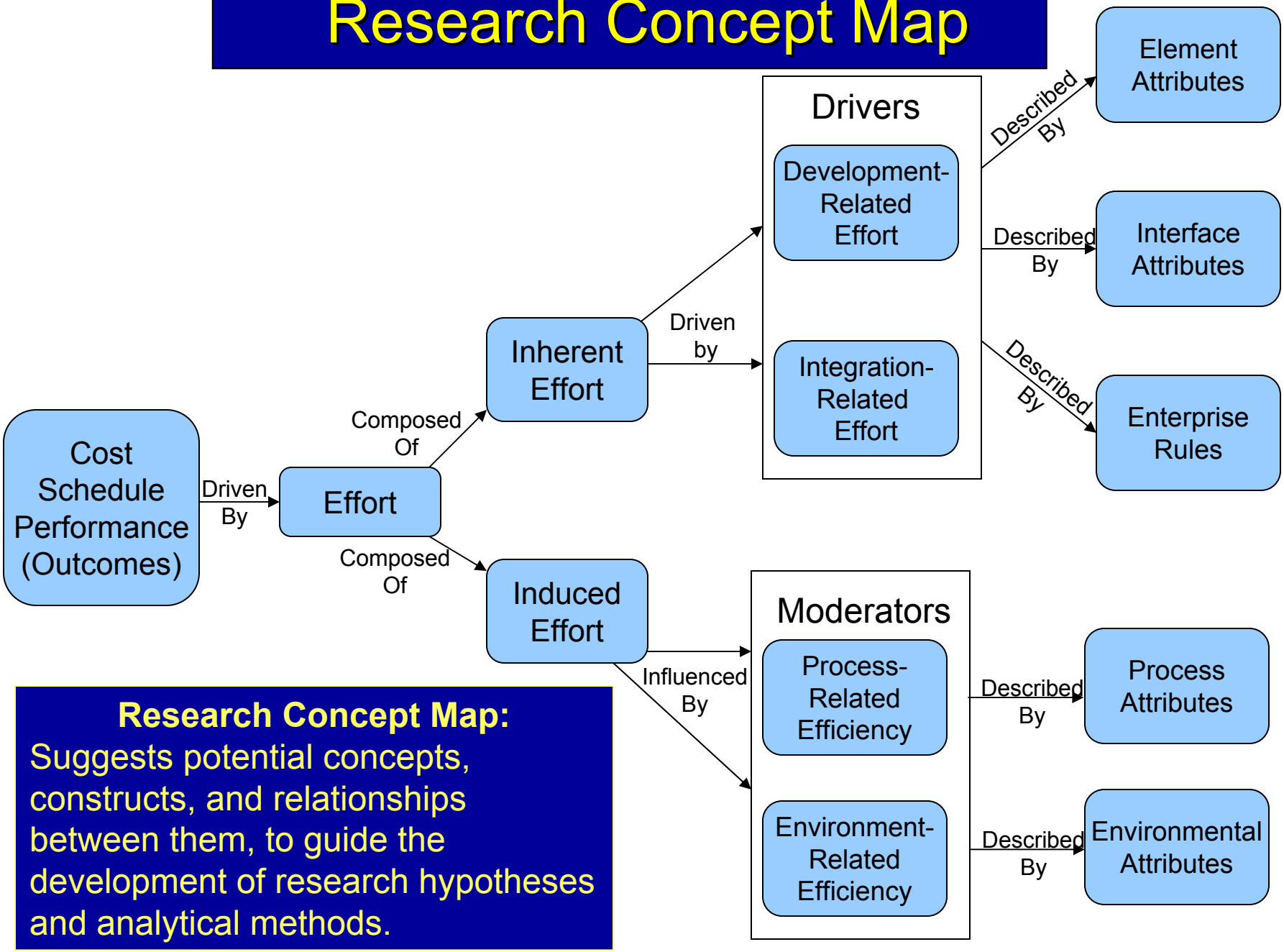
System of Systems Research Project Workshop Outbrief

