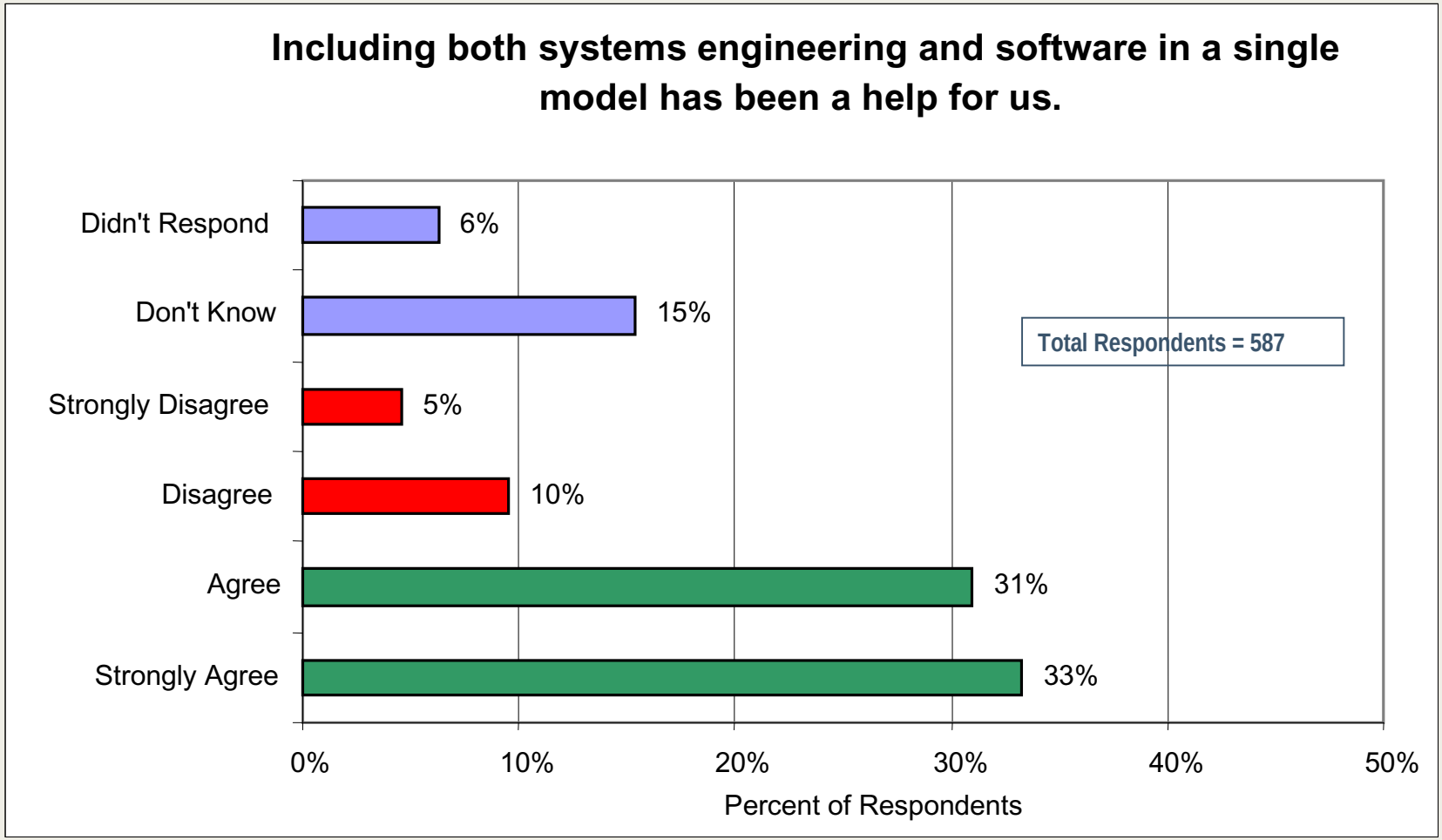


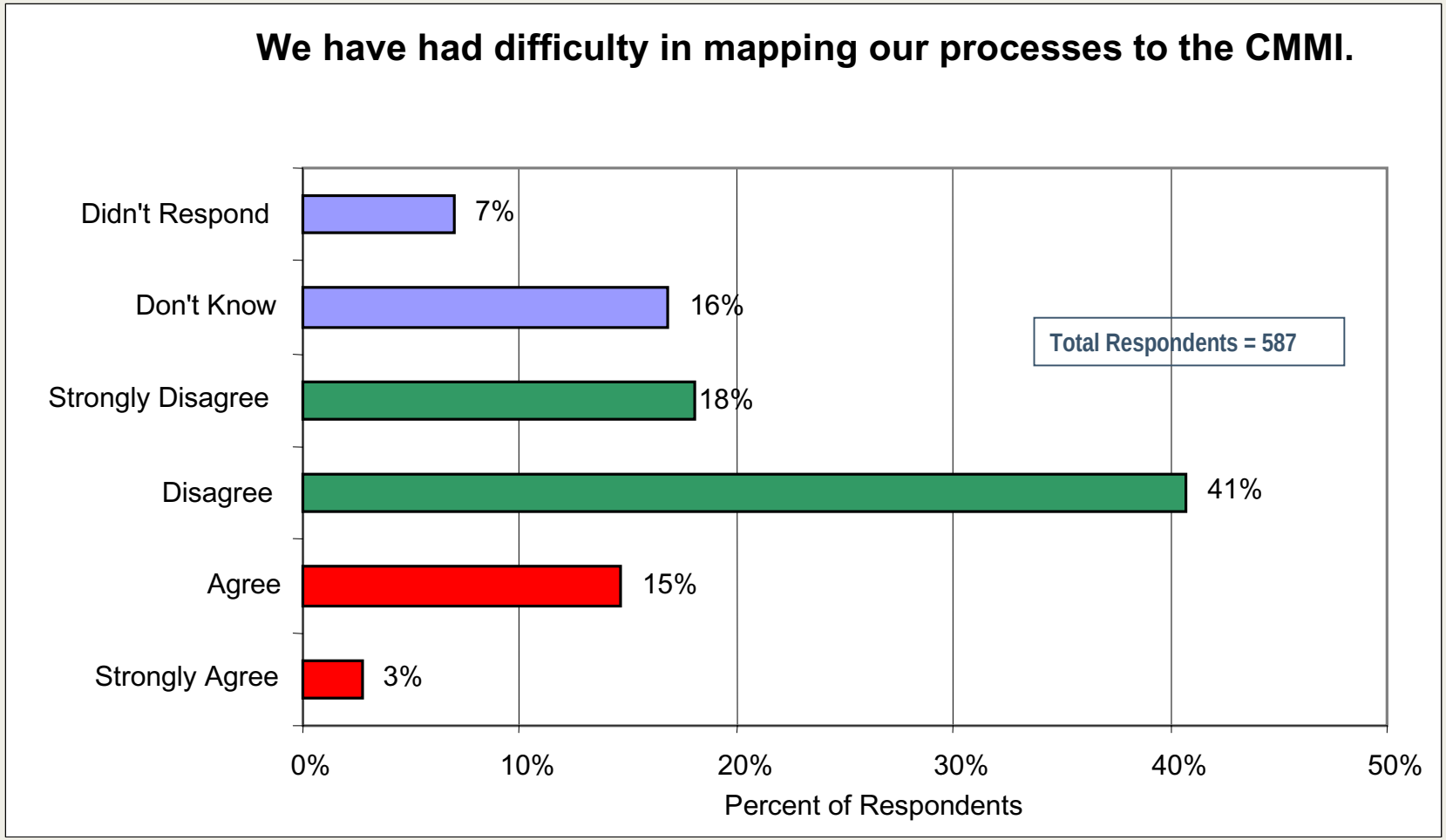


