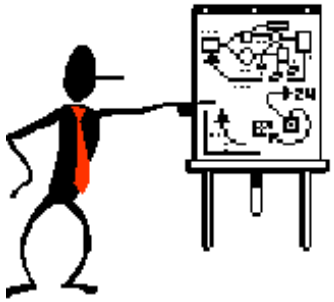
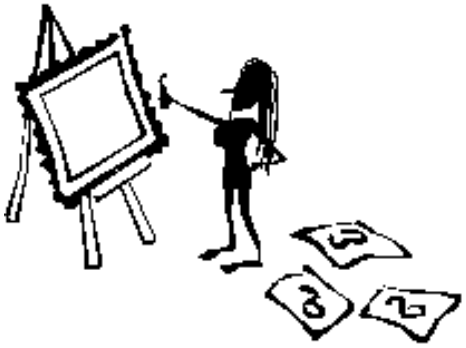
TeraQuest

AgileDigm Incorporated

Measurement within the CMMI®



09 March 2004
SEPG 2004
Orlando, Florida

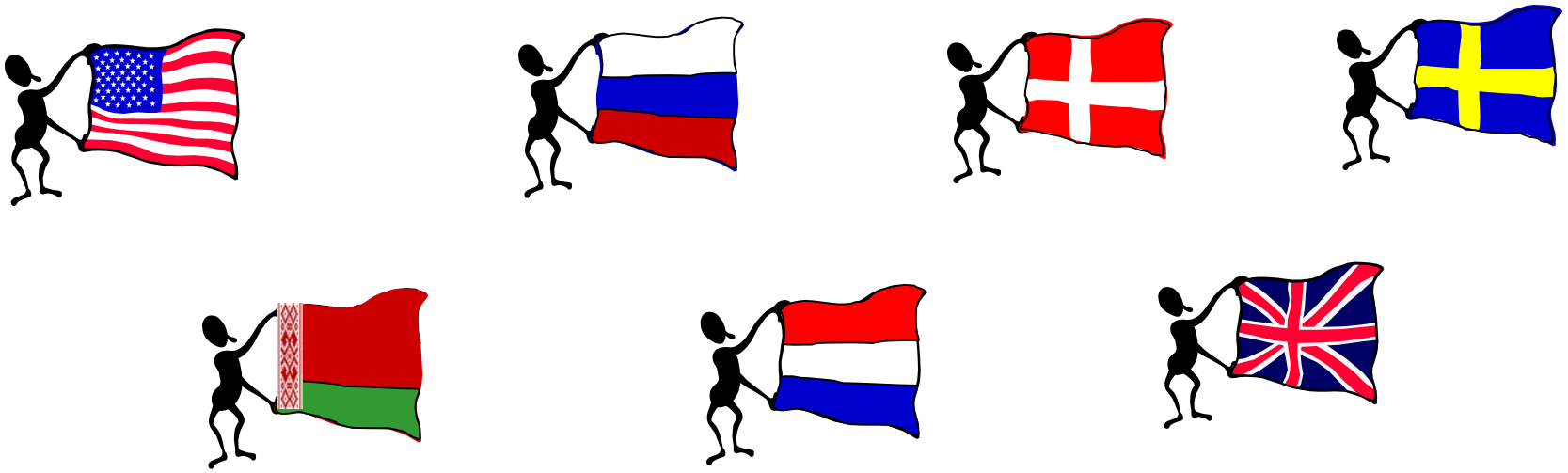


Kent Johnson
kent.johnson@teraquest.com

Margaret Kulpa
margaret.kulpa@agiledigm.com

Introduction

We have been working with companies around the world to better understand how CMMI can work for them. Some of these countries are represented here.



Our goal with this presentation is to share a few lessons learned from working with these world class engineering organizations on their process improvement journey.

Outline

The CMMI has increased the focus on measurement over previous models.

The topics covered include:

- Measurement and Analysis (M&A) Process Area
- Measurements within Engineering Process Areas
- High Maturity (Level 4 and 5) Measurement
- Evolution of Measurement as Processes Mature

This presentation includes the ways in which a number of organizations have addressed this change in focus.

M&A Process Area - 1

Why a new Measurement and Analysis PA?

