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Measurement Challenges of Higher Levels for SE Capability Models

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AGENDA

- *Continuous and Staged Views*
- *Higher Level Measurement Requirements*
- *Overview of Level 4 & 5 Challenges*
- *Approach to Address These Challenges*
- *Summary*

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Continuous View Models

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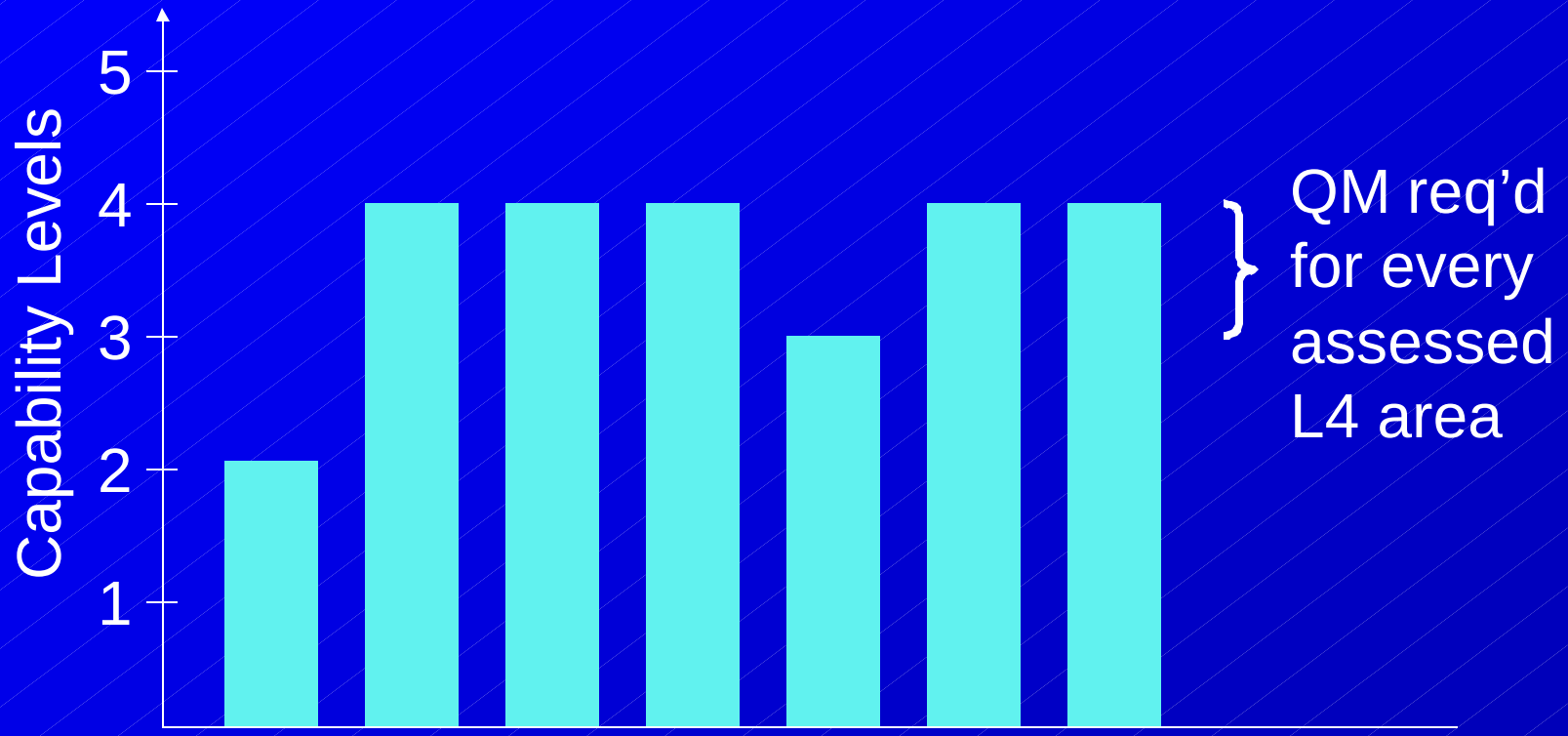

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Measurement at Level 4

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Staged view

- Measurements for key processes for your organization (based on business needs)
- Organization implements and institutionalizes quantitative measurement program

Continuous view

- Measurements for every process/focus area you wish to mature to Level 4 capability
- Can result in 18-19 times as many measurements (measures for each PA/FA)
- Presents additional challenges

