



*Welcome to*

# Capability Maturity Model Overview

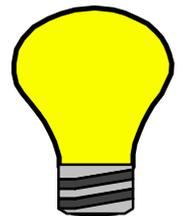
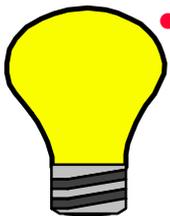
**Presented by: DSDC**

**For more info, send requests to: [sepg@dcdc.dla.mil](mailto:sepg@dcdc.dla.mil)**

# Course Objectives

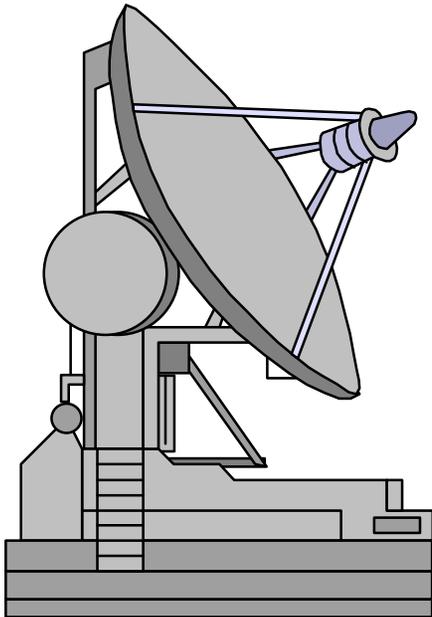
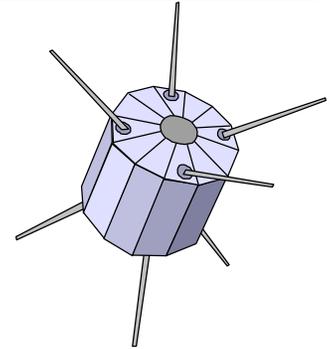
**This course will introduce the student to the Software Process Capability Maturity Model. At the end of the course, the student will be able to:**

- **Identify the terms used with the Capability Maturity Model.**
- **Recognize the elements of the Capability Maturity Model.**
- **Recognize each of the five levels of the Capability Maturity Model**
- **Recognize how the CMM fits in with current and future organizational information systems development projects.**
- **Understand the difference between assessments and evaluations**



# *DoD Objectives for its software community to achieve by the year 2000*

- ① Reduce life-cycle costs by a factor of two**
- ② Reduce software problem rates by a factor of ten**
- ③ Achieve new levels of DoD mission capability and interoperability via software**



## *Additional Readings*

 *Capability Maturity Model for Software*, Software Engineering Institute, CMU/SEI-93-TR-24, Aug '91, Feb '93

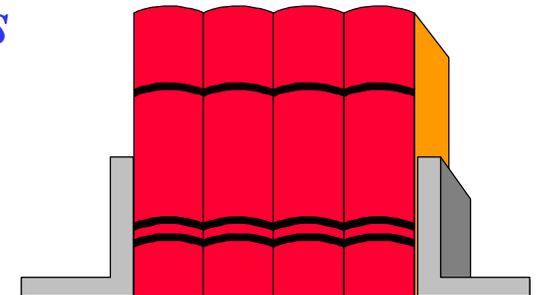
 *Key Practices of the Capability Maturity Model*, Software Engineering Institute, CMU/SEI-93-TR-25, Aug '91, Feb '93

**BOTH AVAILABLE AT:**

[http://www.dataweb.net/~lodewijk/SEI\\_CMM/](http://www.dataweb.net/~lodewijk/SEI_CMM/)

 *Managing the Software Process*, Watts S. Humphrey, Addison Wesley, 1990

 *The Capability Maturity Model: Guidelines for Improving the Software Process*, Mark Paulk et al, Addison-Wesley, 1995