Many organization that used the family of CMMs have learned that measurements need to be

1. **Aligned to the business objectives to provide benefit**
2. **Used regularly in order justify the effort and cost**
3. **Well defined in order for people to understand and compare them**
4. **Communicated in an unbiased manner**

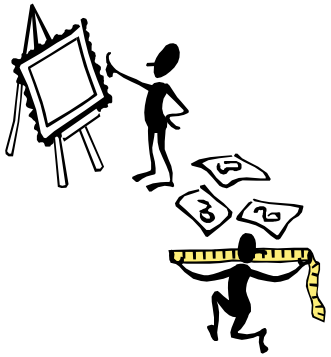
Some organizations just went through the motions of collecting the example measures to pass an assessment and received little or no benefit.

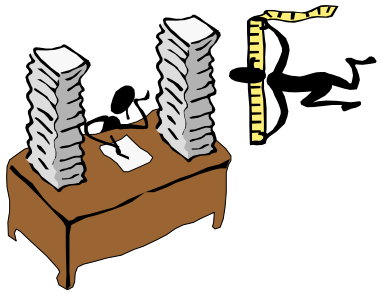
M&A Process Area - 2

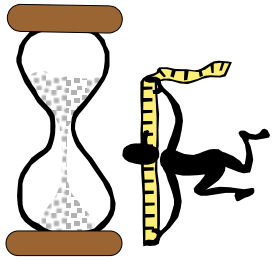
The new PA puts focus on "measurement capability that is used to support management information needs."

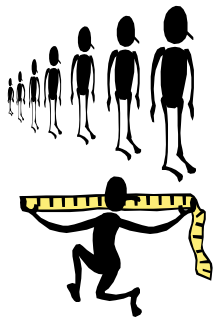
Specific Goals

- **Measurement objectives and activities are aligned with identified information needs and objectives.**
- **Measurement results that address identified information needs and objectives are provided.**









M&A Process Area - 3

What are information needs?

No definition in the CMMI, but the sources are identified as including:

- **Plans – Project Plans, Strategic Plans, Business Plans, and Process Improvement Plans**
- **Monitoring of Project Performance**
- **Management Objectives**
- **Formal Requirements or Contractual Obligations**
- **Recurring or other troublesome management or technical problems**

Measurement specifications

- **Define measures that are aligned to the organization through information needs**
- **Detailed definition or specification of what is to be measured (precise and unambiguous), how it is to be measured, and how measures should be analyzed.**

M&A Process Area – Summary

What people have really done regarding M&A

- Most organizations are developing a rationale for why they have their current measures (not an analysis of what they need).
- Few organizations are really analyzing how their measurement programs support business objectives and information needs.
- Most organizations don't invest serious time and effort into developing meaningful measurement specifications. Therefore their results continue to be disappointing.

Engineering Process Areas - 1

Why additional engineering measures?

Customers are looking for higher and better quality in shorter time.

- The Wall Street Journal developed a Tech To-Do List published in Nov 2003. On the top of their list is "Make Software More Reliable"
- Measuring the development process can lead to better products.

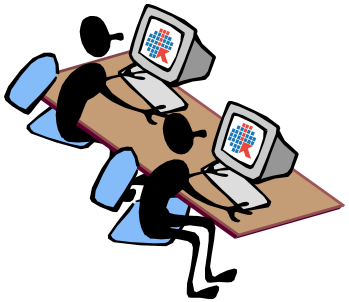
The CMMI has increased the level of engineering detail over the CMM.

- This alone results in an increase in the number of suggested measures.
- Many people see this amount of measurement as overwhelming.

Engineering Process Areas – 2

More measures with the addition of the Engineering PAs

- Requirement Management (ReqM)
- Requirement Development (RD)
- Technical Solution (TS)
- Product Integration (PI)
- Verification (VER)
- Validation (VAL)



And the multiple ways that the model states or implies the need for measures with regards to all PAs including:

- GP 2.8 Monitor and Control the Process [Area]
- GP 2.10 Review Status with Higher Level Management
- GP 3.2 Collect Improvement Information
- PP and PMC Planning parameters