July 18, 2003

Workshop Objectives

- Identify measurable concepts and possible measures related to SoS taxonomy
- Map measurable concepts and measures to PSM ICM table
- Review & revise SoS Measurement white paper
- Solicit community insights on research project, methodology, etc.
- Identify potential sources of data, relevant research for incorporation into DAU project

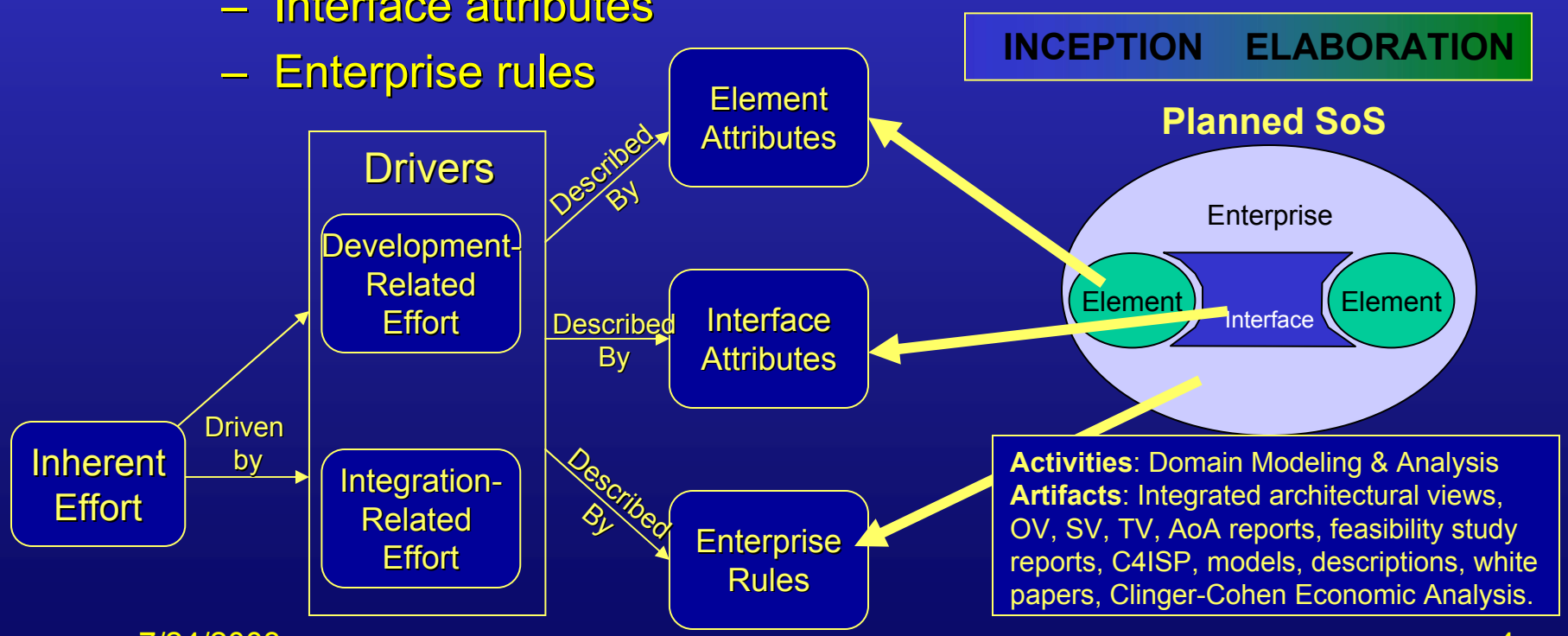
Research Concept Map



Research Concept Map:
Suggests potential concepts, constructs, and relationships between them, to guide the development of research hypotheses and analytical methods.