# *Course Topics*

- **Software Process Management**
- **The Capability Maturity Model**
- **Understanding the Initial and Repeatable Levels**
- **Understanding the Defined Level**
- **Understanding the Managed and Optimizing Levels**
- **Assessments and Evaluations**
- **Conclusion and Discussion**



# *Software Process Management*

**Define Software:**

**Define Process:**

**Define Software Process Improvement:**

# Software Process Management

## Software Engineering Institute's Definition of Process

*The means by which people, procedures, methods, equipment, and tools are integrated to produce a desired end result.*



People with skills,  
training, and motivation



Tools and  
equipment



Procedures and methods  
defining the relationships  
of tasks

# Software Process Management

## Life Cycle Phases:

⇒ **Initiation**

⇒ **Development**

- Analysis
- Design
- Programming

⇒ **Evaluation**

⇒ **Operations**





# *Software Process Management*

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## **To Achieve Improvement**

**The Capability Maturity Model for Software (CMM) is a five-level roadmap for improving the software process and achieving improved quality results.**



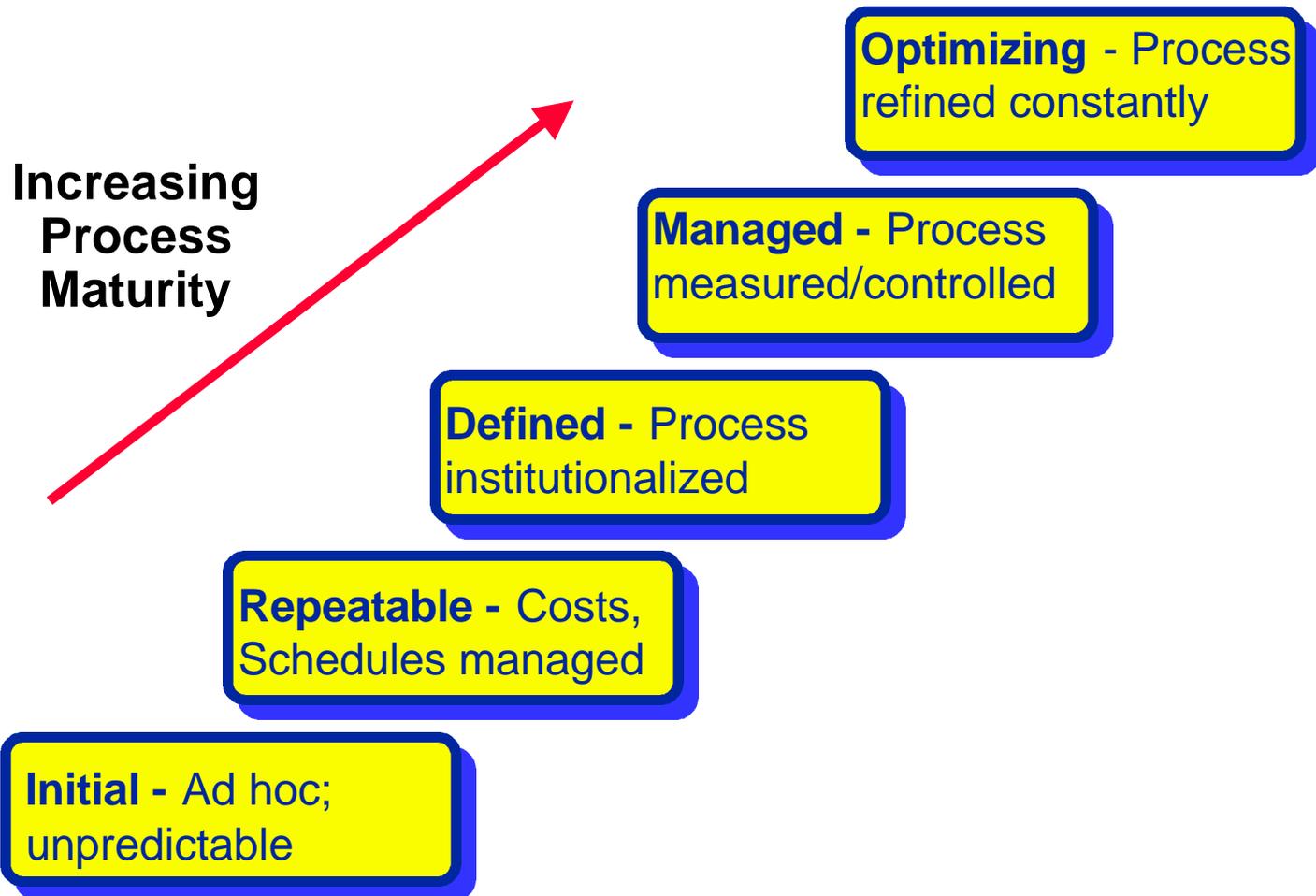
## To Achieve Improvement

The Capability Maturity Model for Software (CMM) is a five-level roadmap for improving the software process and achieving improved quality results.