Engineering Process Areas - 3

PAs	Example Measures from GP 2.8
REQM	Requirement volatility (percentage of requirement changes)
RD	Cost, schedule and effort expended for rework
	Defect density of requirement specifications
TS	Cost, schedule and effort expended for rework
	Percentage of requirements addressed in design
	Size and complexity of product, product-component, interfaces and documentation
	Defect density of technical solutions work products
PI	Product-component integration profile (e.g., assemblies planned and actual, and number of exceptions found
	Integration evaluation problem report trends (e.g., number written and number closed)
	Integration evaluation report aging (i.e., how long each problem report has been open)
VAL	Number of activities planned versus actual
	Validation problem report trends
	Validation problem report aging
VER	Verification profile (e.g., number activities planned versus actual, and the defects found)
	Number of defect detected
	Verification problem report trends
	Verification problem report aging

Engineering PAs – Summary

What people have really done regarding Engineering PA measures

- **Most organization use effort measures related to the process areas to satisfy the Monitor and Control Requirements. This has been shown to provide little benefit.**
- **Some organizations are using measures similar to the examples shown and have demonstrated significant improvements in product quality and less rework.**
- **Most of the organizations that we work with have developed their own in house tool suites that provide measurement data as a side effect of performing the work.**

High Maturity -1

What are high maturity measures and how do you really use them?

Confusion exists around measurement concepts and terms at Level 4 and the use of measurement at Level 5.

- **Level 4: The CMMI does not tell you what a Process Performance Baseline or Process Performance Model looks like – nor why you want them.**
- **Level 5: People are confused about what is the difference between process improvement at Level 3 and continuous process improvement at Level 5.**

High Maturity - 2

Level 4 is focused on predicting the performance of the processes based on historical and project data and managing according. Important Level 4 Concepts:

- Event Level Measure – a measure taken at the completion of an event
- Process Performance Baseline (PPB) – documents the historical results from a process. Used as a benchmark against actual project performance.
- Process Performance Model (PPM) – describes the relationship among attributes of a process and its work products. Based on PPBs and calibrated to the project. Used to estimate or predict a critical project value that cannot be measured until later in the project's life (e.g., no. of delivered defects or total effort).

Source: Interpreting the CMMI

High Maturity - 3

Status Measures
- Size
- Effort
- Cost
- Schedule

Event Level Measures

Hours per event - Productivity
- Requirement (defined)
- Requirement (designed)
- Object Implemented
- Test Executed

Defects, Size, Hours per Event – Quality
- Design Review
- Inspection
- Test Executed

