

# **Measuring and Estimating Process Performance**

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# Topics

- **Defining and Controlling Production Processes**
- **Measuring Process Performance**
- **Predicting Process Performance**
- **References**

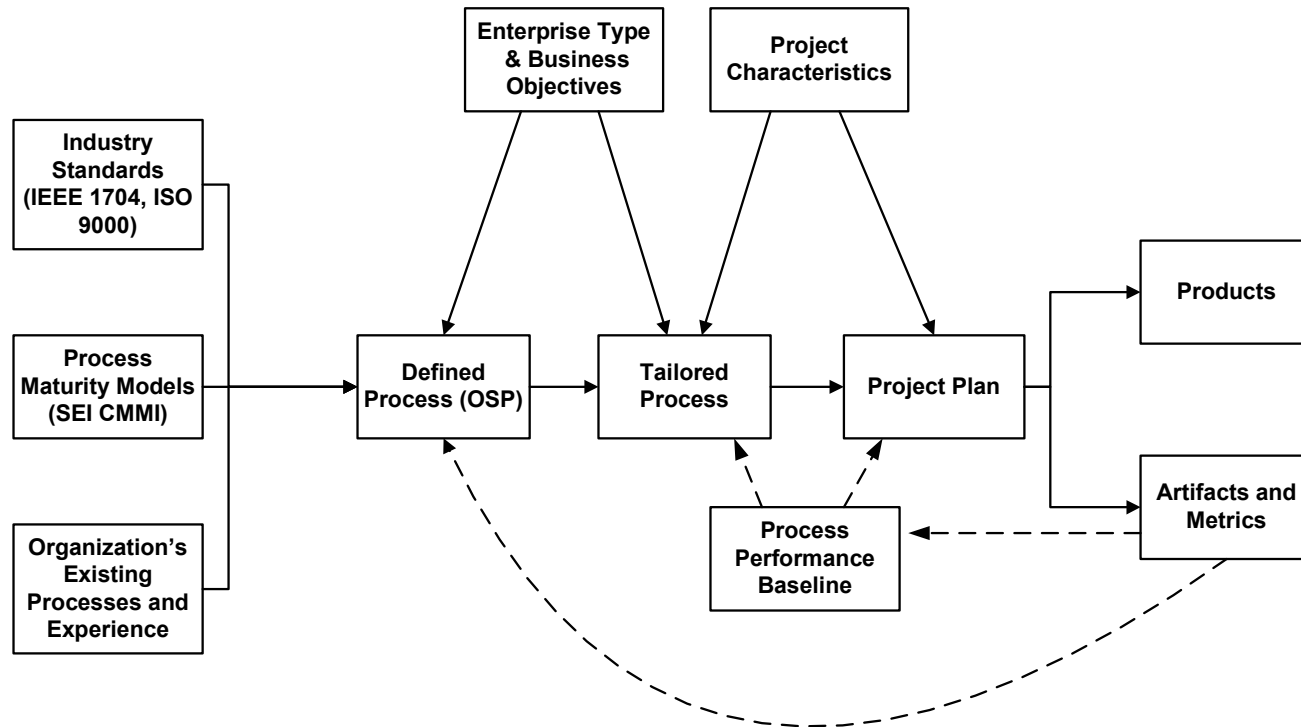
# Definition of Process

**A set of activities, methods, practices, and tools that people use to develop and maintain a product and its associated work products (e.g., plans, design documents, code, test cases, and user manuals).**