Drivers of Inherent Effort

- Within this model, we assert that the SoS attributes that drive inherent effort fall into three major categories
  - Element attributes
  - Interface attributes
  - Enterprise rules



Element Attributes

- Number and Size of System Elements
- System Element Design/Complexity
- Homogeneity of System Element design
  - Procedures
  - Architectures
  - Infrastructure
  - Data
- Percentage of elements to be integrated versus built
  - Degree of reuse
  - How many are COTS or NDI?
- Number/complexity of Algorithms
- Others

Interface Attributes

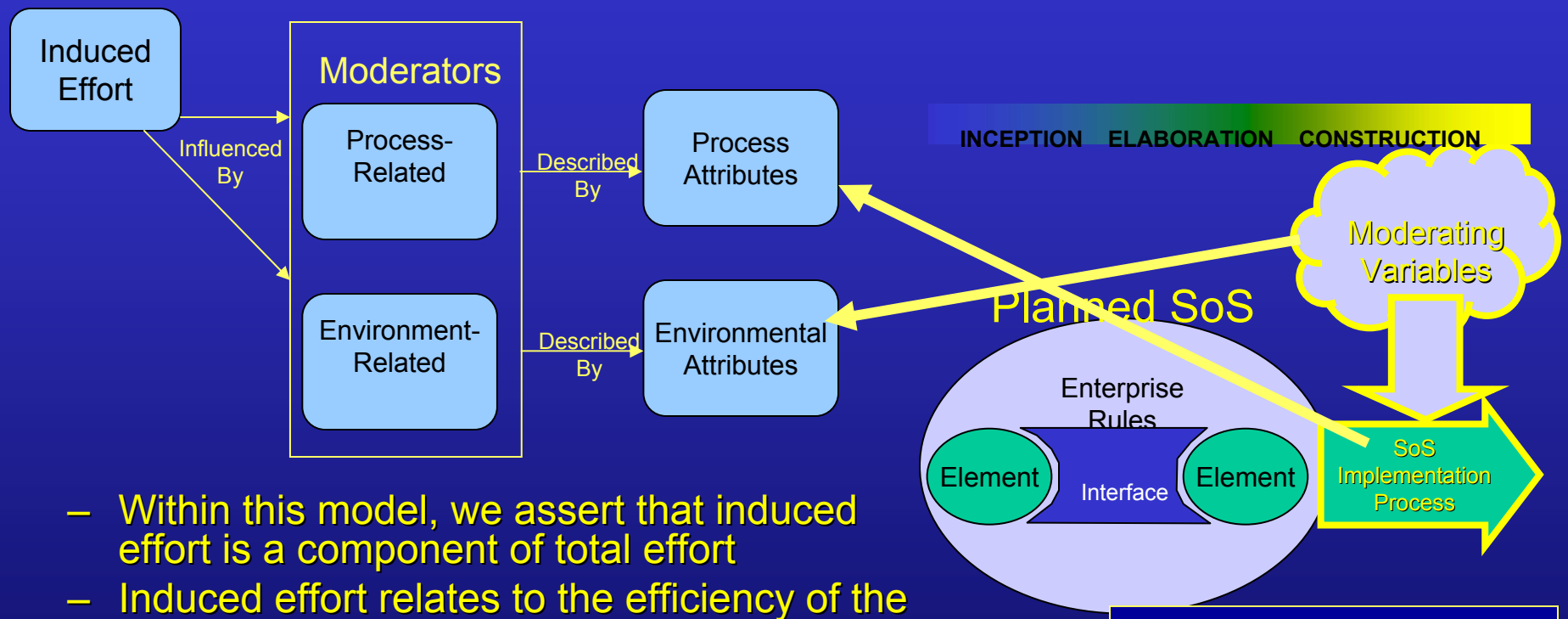
- Number of Interfaces
  - Internal
  - External
- Nature of Interfaces
  - Complexity
  - Volatility
  - Diversity
  - Criticality
  - Security
- Others

Enterprise Rules Attributes

- Synchronous vs Asynchronous
  - Timing constraints for near-real-time SoS
  - Example: sensor-to-shooter applications
- Deterministic vs Stochastic
  - Criticality of event timing/sequencing
    - Particularly important in synchronous applications
- Percent of Total functions that are “global”
  - “thin” versus “fat” clients (distributed components)
- Security, privacy, and safety
- Others

Research Framework

Defense Acquisition University



- Within this model, we assert that induced effort is a component of total effort
- Induced effort relates to the efficiency of the SoS implementation process
- Attributes that influence efficiency of SoS implementation
  - Environmental attributes
  - Process attributes

Activities: Implementation strategy planning, PPBS, AoA, IPT meetings, status reporting
Artifacts: Implementation & acquisition strategies, specifications, SOWs, PPBS exhibits, DAES reports, IPT briefings

Process Attributes

- Acquisition Process
  - What strategy is the SoS implementer pursuing?
    - Single-step to full capability
    - Evolutionary
    - Incremental
  - Do the Stakeholders buy-in to the process?
- Process Capability
  - Does an Enterprise-level process exist?
  - Are Enterprise-level processes being adhered to?
  - Are acquisition processes sufficiently mature to implement the SoS?