# Software Process Management

## Capability Maturity Model Overview





# *The Capability Maturity Model*

## **What is the Capability Maturity Model (CMM)?**

**The application of process management and quality improvement concepts to software development and maintenance.**

**A guide for evolving toward a culture of engineering excellence.**

**A model for organizational improvement.**



# *The Capability Maturity Model*

## **The CMM Community**

**CMM provides a principled, public model for appraising software development capability.**

**CMM owned by national software community (and is being accepted abroad).**

### **SEI exercises stewardship over the CMM**

- **evolves CMM from industry and government experience**
- **performs empirical research**
- **develops CMM-based improvement methods**



# *The Capability Maturity Model*

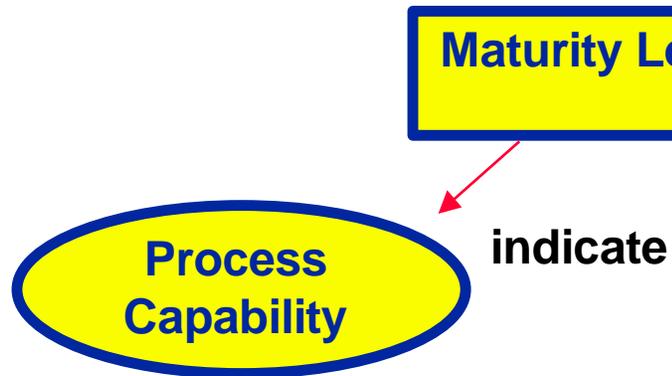
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## *The CMM Structure*

**Maturity Levels**

# The Capability Maturity Model

## The CMM Structure



# *The Capability Maturity Model*

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## **Maturity Levels**

***A maturity level is a well-defined evolutionary plateau on the path toward becoming a mature software organization.***

- **each level is a layer in the foundation for continuous process improvement**
- **there are five maturity levels in the CMM**

***Process capability describes the range of expected results from following a process.***

# *The Capability Maturity Model*

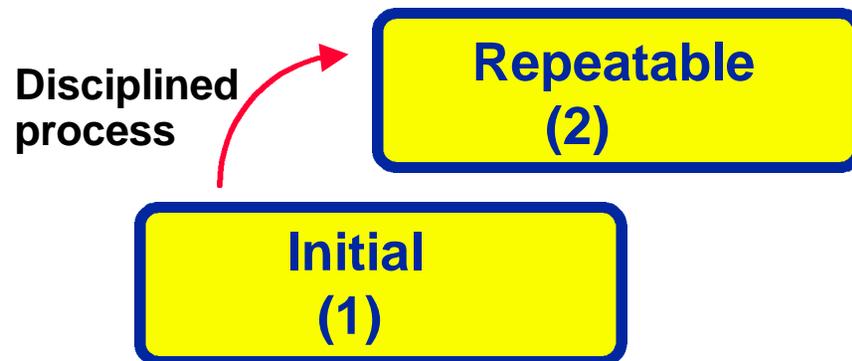
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## **The Five Maturity Levels**