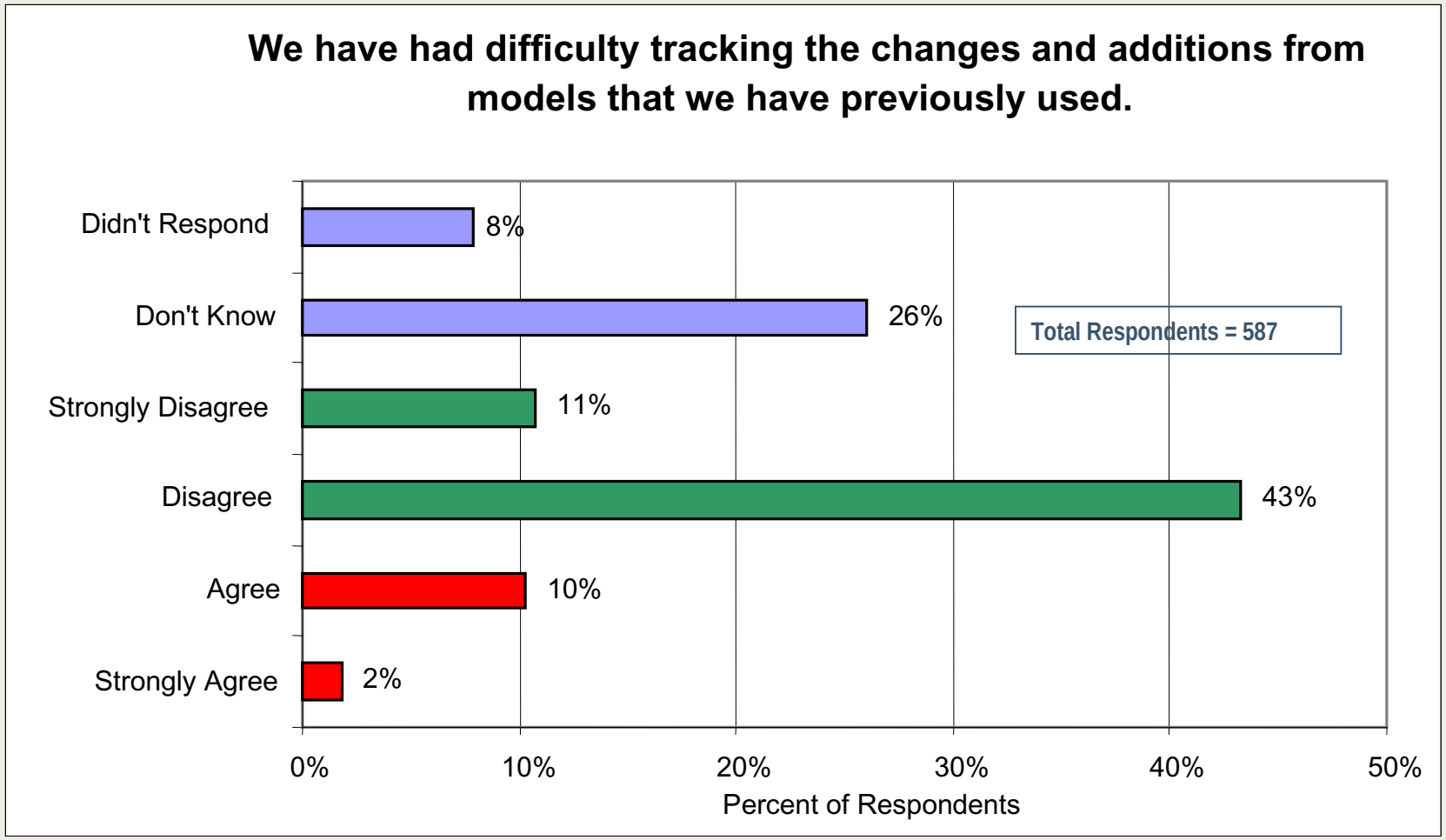




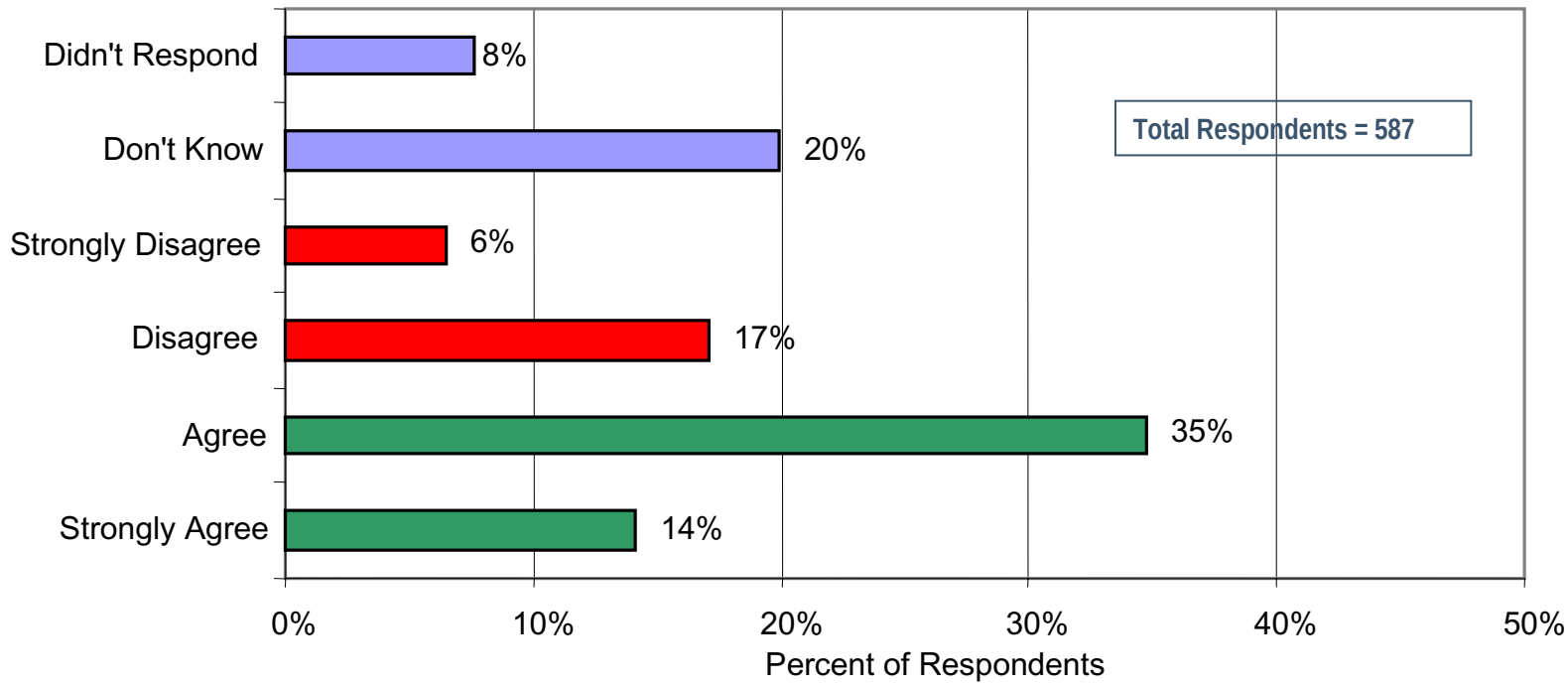