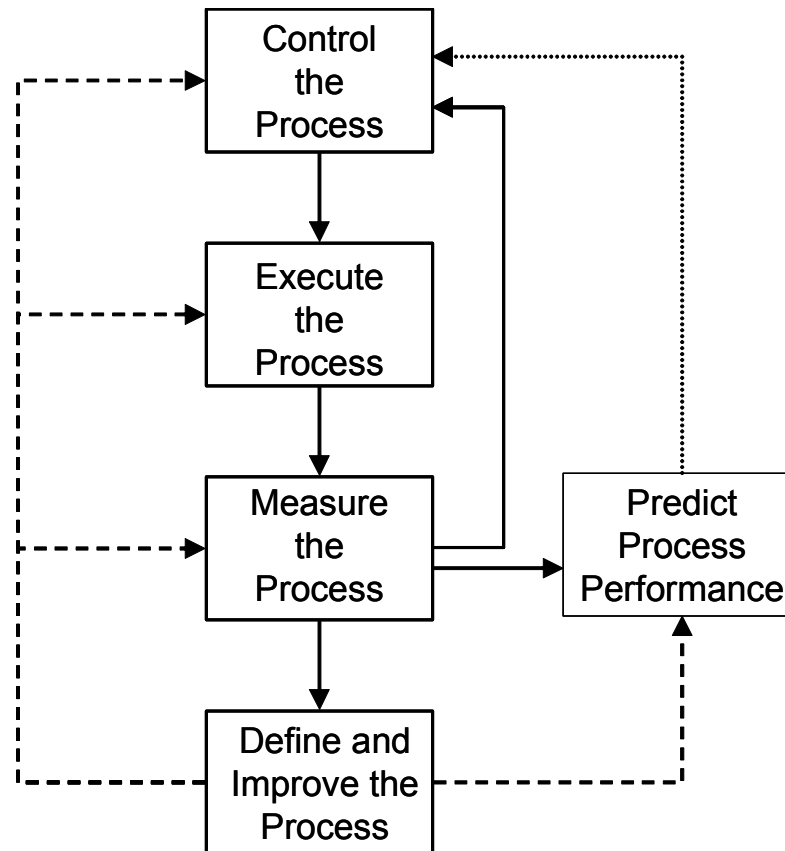
# Types of Process Models

- **Capability Maturity Model**
  - Best Practices
  - “Ought to”
- **Process Architecture**
  - Project life cycle model
  - Activities, artifacts, and timing
  - High-level “How to”
  - Basis for early planning
- **Defined Process**
  - Organization’s Standard Process (OSP)
  - Detailed “How to” plus aids (template tools)
- **Project’s Tailored Process**
  - Selected subset of the OSP
  - Some elements may be tailored
  - Basis for detailed planning (budget, status) and improvement

# From Best Practices to Products



# Process Control: Measurements + Models



## Legend

- Data, Information, and Measurements
- ..... Predictions
- - - - - Defined (and Improved) Process

# Measuring Process Performance

- **Key Questions**
  - **What is the current performance?**
  - **Is this value "good"?**
  - **Is it changing?**
  - **How can I make the value “better”?**
- **Candidate Attributes\***
  - **Definition (completeness, compatibility)**
  - **Usage (compliance, consistency)**
  - **Stability (repeatability, variability)**
  - **Effectiveness (capability)**
  - **Efficiency (productivity, affordability)**
  - **Predictive Ability (accuracy, effects of tailoring and improvements)**

\*Motivated by [Florac, 1999, Section 2.4]

# Some Examples

Goal	Measure
Completeness	The number of process elements added, changed, and deleted during tailoring.
Compliance	Number of discrepancy reports generated by Quality Assurance audits
Stability (volatility)	The number of process elements changed within a specified time interval.
Effectiveness	Product quality
Effectiveness	Defect leakage to subsequent phases
Efficiency	Productivity (or production coefficient)
Efficiency	Rework as a fraction of total effort
Predictability	Probability distribution for an estimated quantity or related population statistics



# Choosing Your Measures

- **Measurement costs money**
  - Choose what is useful (e.g., use Goal – Question – Measure)
  - Your needs will change over time
- **Factors to consider:**
  - Business objectives
  - Customer desires
  - Government regulations and statutes