**Initial  
(1)**

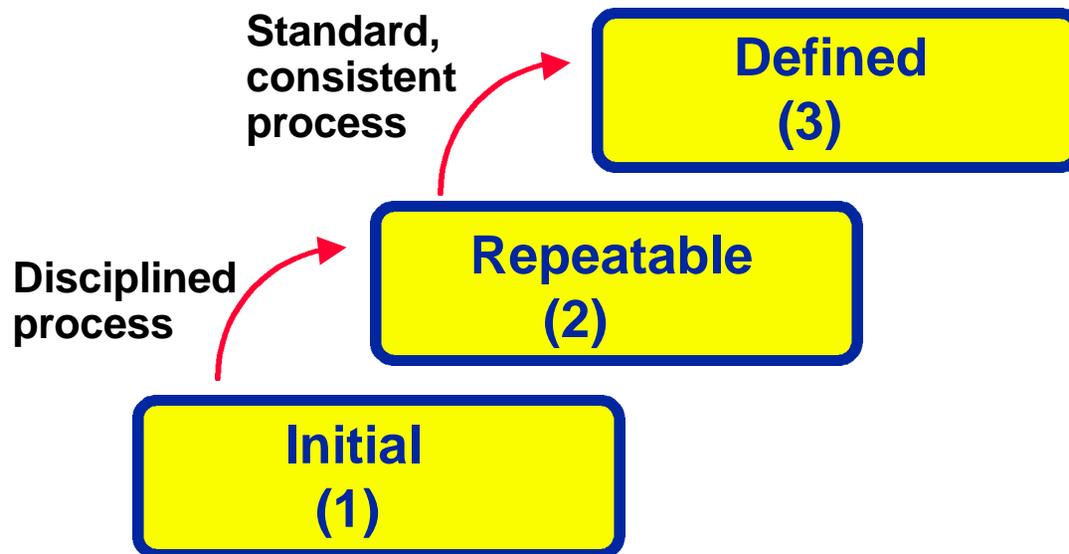
# *The Capability Maturity Model*

## **The Five Maturity Levels**