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Level 4: Quantitatively Controlled or Measured

- **Use quantitative techniques to manage process performance on projects**
  - Stable process
  - Measure process performance and product quality
  - Feed project measurements to organization
  - Process capability known (average, range, thresholds)
  - Project goals for process performance & product quality
  - Address special causes of variation
  - Control projects against goals
    - Bring the process performance within its natural bounds
    - Focus on project control

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Level 4: Quantitatively Controlled or Measured

- **Ingrained within organization**
- **Measurements incorporated into organizational repository**
- **Take corrective action when determine objectives will not be satisfied**
  - Fix special causes of variation
  - Change objectives
  - Stakeholder agreement to performance shortfall
  - Common cause fixes to meet objectives not required for Level 4

Level 3 Analysis

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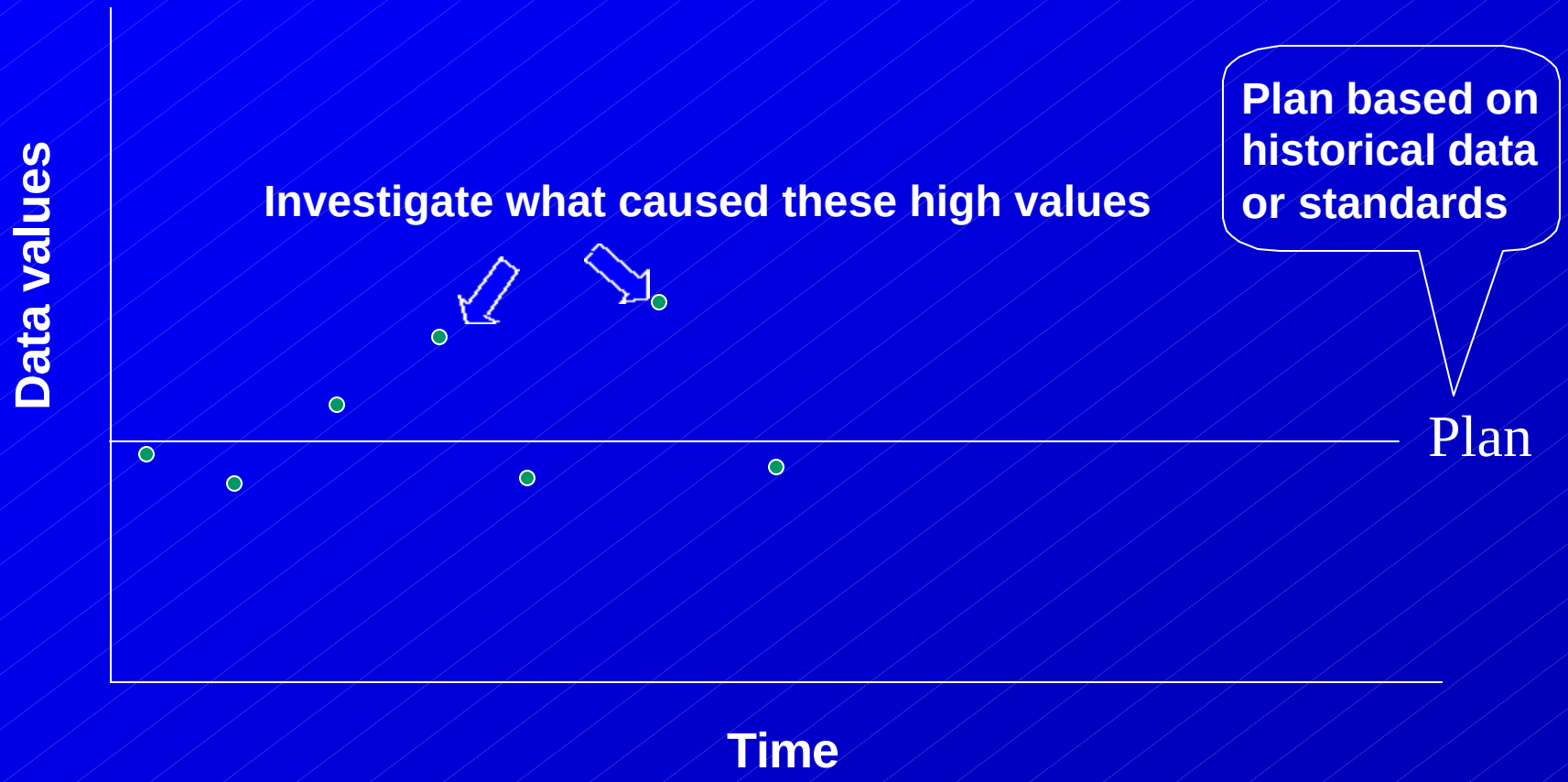