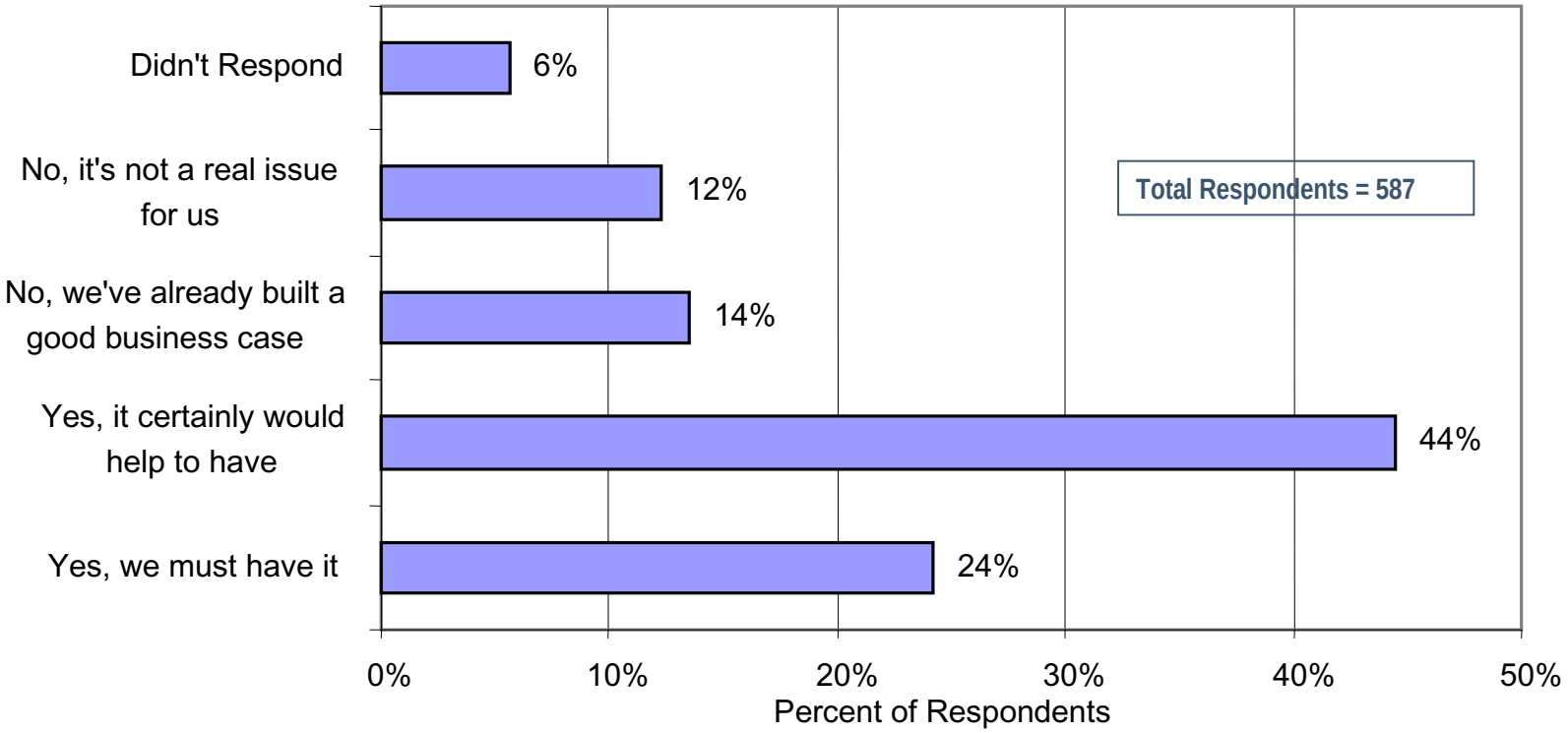




Having a choice between the two model representations (staged or continuous) and variations (SW, SE, IPPD, SS) has been helpful for us.