Days Late or Early - Schedule
- Task Completed

Process Performance Baselines

Review Baseline
- Defects per page and per hour

Productivity Baseline
- Hours per requirement by phase

Effort Distribution
- Percentage of effort by phase

Process Performance Models

Effort (estimation and prediction)
- New Development
- Maintenance

Defect Insertion and Removal
- New Development
- Maintenance

Real Project Decisions

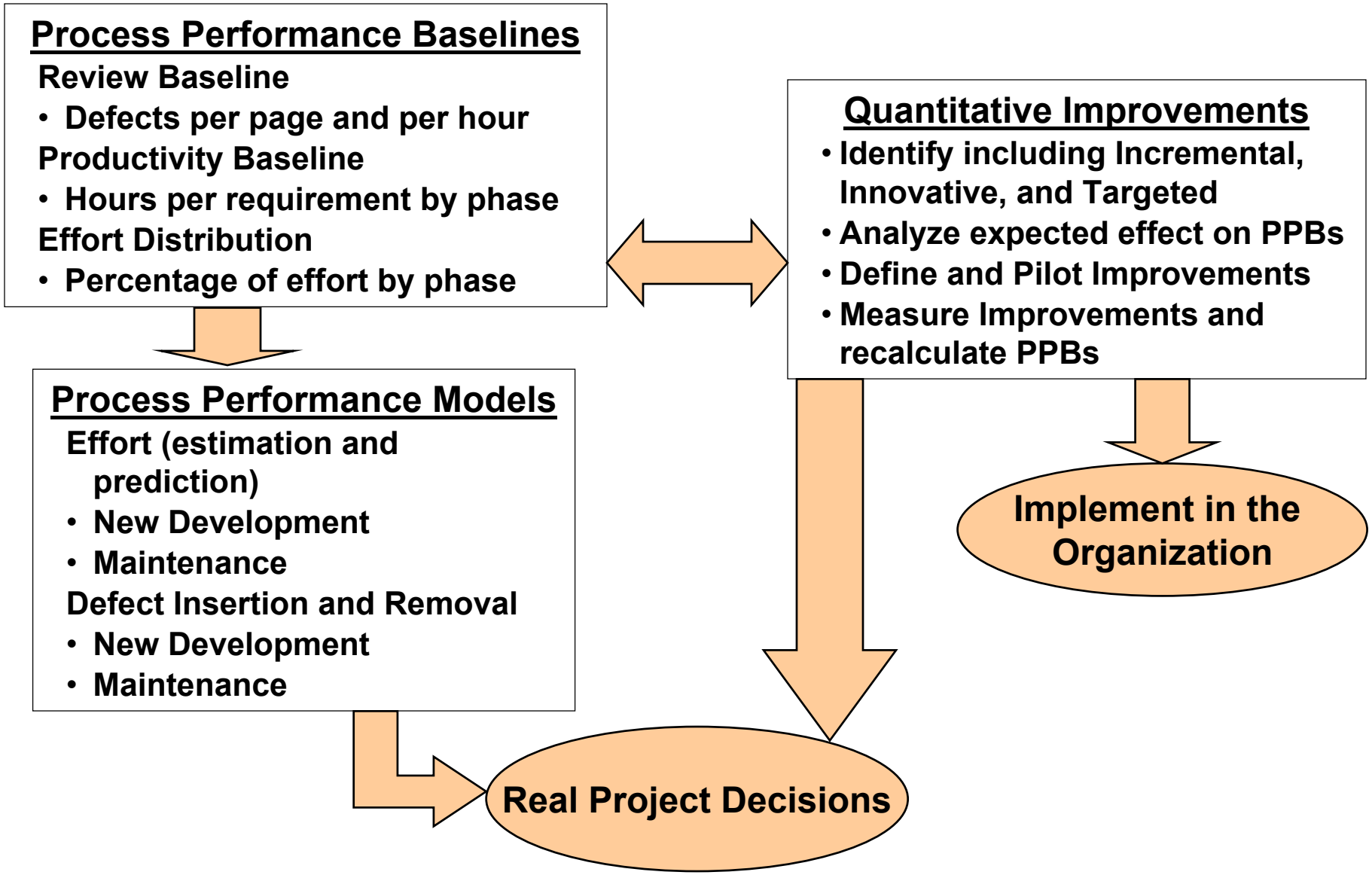
High Maturity - 4

Level 5 is focused on quantitative improvement based on quantitative understanding of the common causes of variation inherent in the processes. Level 5 Concepts

- Incremental Improvements – stepwise improvement accomplished by making the current processes and tools a little better.
- Innovative Improvements – major performance leaps accomplished by bringing in a significantly different process or technology.
- Target Improvements – specific areas that have been identified as problematic, often by senior management (e.g., 20% decrease in complaints).
- Common causes of variation – variation caused by normal and expected interactions among components of the process.

Source: Interpreting the CMMI

High Maturity 5



High Maturity – Summary

Most organizations have problems collecting event level data.

- Many have problems with data collection systems and collecting enough data.
- Many only collect phase completion data.

Successful organizations focus on a small number of PPBs and PPMs that are used to make real decisions, for example

- Review PPB, Effort Distribution PPB, and Productivity PPB
- Estimation/Prediction PPM for effort and duration and a Defect Insertion and Removal Model.

Few organizations perform real continuous quantitative improvement

- Many do not identify and pilot their improvements quantitatively
- Few clearly demonstrate a change in performance baselines.

Evolution of Measurement - 1

The CMMI has a natural evolution of measurement that should occur as organizations strive to improve their processes across the levels.

Most organizations encounter confusion because of what appears to be abrupt differences in scope and terminology.