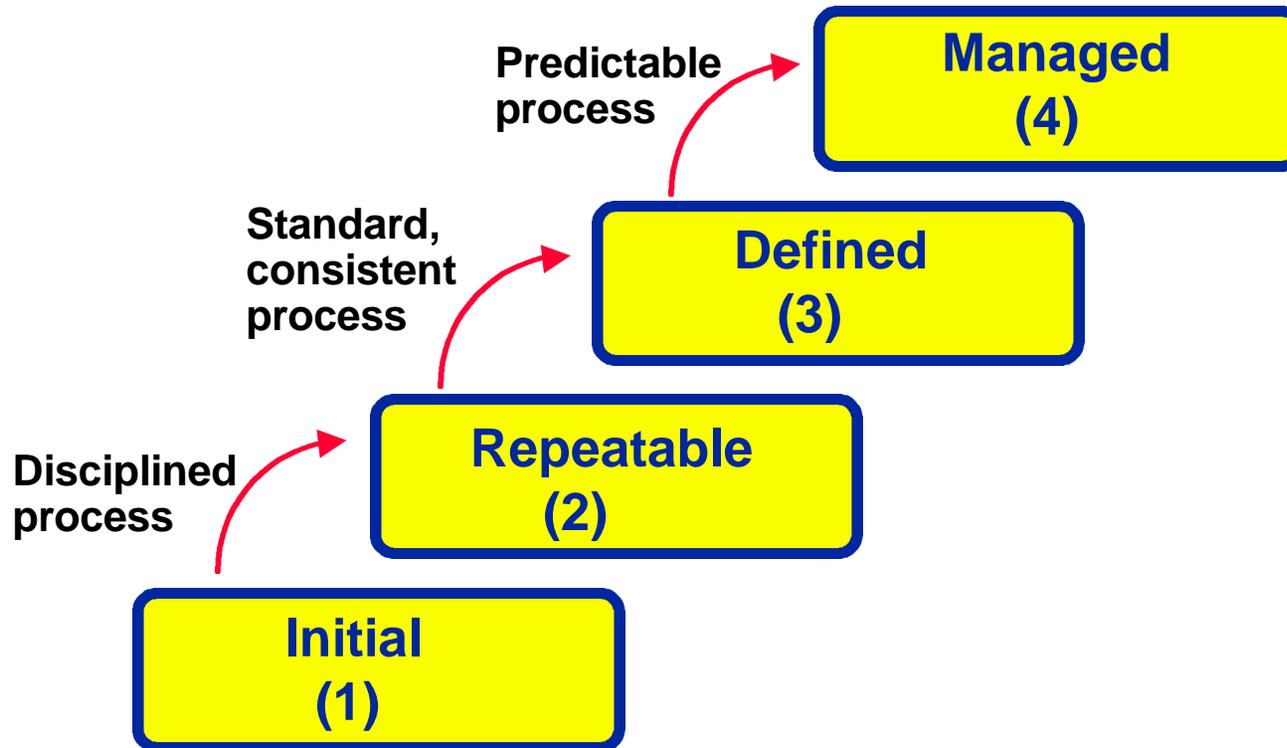
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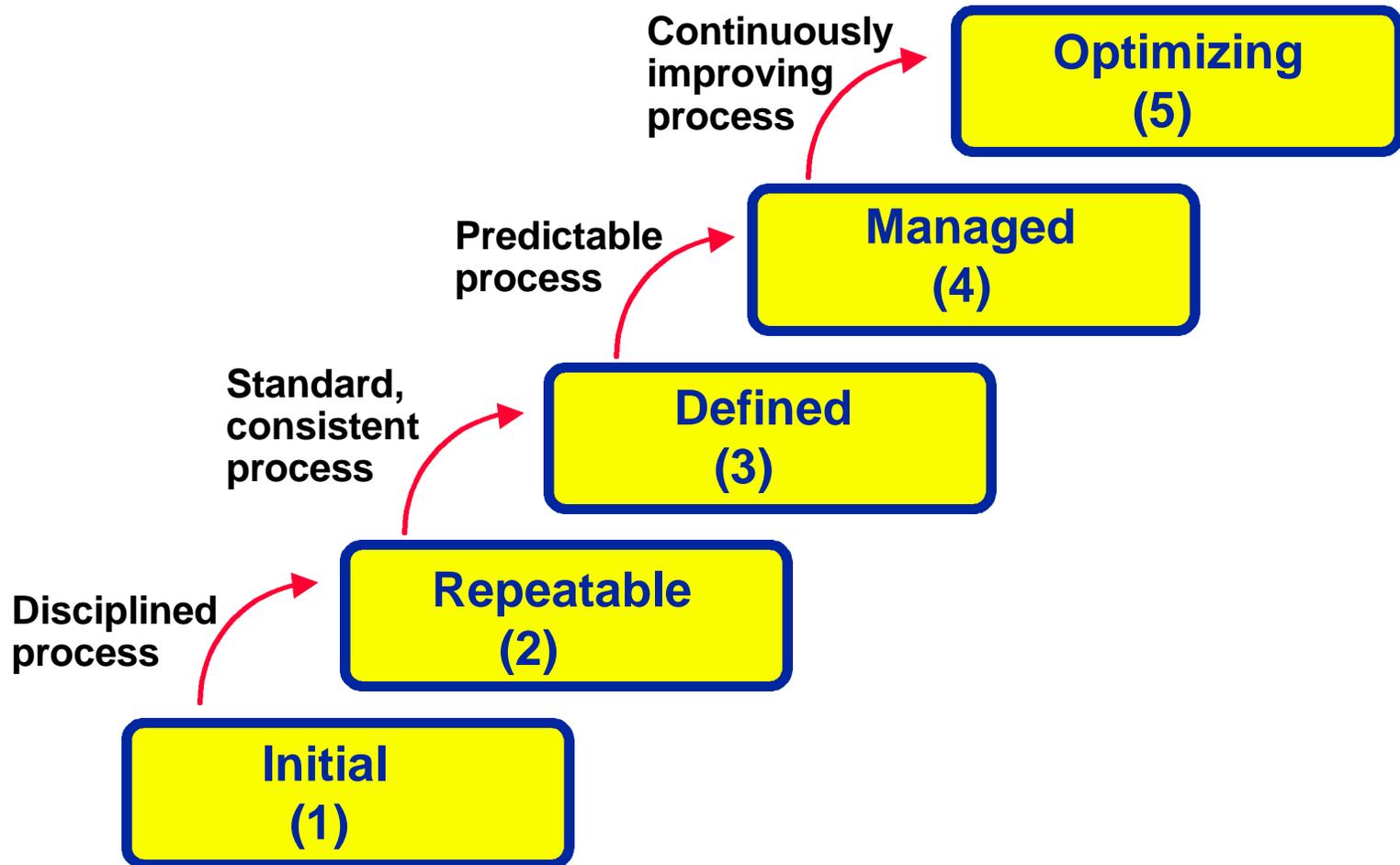