Does your organization need ROI or other quantitative evidence to help make the business case for adopting CMMI?



Model Components

Seven questions were asked.

Questions addressed

- confusing words or phrases
- inappropriate level of detail
- difficulty of application

The term “comments” is used to show where a respondent provided information. In many cases this information did not contain an issue.

The term “issues” is used where there is a comment that is either positive or negative and can be analyzed.

Generic Goals (GGs) and Generic Practices (GPs) Issues

There were 979 comments received; ~90% contained issues.

Many issues applied to the product suite in general, not just the GGs and GPs.

Some examples of the issues included:

- During SCAMPI interviews, how specific to each PA must the affirmations for GPs be?
- GP 2.8 is somewhat redundant with M&A.
- GP 2.2: What comprises a minimum acceptable plan? Would a description of activities, a budget, and a schedule be considered either necessary or sufficient (or both)? These are not explicitly identified as either necessary or sufficient under GP 2.2 in Chapter 4.

Process Area Issues

There were 2,523 comments collected; 783 were issues (31%).

OPD, CAR, OPF, and OID received the fewest issues.

REQM, PP, and SAM received the most issues. However, these were the first three PAs that respondents encountered in the questionnaire.

Issues are being investigated further during the detailed interviews.

Many of the issues have been submitted as change requests for CMMI Version 1.2.

Other issues will be addressed in frequently asked questions (FAQs).

For a few issues, interpretive guidance will be developed.

Examples of PA Issues

For software development, the practices described in DAR will not have to be applied everyday! The relationships with any business goal are not obvious for software. On the other side, this PA describes good practices for Systems Engineering.

For Measurement and Analysis, SP 2.3: What are "measurement specifications," and what is required to manage and store them?

Breaking out REQM and RD leads to confusion for practicing engineers. Most often these processes for the organization are defined as one. This makes it a little more difficult to evaluate on a SCAMPI.

What We've Learned

The responses were overwhelmingly positive.

Many of the issues are not unique to commercial software, IT, and IS organizations.

Many of the issues will be addressed by SEI activities that are currently underway:

- SCAMPI B and C development
- QA activities
- Frequently asked questions (FAQs)
- Technical notes and articles
- V1.2 revision
- Training updates

What's Next

Provide additional information for change requests already submitted by the Interpretive Guidance project for the V1.2 revision effort.

Generate additional change requests if new issues are discovered.

Identify interpretation issues to be addressed by the creation of interpretive guidance.

Identify positive issues that can be shared as part of our "marketing" communications.

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Conclusion

A final Interpretive Guidance Report will be published in the 3rd quarter of 2004.

Interpretive guidance information will be developed where necessary.

Copies of the preliminary report and this presentation are available on the CMMI Website at http://www.sei.cmu.edu.cmmi/adoption/interpretiveguidance.html

Questions

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For More Information About CMMI

Go to CMMI Web site:

http://www.sei.cmu.edu/cmmi
http://seir.sei.cmu.edu

Contact SEI Customer Relations:

Customer Relations
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Backup Slides

The following slides provide examples of the issues we collected for each PA.

Causal Analysis and Resolution (CAR)

51 comments received; 9 of these were issues

Positive:

- Extending the scope from defects to other problems
- Examples and typical work products are very helpful

Areas for Improvement:

- CAR should really be a level 4 process area (PA). Optimal causal analysis practices are required at level 4 (to resolve causes of variation from expected/historical performance) and level 5 (to fully understand the gaps between performance baseline and performance goals
- This is a level 5 PA and therefore must be driven by data. I don't believe that this is explained well within the model. A better overall diagram of level-to-level behavior is needed.
- This PA risks having people think that root cause analysis does not apply until level 5.
- Typical work products covering other problems could be improved.