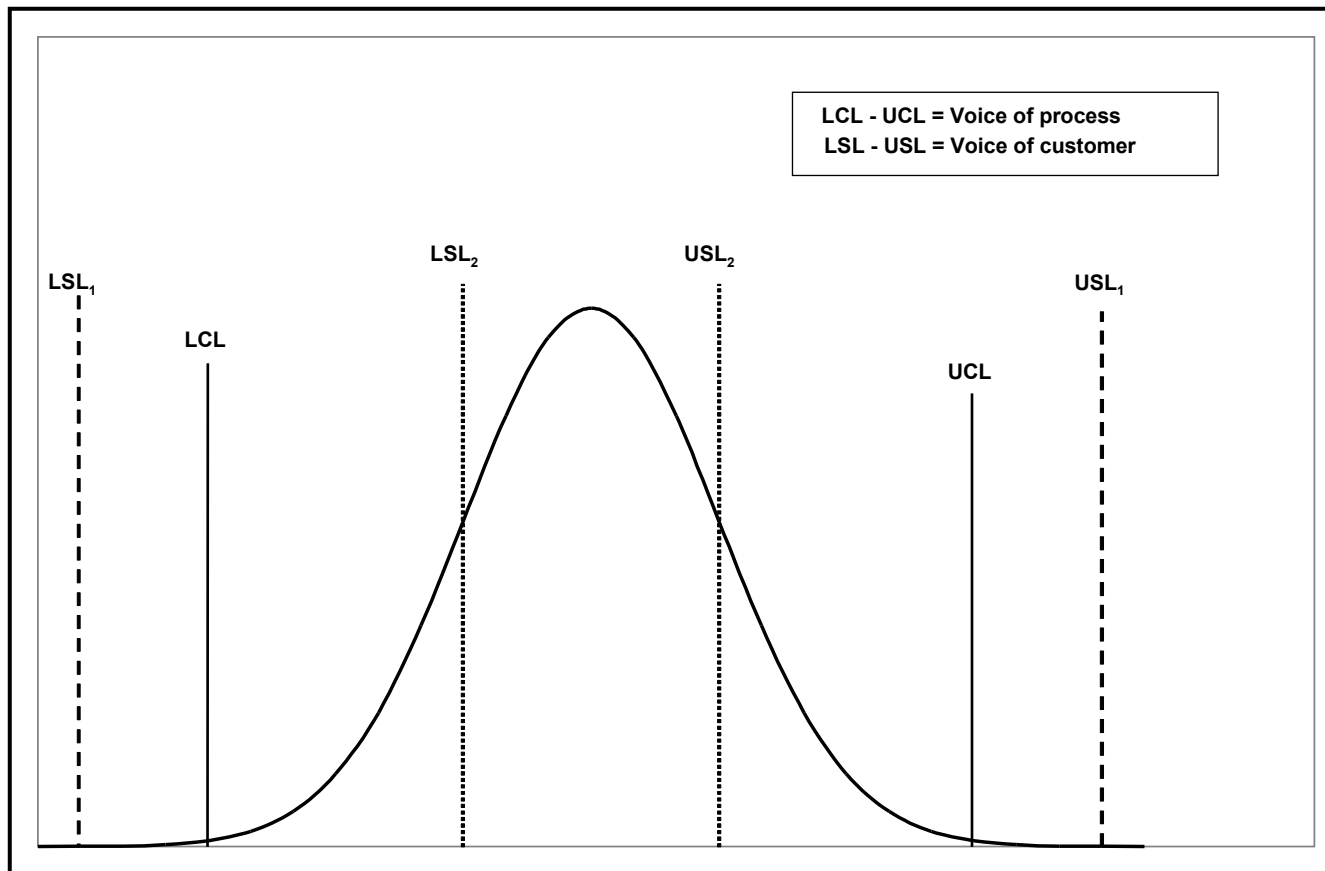
# Predicting Process Performance

- **Key Questions**
  - **How do process parameters affect project productivity, cost, and schedule?**
  - **How do process parameters affect product quality?**
  - **How can I improve the process? (What is the increase in product quality if I invest more effort in design instead of testing?)**
- **Process Performance Model**
  - **Makes quantitative predictions about a particular production process**
  - **May estimate resource consumption, time delays, effectiveness, and efficiency**

# Types of Process Performance Models

Type	Handles Unstable Processes?	Representation of Process Mechanisms	Examples
Statistical	No	None	Statistical process control
Functional	No	Explicit	Parametric models (algorithms based on causal mechanisms). COQUALMO and staged models.
Dynamic	Yes	Implicit (via propagation)	System dynamics models (Coupled equations embody the causal mechanisms. Solving numerically gives predicted behavior.)