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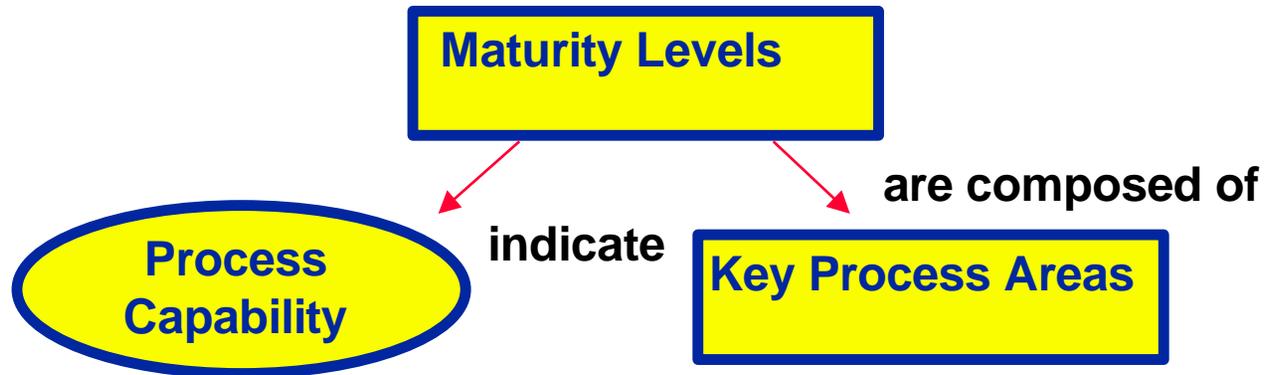
# The Capability Maturity Model