Configuration Management (CM)

135 comments received; 33 of these were issues

Positive:

- Appropriate content, well aligned with traditional CM activities

Areas for Improvement:

- Alignment of data management (DM) versus CM is needed due to handling DM in Project Planning separately.
- Configuration audits are frequently confused with quality assurance (QA) audits, especially in an organization that still thinks of testing as a QA activity
- Baseline audits are not applicable for organizations that do, for example, only studies or system engineering analyses
- Some clarification on the conceptual boundary between this PA and REQM would be helpful

Decision Analysis and Resolution (DAR)

84 comments received; 40 of these were issues

Positive:

- Structured decisions analysis process adds immense value for organizational level decisions such as new technology. Initiatives, growth plans, market, new tools which have impact on entire organization

Areas for Improvement:

- The inclusion of DAR as a process area gives it too much emphasis. It seems that it should only be a goal in another process area, or somehow be considered an extension to the base model
- For software development, the practices described will not have to be applied everyday! The relationships with any business goal are not obvious for software. On the other side, this PA describes good practices for Systems Engineering.
- Not sure how to unweave TS, DAR and RD pieces so as to be able to tell when to apply which one

Integrated Project Management (IPM)

62 comments received; 23 of these were issues

Positive:

- Much more useful that ISM in CMM. Has a lot of good practices that benefit the project and provide ROI.
- Very helpful stakeholder information.

Areas for Improvement:

- There is confusion that has arisen in many appraisals about the relative capabilities indicated by the two goals. There is no explicit reference to a "defined process" in Goal 2, so it is unclear whether the collaboration/ cooperation must be seen in the context of a defined process or simply a managed process. As a result it is common to have ratings of "Not Achieved" for Goal 1 and "Fully Achieved" for Goal 2.
- "Integrated plans"--unclearly described.
- There is no real linkage between the two "normal" goals and the IPPD goals; they are absolutely separate. There is no reference to a "defined process" in any of the IPPD material! Some effort needs to be made to make the overall content in the IPPD extension consistent.

Integrated Supplier Management (ISM)

60 comments received; 18 of these were issues

Positive:

- Good addition to SAM

Areas for Improvement:

- PA is OK, but is an overkill for small projects. Do the activities defined in the PA, but not as formal as required.
- Most things of ISM should be done at level 2.
- "Little A" acquisition process adds very little value over SAM, and does not address the process content needed for a mature acquisition organization (as in SA-CMM). There is insufficient value of this PA to justify its adoption.
- Very redundant with SAM - but, at least it was easier to address that way.

Integrated Teaming (IT)

51 comments received; 14 of these were issues

Positive:

- IT PA is suitable for embedded, real-time systems.

Areas for Improvement:

- This is one PA we are not fond of. We do everything in the PA, but a lot more informally. This PA may be an overkill on teaming.
- Use the People CMM process areas as needed to establish the same purpose.
- Team charter and shared vision are particularly important when the team members are coming from different organizations. But it also the case where the model is difficult to apply and particularly when the assessed organization is only a component of the IPT even if it is the leader.
- Could be combine with PP as a planning PA.

Measurement and Analysis (MA)

167 comments received; 67 of these were issues

Positive:

- Separating M&A into a separate PA is one of the most powerful changes from the CMMs, since it highlights the integration of business objectives and goals with the measurement data collected, analyzed, and reported. Prior implementations of measurement were weak, ineffective, ambiguous, and undirected.
- Actually it was 'Establish Measurement Objectives' combined with the GP 'Plan the Process' that was most useful as we had not planned this process sufficiently before.

Areas for Improvement:

- Useful information but too much detail. A level 2 organization is not able to meet this criteria. Too costly for projects. Not applicable for small tasks or projects.
- SP 2.3: What are "measurement specifications", and what is required to manage and store them?

Organizational Environment for Integration (OEI)

59 comments received; 23 of these were issues

Positive:

- Appreciate the inclusion of the IPPD concepts into the model.

Areas for Improvement:

- Too wordy and has a lot of elements that we feel are not necessary or should not be required. Management in particular, does not like putting the incentive for integration on paper
- SP1.2-1 - need some more specific guidance on what is needed for the integrated work environment and what alternatives would satisfy.
- Combine with OT under a Work Environment PA to reduce volume.

Organizational Innovation and Deployment (OID)

48 comments received; 12 of these were issues

Positive:

- Glad to see that PCM and TCM have been merged. The fact that both existed in the CMM made little sense.

Areas for Improvement:

- TCM was diluted by the way it has been implemented in CMMI.
- Concerns on the de-emphasis of incorporation of new technologies into end products. This will be a missed opportunitity for those undertaking process improvement in terms of the benefits and results they will report on.
- The Systems Engineering CMM's Manage Product Line Evolution provided a wonderful perspective on the need to identify and evolve the products provided to customers. This is missing in CMMI and references to product in OID are weak.

Organizational Process Definition (OPD)

52 comments received; 4 of these were issues

Positive:

- Clear definition of organizational process assets has been useful.