Environment Attributes

- Resource Stability & Control:
  - Are the resources allocated to SoS implementation stable over the implementation period?
  - Does the SoS implementer have the ability to identify and maintain resource requirements over the implementation period?
- Unity of Command:
  - Does the SoS implementer exercise control over the development and evolution of individual system elements/components?
  - Does the SoS implementer have the ability to allocate resources and requirements across the system elements?
  - Can the SoS implementer apply risk management strategies at the SoS level?
- Complexity
  - Number of Stakeholders and Requirements Drivers
  - Number of Compliance regulations
  - Number of Oversight entities

Mapping to PSM ICM (example)

Information Categories	Measurable Concepts	Prospective Measures
Schedule and Progress	Element	Elements Developed Elements Acquired Elements Reused
	Interface	Interfaces Defined Interfaces Controlled
	Enterprise Rule	Conforming elements & interfaces Nonconforming elements & interfaces
Product Size and Stability	Element	Number of Elements Element Size Element Type Algorithmic Complexity
	Interface	Number of Internal Interfaces Number of External Interfaces Number of Custom Interfaces Number of Standard Interfaces Interface Complexity Interface Volatility
	Enterprise Rule	Number of Unique Rules Number of Common Rules Number of Global Rules
	Aggregate	Number of Operational Scenarios

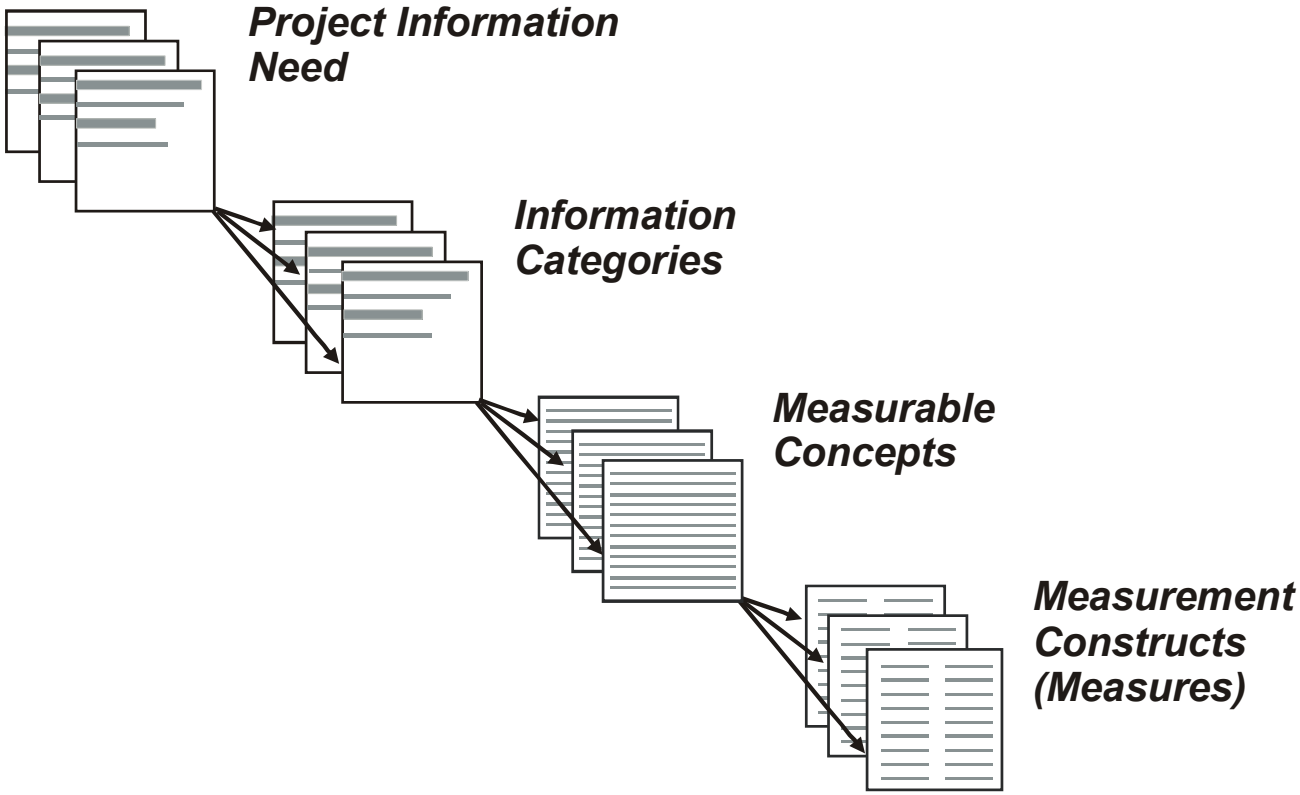
Mapping to PSM ICM (example)