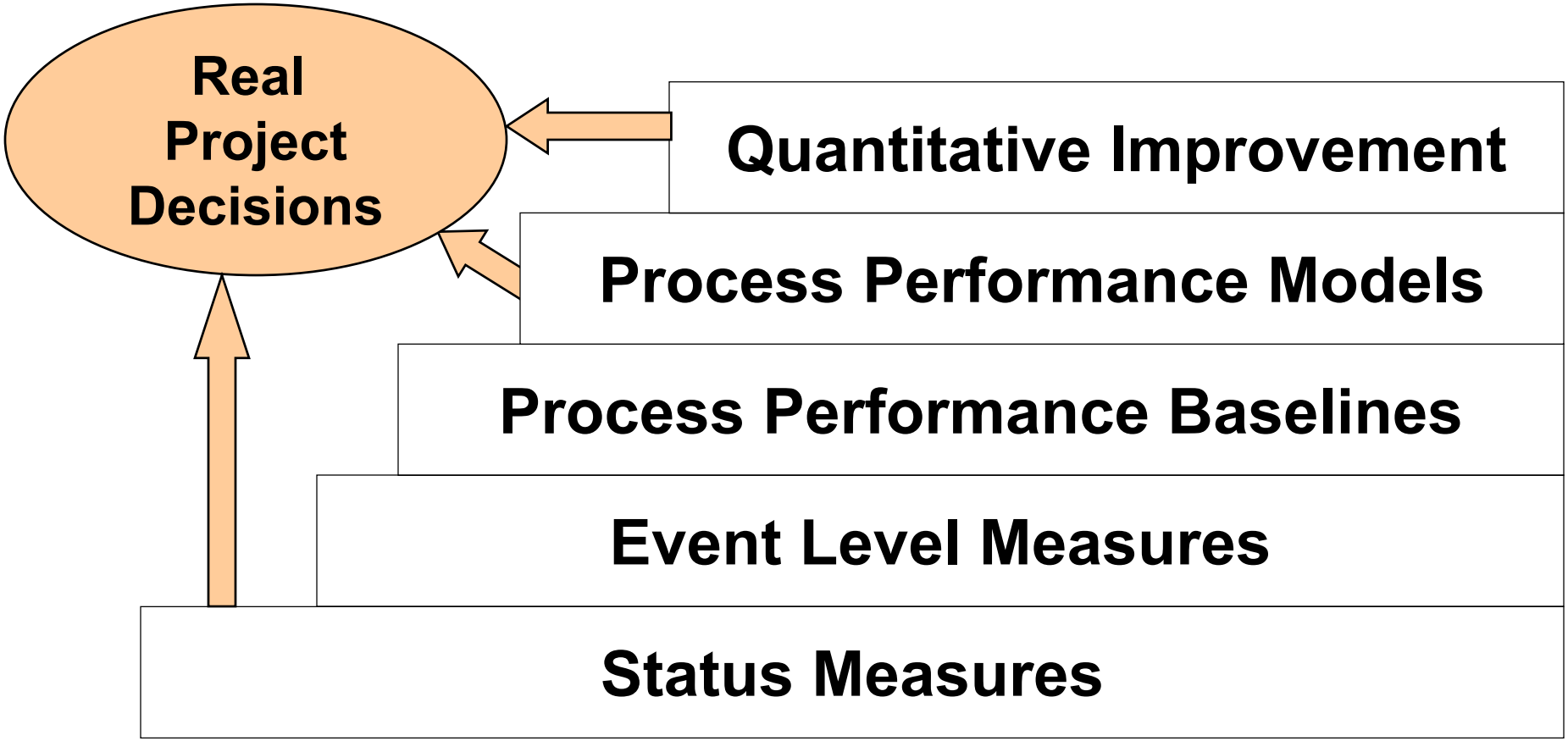
People struggle with the apparent paradigm shifts between the levels as they transition from Level 2 to 3 – from Level 3 to 4 and from Level 4 to 5.

Evolution of Measurement - 2

Measurement concepts are actually consistent and simply evolve through the levels.

- **Level 2: primarily status measures – planned versus actual size, effort, cost, and schedule; also includes number of changes, number of non-conformances in product and processes**
- **Level 3: Adds measures for process improvement and quality measures including defect density and productivity.**
- **Level 4: Creation and usage of PPBs and PPMs. Looks like a drastic change, but PPBs and PPMs are based on historical data from lower levels.**
- **Level 5: Quantitative improvements based on baselines – using PPBs to plan and demonstrate improvements**

Evolution of Measurement - 3



Evolution of Measurement – Summary

Successful organizations have

- **Shown the value from lower level measures to justify the transition to more mature measures**
- **Created useful measurement specifications that work through all the levels**
- **Started using simple PPBs and PPMs early**

Unsuccessful organizations have gone through the actions of collecting measures with little or no benefit – Taking the easy way out with measures and not being ready for the next step.