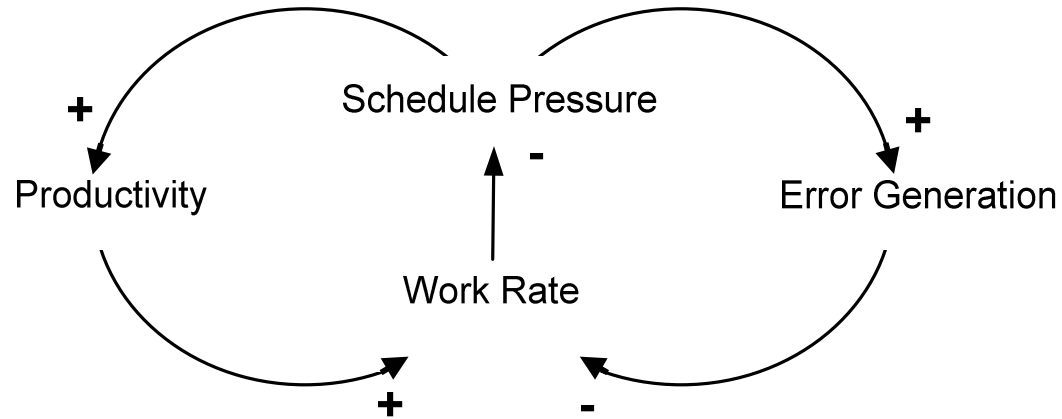
# Statistical Process Control



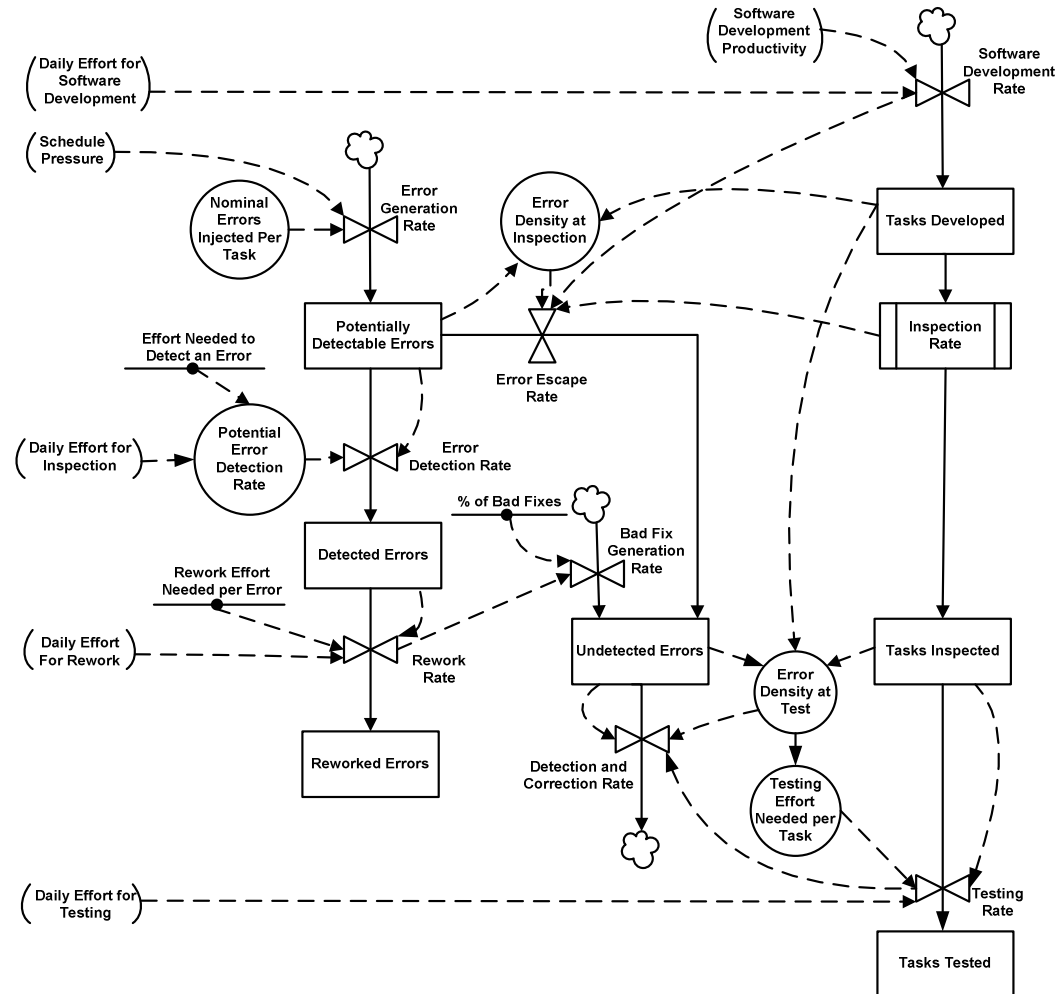
# Sample Defect Leakage Matrix

	Phase Detected					
Phase Injected	Analysis	Design	Code	Integ. Test	Alpha Test	Beta Test
Analysis	98.0	6.0	12.0	14.0	27.0	18.0
Design		142.0	38.0	23.0	17.0	8.0
Code			114.0	61.0	23.0	4.0
Integ. Test				16.0	2.0	1.0
Alpha Test					2.0	0.0
Beta Test						1.0