Information Categories	Measurable Concepts	Prospective Measures
Product Quality	Element	Same
	Interface	Defects Incompatibility Reduced throughput Translation errors Change rate Standards compliance
	Enterprise Rule	Compliance Conformity Balance
Process Performance	Element	
	Interface	
	Enterprise Rule	
	Aggregate	Existence of Enterprise-Level Processes Adherence to Enterprise-Level Processes Suitability of SoS Implementation Process Feasibility of SoS Implementation Process Stakeholder Buy-In to Process

Next Steps

- Post Draft White Paper on PSM Website
- 25 July Outbrief to OUSD(AT&L), OASD(NII), OSD CAIG on FY03 DAU research results
- Post FY03 Research results on PM COP website
- Continue the dialog

PSM Measurement Hierarchy



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Information Categories

- Schedule and Progress
- Resources and Cost
- Product Size and Stability
- Product Quality
- Process Performance
- Technology Effectiveness
- Customer Satisfaction

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PSM Mapping of Information Categories, Concepts, and Measures

Information Category - Measurable Concept - Measure		
Information Categories	**Measurable Concepts**	**Prospective Measures**
Schedule and Progress	Milestone Completion	Milestone Dates
	Critical Path Performance	Slack Time
	Work Unit Progress	Requirements Traced Requirements Tested Problem Reports Opened Problem Reports Closed Reviews Completed Change Requests Opened Change Requests Resolved Units Designed Units Coded Units Integrated Test Cases Attempted Test Cases Passed Action Items Opened Action Items Completed
	Incremental Capability	Components Integrated Functionality Integrated
Resources and Cost	Personnel Effort	Staff Level Development Effort Experience Level Staff Turnover
	Financial Performance	BCWS, BCWP, ACWP Budget Cost
	Environment and Support Resources	Quantity Needed Quantity Available Time Available Time Used
Product Size and Stability	Physical Size and Stability	Database Size Components Interfaces Lines of Code
	Functional Size and Stability	Requirements Functional Changes Function Points

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PSM Mapping of Information Categories, Concepts, and Measures (continued)

Information - Category - Measure Mapping		
Information Categories	**Measurable Concepts**	**Prospective Measures**
Product Quality	Functional Correctness	Defects Age of Defects Technical Performance Level
	Supportability-Maintainability	Time to Restore Cyclomatic Complexity
	Efficiency	Utilization Throughput Response Time
	Portability	Standards Compliance
	Usability	Operator Errors
	Dependability-Reliability	Mean Time to Failure
Process Performance	Process Compliance	Reference Maturity Rating Process Audit Findings
	Process Efficiency	Productivity Cycle Time
	Process Effectiveness	Defects Contained Defects Escaping Rework Effort Rework Components
Technology Effectiveness	Technology Suitability Technology Volatility	Requirements Coverage Baseline Changes
Customer Satisfaction	Customer Feedback	Satisfaction Ratings Award Fee
	Customer Support	Requests for Support Support Time

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