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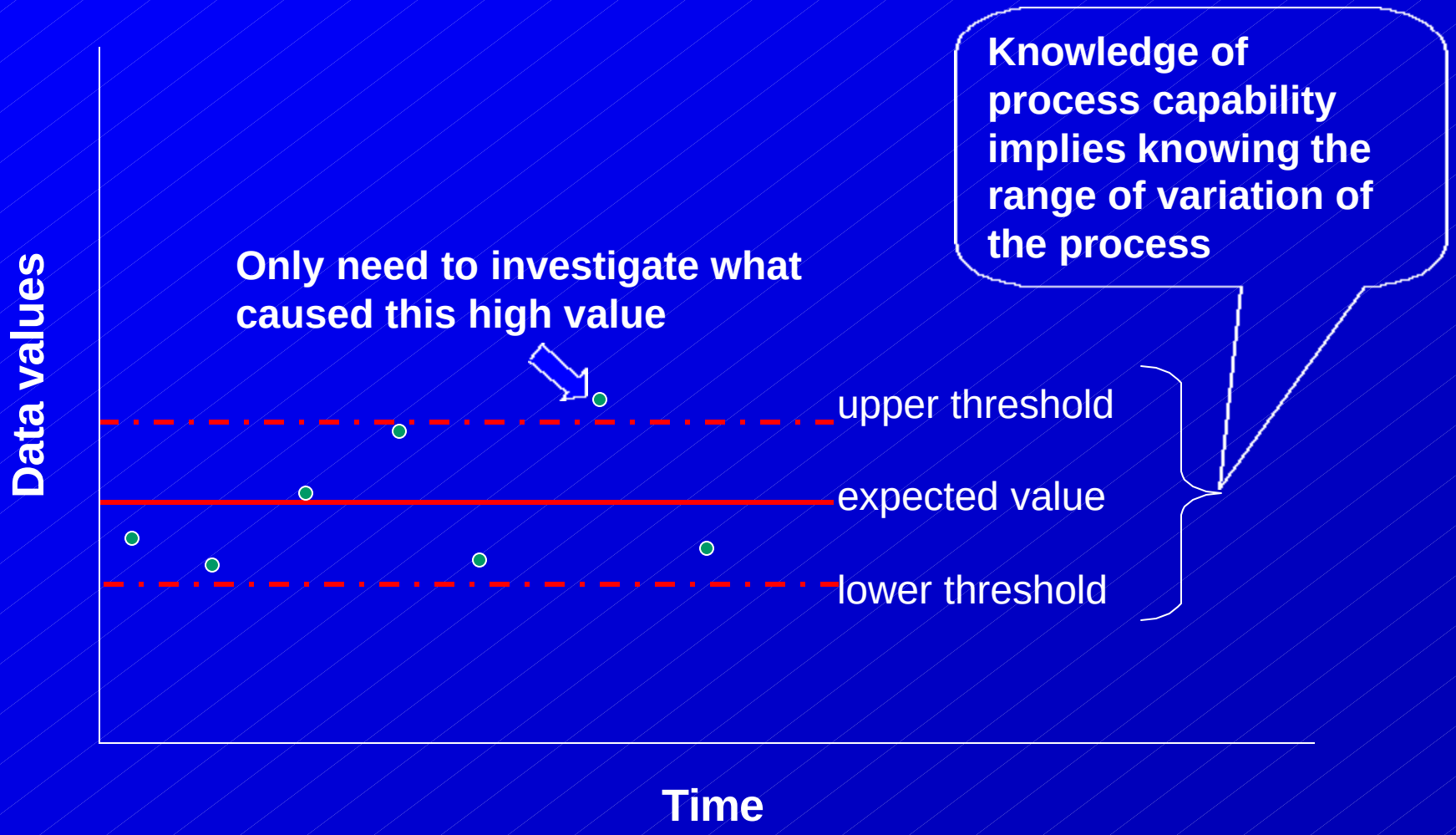
Level 4 Analysis