## The Five Maturity Levels



# The Capability Maturity Model

## The CMM Structure





# *The Capability Maturity Model*

## **Key Process Areas**

*Key process areas* are the major building blocks in establishing the process capability of an organization.

They are a cluster of related activities performed collectively to achieve a set of goals



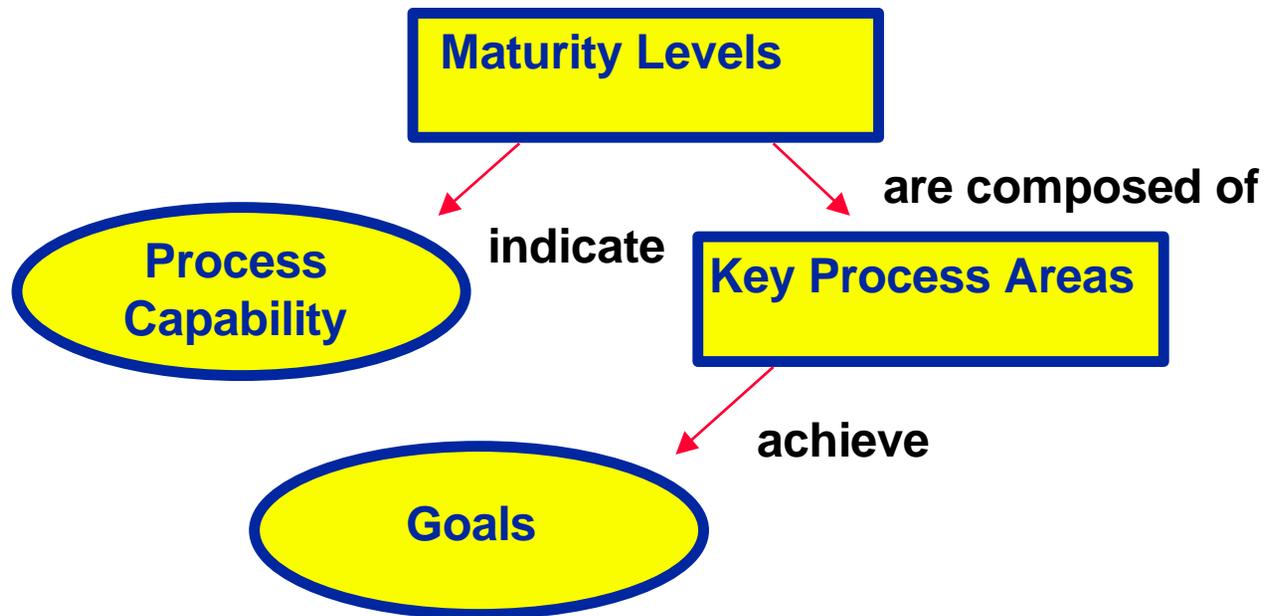
# The Capability Maturity Model

## Focus of the Key Process Areas

Level	Focus	Key Process Area
<b>Optimizing (5)</b>	<b>Continuous Process improvement</b>	<b>Defect Prevention</b> <b>Technology Change Management</b> <b>Process Change Management</b>
<b>Managed (4)</b>	<b>Product &amp; process quality</b>	<b>Quantitative process management</b> <b>Software quality management</b>
<b>Defined (3)</b>	<b>Engineering process</b>	<b>Organization process focus</b> <b>Organization process definition</b> <b>Training program</b> <b>Integrated software management</b> <b>Software product engineering</b> <b>Intergroup coordination</b> <b>Peer Reviews</b>
<b>Repeatable (2)</b>	<b>Project management</b>	<b>Requirements management</b> <b>Software project planning</b> <b>Software project tracking &amp; oversight</b> <b>Software subcontract management</b> <b>Software quality assurance</b> <b>Software configuration management</b>
<b>Initial (1)</b>		

# The Capability Maturity Model

## The CMM Structure





# *The Capability Maturity Model*

## **An Example of Goals: Software Project Planning**

**Software estimates are documented for use in planning and tracking the software project.**

**Software project activities and commitments are planned and documented.**

**Affected groups and individuals agree to their commitments related to the software project.**

# *The Capability Maturity Model*

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## **Example Maturity Questions on Size Estimating**