Areas for Improvement:

- Never seen an organization achieve level 2 without a Process asset library. That portion of the model might belong in level 2
- Combine with OPF to reduce volume
- SP 1.3 in many cases would have very limited applicability with a new trend that is emerging - 'pre-tailored lifecycles' that are proven to work

Organizational Process Focus (OPF)

65 comments received; 10 of these were issues

Positive:

- Well aligned with OPF/OPD from SW-CMM -- little or no transition impact for organizations that already have process improvement programs in place.

Areas for Improvement:

- We have struggled with OPF SP1.1 and MA SP1.1. These practices need to be integrated and supportive of each other. However, the different verbage used in each "process needs" "information needs" do not always map easily.
- I have never seen an organization get to level 2 without this. Not sure why it is in level 3.
- Combine with OPD to reduce volume.

Organizational Process Performance (OPP)

53 comments received; 19 of these were issues

Positive:

- Merging the SW CMM material for SQM and QPM, and then splitting them based on what the organization does (OPP) and what the project does (QPM) was a very effective reorganization. It has made implementation of, and mapping to, the material much more straightforward.

Areas for Improvement:

- For SP1.2, change the word "Establish" to "Refine" since the process measures have to be in place already to perform this process area. It is not a matter of selecting process measures but deciding which existing measures should be quantitatively managed.
- SP 1.4 and SP 1.5 are highly confusing ... which is required first, a model and then a baseline or a baseline and therefore a model!

Organizational Training (OT)

62 comments received; 20 of these were issues

Positive:

- Like the separation of organizational training from project training (in PP). This provides greater focus within the PA, and makes it easier to facilitate adoption.
- SP 1.2 is useful, since we do have some training needs that are the responsibility of the organization, and some that are the responsibility of the projects

Areas for Improvement:

- SP 2.3: Are class evaluation forms filled out by the students sufficient evidence of this practice? What about those forms, plus a statistical summary of the data on these forms? What about those forms and the summary, plus evidence that this summary was reviewed by those responsible for the organizational training program?
- There is confusion about the interpretations of the relationship between strategic and tactical training needs.

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Product Integration (PI)

83 comments received; 26 of these were issues

Positive:

- Product Integration and Build was a neglected area in CMM

Areas for Improvement:

- Not completely clear to the meaning of "sequence" relative to the integration of product or product components. Example, for “assemble", it is described as the assembly of the products or components. In software, this is actually accomplished by the use of scripts to automatically perform then creation of the load module (or "executable" for instantiation during product execution). The executable is then verified to perform its intended purpose according to requirement. It is difficult to show this "assembly" process results. This does not appear to be workable for large scale, software intensive projects.
- Too many references to product/ product components assembly vs. software/ services.
- Considerable redundancy with REQM, DAR and CM.

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Project Monitoring and Control (PMC)

158 comments received; 41 of these were issues

Positive:

- We were fortunate to have most of the PMC covered by the preexisting PMC processes developed for our ISO 9001 certification
- Helped a lot to better focus on Quality

Areas for Improvement:

- Could clarify what is intended by the terms "commitments", typical implementations/artifacts, and how they are established, monitored, and revised.
- Can be difficult to distinguish between risk management at level 2 (PP, PMC)and level 3 (RSKM). In my opinion, PMC goes too far in risk mitigation - the proactive management of risks is best treated at ML3.
- It seems inconsistent not to include a practice for tracking the acquisition of needed knowledge and skills against the plan for needed knowledge and skills developed under PP.

Project Planning (PP)

197 comments received; 91 of these were issues

Positive:

- The move to attributes, with examples, away from size
- Abandoning critical computer resources as a mandatory element

Areas for Improvement:

- Define work breakdown structure (WBS) or identify what information constitutes a WBS. Define what goes into a project plan. Provide more examples of 'attributes' of products. Amplify information about Data Management Plan.
- Clearer on "size" estimates; are they required (different lead appraisers/consultant interpret the model differently)
- The level of detail available for explanation of SP1.4 for system engineering projects is insufficient. For system engineering projects, engineering judgments may also be a good method of basis of estimates.

Process and Product Quality Assurance (PPQA)

152 comments received; 57 of these were issues

Positive:

- Adding the product evaluations to this PA. Project always confused the process and product audits so now they are doing both.

Areas for Improvement:

- Our quality function is distributed across the organization. This fact made it very difficult to fulfill this process area, due to the interpretation of "objectivity". There was difficulty in bringing the assessment team to agreement that a distributed quality function could be objective.
- Redundant with verification and validation. By separating these into different PAs, you have added cost and people to a project. This is not feasible in today's market.