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Level 5: Continuously Improving or Optimizing

- **Level 5 requires measurements be used to:**
  - identify organizational process improvement opportunities
  - establish quantitative process improvement goals for the organization
  - quantify process improvement accomplishments
  - “reduce common causes of variation”

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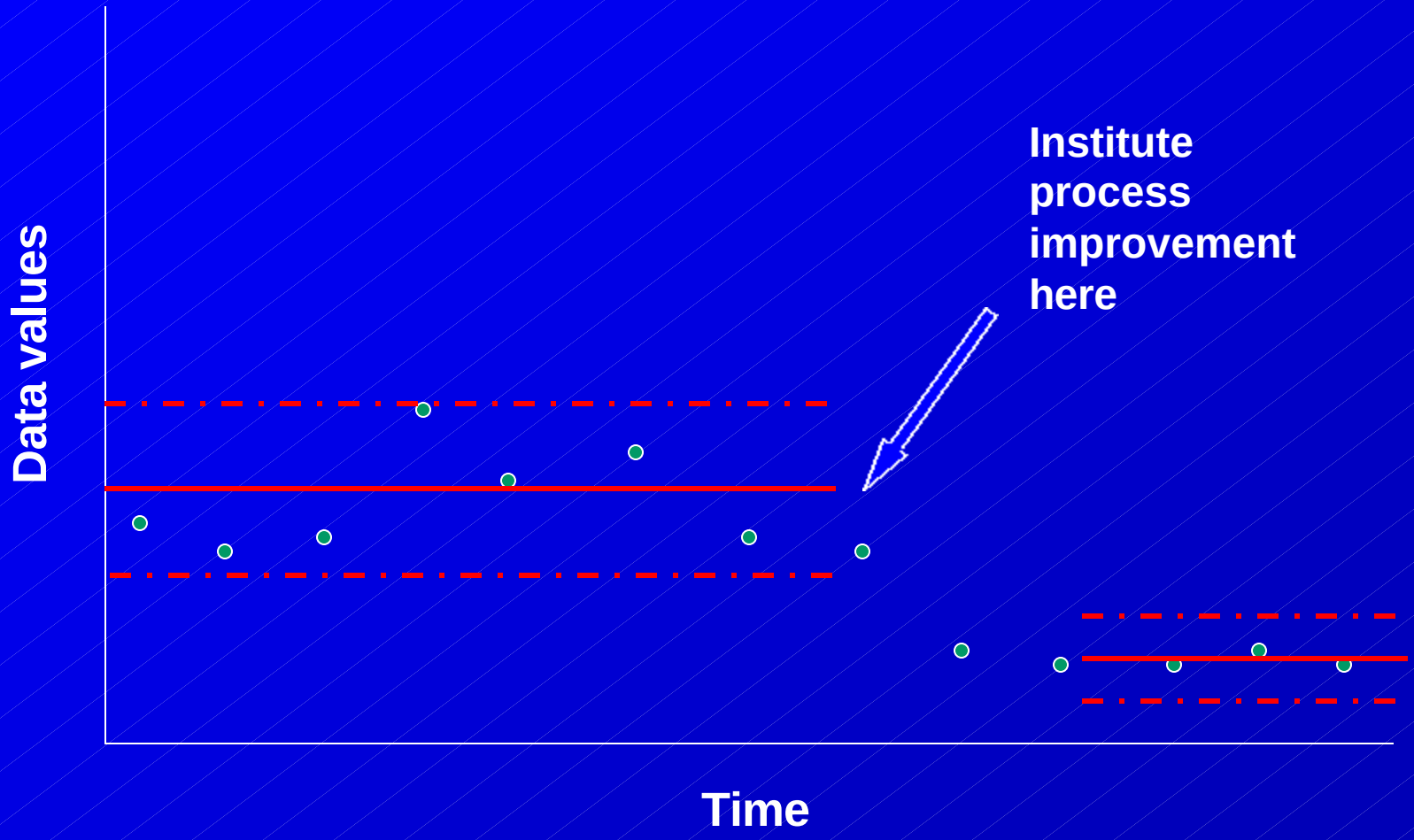
Level 5 Analysis



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Level 4 & 5 Challenges

- **Amount of measurement required**
  - previously discussed
- **Meaning of "Maturity Level" in staged and continuous models**