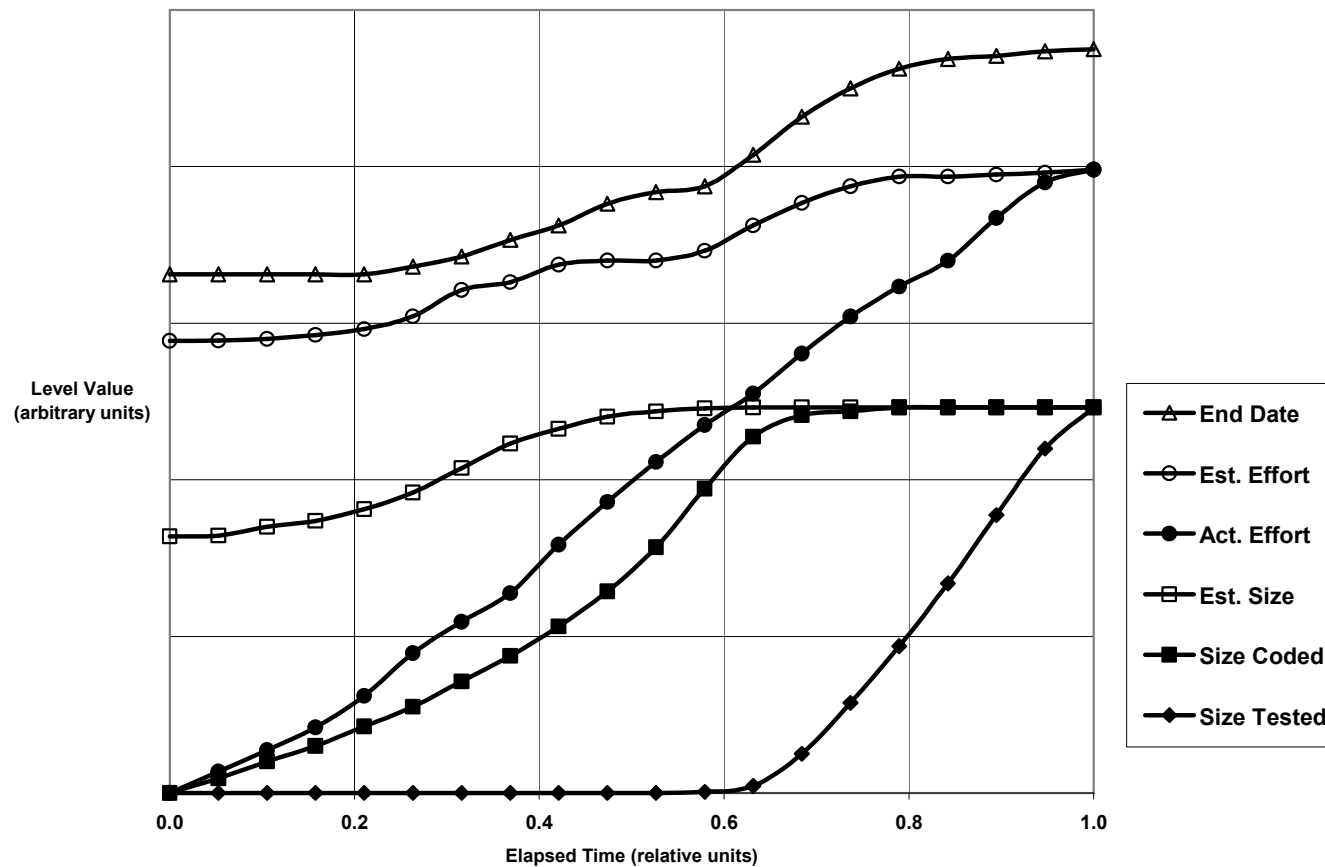
# System Dynamics Model: Concept



# System Dynamics Model: Relationships for CoSQ



# System Dynamics Model: Sample Output





# Summary

- **Measures help control the production process**
- **The choice of process performance measures depends on organizational goals**
- **Predictive models supplement measures**
- **Predictive accuracy depends on**
  - **The process definition (detail, stability, tailoring)**
  - **The process execution (compliance, consistency)**
  - **The model's scope and validity (relevant factors and interactions, fidelity)**

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