Summary

Successful Organizations

- Analyze how their measurement programs support business objectives and information needs
- Invest serious time and effort into developing meaningful measurement specifications
- Collect measures “painlessly” and as a side effect of performing the work
- Focus on a small number of PPBs and PPMs that are used to make real decisions
- Perform real continuous quantitative improvement

Contact Information

Contacting the Presenters:

Kent Johnson
Director of Systems Engineering
TeraQuest Metrics, Inc.

kent.johnson@teraquest.com
office phone: 1.386.673.1384

Margaret Kulpa
Chief Operating Officer
AgileDigm, Inc.

margaret.kulpa@agiledigm.com
office phone: 1.386.673.3600

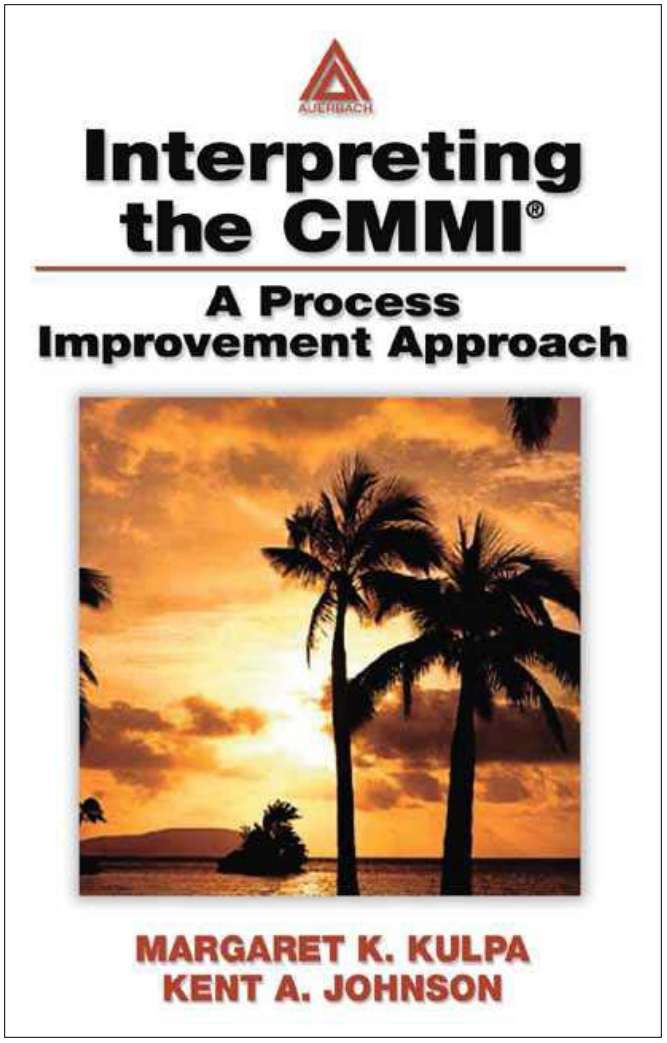
Contacting TeraQuest:

TeraQuest Metrics, Inc.
P.O. Box 200490
12885 Research Blvd., Suite 207
Austin, Texas 78720 USA
www.teraquest.com

Contracting AgileDigm

AgileDigm, Inc.
11 Twelve Oaks Trail
Ormond Beach, FL 32174 USA
www.agiledigm.com

More Detailed Information of the Subject



Features includes

- Presents the pros and cons of attempting process improvement and implementing CMMI®
- Guides you through a proven approach for designing the process improvement effort, for monitoring and controlling the effort, and measuring its success
- Offers advice for implementing several process improvement projects simultaneously to avoid added costs and missteps
- Discusses older methods of assessing organizations and compares them to the new SCAMPI method
- Includes a CD-ROM with forms, templates, and examples

Available from Auerbach / CRC Press Publications and Amazon.com