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Meaning of "Maturity Level" in Continuous Model

- **Not defined by models**
- **Often assumed to mean "Achieve that level in all focus areas"**
- **But, is this what we really want**
  - **See "Interpreting Continuous-View Capability Models for Higher Levels of Maturity" by Sarah A. Sheard and Garry J. Roedler, *Systems Engineering*, 2(1), 1999**
  - **Available from Consortium web site, www.software.org**
- **CMMI draft includes "Equivalent Staging"**
  - Comparable to Sheard/Roedler approach

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Addressing the Challenge

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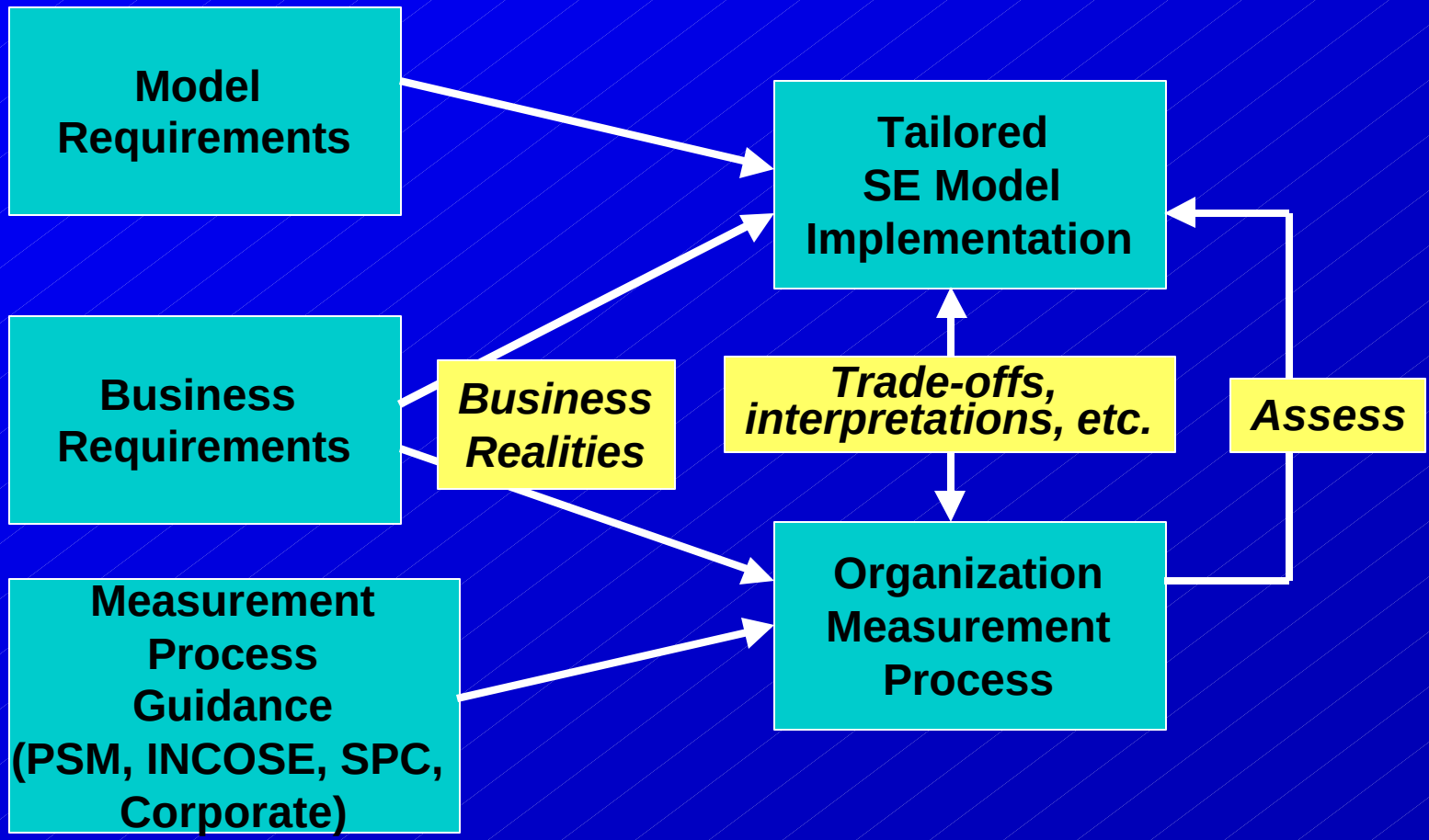
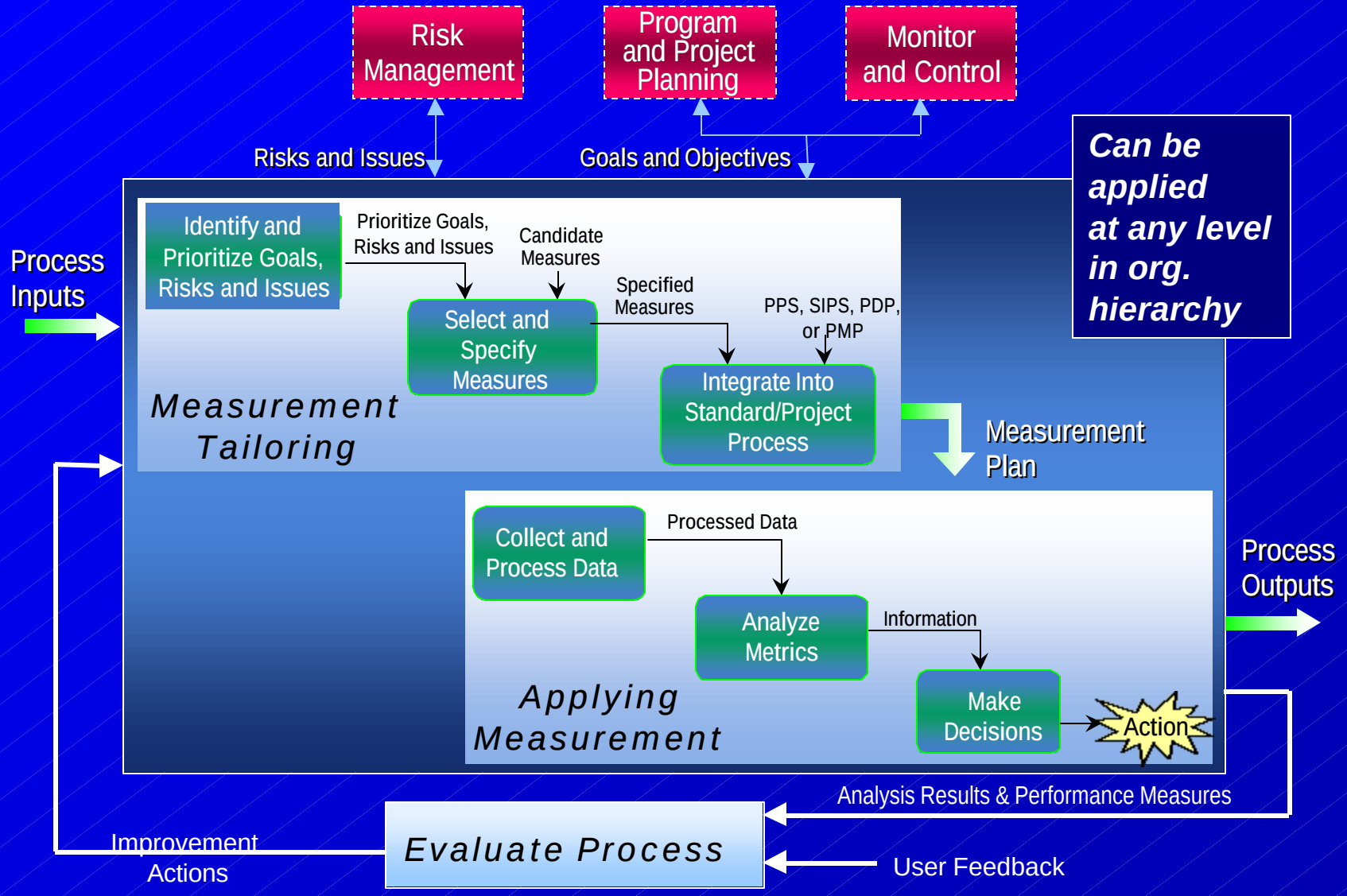
Aligning Measurement to Meet Both Model & Business Requirements



SI Measurement Process



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Measurement Tailoring *(Selection)*