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Quantitative Project Management (QPM)

51 comments received; 10 of these were issues

Positive:

- This PA allowed us to focus more directly on process and procedure problems and improvements. Quantitative analysis quickly separates the wheat from the chaff

Areas for Improvement:

- SP 1.2-1 has been somewhat confusing. Having to select specific processes based on process capability vs. selecting processes based on standards that have worked as a collective set of processes has led to a number of discussions. In most cases, the latter approach is probably the more realistic approach.
- The de-emphasis of using control charts to define process performance and capability was a mistake. This should have been clarified and emphasized.
- SP 2.2 & SP 2.3 could have been combined since they are overlapping.

Requirements Development (RD)

120 comments received; 48 of these were issues

Positive:

- Introduced in our organization better defined or new concepts (e.g., operational scenarios, non-functional requirements, elicitation, validation)
- Gives a good road map on capturing, analyzing and establishing requirements

Areas for Improvement:

- Why are there validation steps part of the process areas and yet there is still a validation PA? How do they map?
- SP 3.4-3 achieve balance - when do you determine that balance achieved?
- SP 1.4 & SP 1.5 could have been combined as 1.5 is a logical step which could be done in 1.4 itself.

Requirements Management (REQM)

249 comments received; 91 of these were issues

Positive:

- SYSTEMS + SOFTWARE = GREAT
- Traceability has finally been directly addressed

Areas for Improvement:

- Some strong redundancies with configuration management here. REQM looks like some kind of "specialization" of CM. It is not so easy to work with these redundancies
- Bi-directional traceability could be better explained, with examples
- Horizontal versus vertical traceability can be explained better
- Breaking out REQM and RD leads to confusion for practicing engineers. Most often these processes for the organization are defined as one. This makes it a little more difficult to evaluate on a SCAMPI.

Risk Management (RM)

87 comments received; 27 of these were issues

Positive:

- Very good addition to model. Focus on Risk Management as a stand alone process area gives needed focus.
- This PA will be one of the most useful PAs in the model.

Areas for Improvement:

- Clarify difference in RSKM with respect to risk identification and tracking in PP and PMC.
  - Although the specific practices in RSKM should be done according to the Risk Taxonomy established in SG1, it is still redundant as at a CL1 for RSKM, this could be the same as SP2.2 in PP.
- Could be combined with DAR under a decision making process area.

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Supplier Agreement Management (SAM)

197 comments received; 91 of these were issues

Positive:

- Obviously a vast step above the SCM of SW CMM
- Goals and practices are well aligned with typical industry processes for supplier selection and monitoring.

Areas for Improvement:

- Both SAM and ISM neglect an important topic: procurement planning
- Is purchasing from a catalog a supplier agreement?
- The sudden inclusion of COTS in SG2 seems a little out of place. Need to clarify the concepts of how COTS applies and fits into this PA (and relationship with other PAs, TS etc.)
- SP2.1-1 should be in goal 1

Technical Solution (TS)

101 comments received; 39 of these were issues

Positive:

- Improves the way project managers and engineers judge their technical solutions. Gets away from running a one man show with only that person's ideas.

Areas for Improvement:

- Not sure how to unweave TS, DAR and RD pieces so as to be able to tell when to apply which one
- Very difficult to map to a service environment. Most of the work is of 2 - 5 days duration. You will not be evaluating alternatives.
- SP1.2 - practice is redundant - in at least one industry guideline, "operational concept" includes scenarios, environments, conditions, operating modes, operating states, and much more.

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Validation (VAL)

89 comments received; 45 of these were issues

Positive:

- The introduction of this PA is extremely useful to explain to people what it is all about and the added value on top of verification.
- Definition of validation (purpose and introductory notes)

Areas for Improvement:

- Separating Validation from Verification was a mistake. In practice, many organizations are not specifically responsible for Validation.
- SP 1.1: Can validation be applicable to interim work products as well as the final "products and product components"? This is mentioned in the Validation PA Introductory Notes, but not here. Suggest that if applicable, it should be explicitly mentioned in this practice and/or the elaboration of this practice.

Verification (VER)

90 comments received; 43 of these were issues

Positive:

- Very useful PA for project with safety constraints

Areas for Improvement:

- Lot of literature talks about Verification and Validation together. Also, some organization perform V&V. In such situations, how can these PAs be interpreted separately and implemented?
- Sometimes difficult to separate the evidence for PI vs. VER vs. VAL because they are often done in the same tests.
- Need to define inspections, structured walkthroughs and active reviews in Glossary
- Its confusing from the standpoint that peer reviews are a form of verification (a way to verify) and they are called out separately even when they should be subsumed under the other goal