- Key to achieving a manageable set of measures
- Based on issues/objectives at appropriate level
  - Company/Line of Business/Functional Org. Measures
    - Focus on:
      - issues common to most projects
      - information needed to manage the business
      - evaluation of standard process effectiveness
      - evaluation of product quality
      - establishment of process capability
  - Project-Specific Measures
    - Focus on:
      - issues specific to the individual project
      - customer-related or required information needs

Integrated Approach that Considers:

- Product / Process / Project
- Cost / Schedule / Quality / Performance
- Whole Life Cycle (Concept through O&M)
- Organization hierarchy and external data requirements
- Minimizing number of measures

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Measurement Tailoring *(Selection)*

- **Quantity of measures and data availability are major considerations**
  - Identify data available in conduct of processes
  - Identify metrics that provide insight into multiple processes
    - Select measures based on SI processes, not PAs
    - Processes mapped back to PAs for traceability
    - Realized that product performance provides insight into process performance
      - Separate measures are not always necessary
      - E.g., Approval rates provide insight into product quality, but also provide insight into effectiveness of in-process reviews
  - Consider analysis and usage during selection and specification
  - Trade-offs to get most process coverage and insight with least number of measures
- **Document in Measurement Plans**

PAs Included in Assessment

Engineering	Project	Organization
Analyze Candidate Solutions	Ensure Quality	Define Organization's Systems Engineering Process
Derive and Allocate Requirements	Manage Configurations *	Improve Organization's Systems Engineering Process
Evolve System Architecture	Manage Risk	Manage Product Line Evolution
Integrate Disciplines	Monitor and control Technical Effort	Manage Systems Engineering Support Environment
Integrate System	Plan Technical Effort	Provide Ongoing Skills and Knowledge
Understand Customer Needs and Expectations	* Received Level 4 Rating in 1998	Coordinate with Suppliers
Verify and Validate System		

Number of Potential Measures:

- 13 Process Areas
- 1 Process Measure per PA
- 1 Product Measure per PA

} 26 Measures

Organizational Standard Measures

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Issue	Category	Measure
Customer Satisfaction	Customer Feedback	Award Fee Percent
Process Performance	Process Compliance	**Award Fee Comments** Program/Process Tailoring **Self-Audit Findings**
	Process Effectiveness	**Rework Effort Percent**
	Process Efficiency	Cycle Time Variance System Engineering Productivity
Product Quality	Functional Correctness	**Approval Rates**
Product Size and Stability	Functional Size and Stability	TBD/TBR (Percent Overdue)
Resources and Cost	Financial Performance	Cost Variance
	Personnel	Effort (Data Only)
Schedule and Progress	Work Unit Progress	Requirements Verification (Percent Overdue) Self-Audit Progress TBD/TBR (Percent Overdue)

13 measures defined and used. However, 4 measures provided insight across set of processes and products

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Applying Measurement

- **Data Collection**
  - Collect data as process is being performed
  - Use tools to assist, where possible
- **Measurement Analysis**
  - Establish product quality goals and process capability thresholds
    - Establish “loose” thresholds/goals based on available data (if any) and engineering judgment
    - Measure, analyze, and review trends ⇒ adjust thresholds/goals
    - Organizational goals must be consistent with organizational capability and business strategic plan
    - Project goals must be driven by important project issues and integrate organizational goals to the degree appropriate
  - Analyze data collected against goals and thresholds

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Decision Support & Evaluating Measurement

- **Decision Support**
  - Use results of analysis to initiate investigation of outliers and trends
  - Take appropriate action, as warranted by investigation (i.e., quantitatively manage)
  - Document actions & decisions resulting from each measure
    - Get all levels of management involved in decisions
  - Periodically, use analysis results to refine values
- **Evaluating Measurement**
  - Periodically review utility of each measure and retire or modify those of low utility or inconsistent

References & Summary

References & Resources

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Reference

- Sheard, Sarah A. and Garry J. Roedler, "Interpreting Continuous-View Capability Models for Higher Levels of Maturity", INCOSE Systems Engineering Journal, Volume 2, Issue 1

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Summary

- **Continuous view models can drive much more measurement at Level 4**
- **Quantitative management: product quality and process performance are**
  - understood in statistical terms
  - managed throughout the life of the process
- **Quantitative objectives based on stakeholder needs**
- **A structured approach to select and apply measurement is necessary**
- **Quantitative understanding and focus lead to identifying and evaluating opportunities for process improvement**