**Do you use a documented procedure to estimate software size (e.g. lines of code, function points, etc.)?**

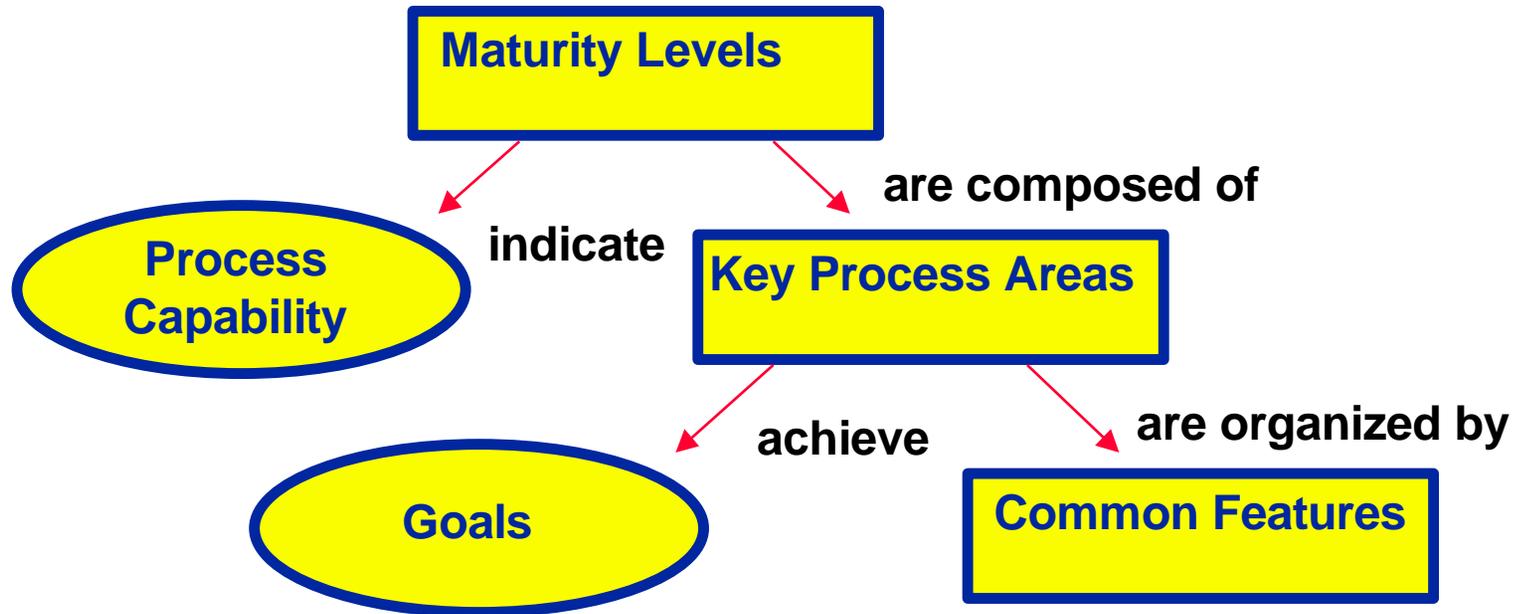
**Do you use historical size data, when available, to help derive software size estimates?**

**Do you document the assumptions made in estimating software size?**

**Do you review software size estimates?**

# The Capability Maturity Model

## The CMM Structure





# *The Capability Maturity Model*

## **Key Process Area Common Features**

- **Commitment to Perform**
- **Ability to Perform**
- **Activities Performed**
- **Measurement and Analysis**
- **Verifying Implementation**



# *The Capability Maturity Model*

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## **Commitment to Perform**

- **Describes the actions an organization must take to ensure the process is established and will endure.**
- **Typically involves establishing organizational policies and senior management sponsorship.**



# *The Capability Maturity Model*

## **Ability to Perform**

- **Describes the preconditions that must exist to implement the process competently.**
- **Typically involves resources, organizational structures, and training.**



# *The Capability Maturity Model*

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## **Activities Performed**

- **Describes the roles and procedures necessary to implement a Key Process Area.**
- **Typically involves establishing plans and procedures, performing the work, tracking it, and taking corrective actions as necessary.**



# *The Capability Maturity Model*

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## **Measurement and Analysis**

- **Describes the need to measure the process and analyze the measurements.**
- **Typically includes examples of the measurements that could be taken to determine the status and effectiveness of the Activities Performed.**



# *The Capability Maturity Model*

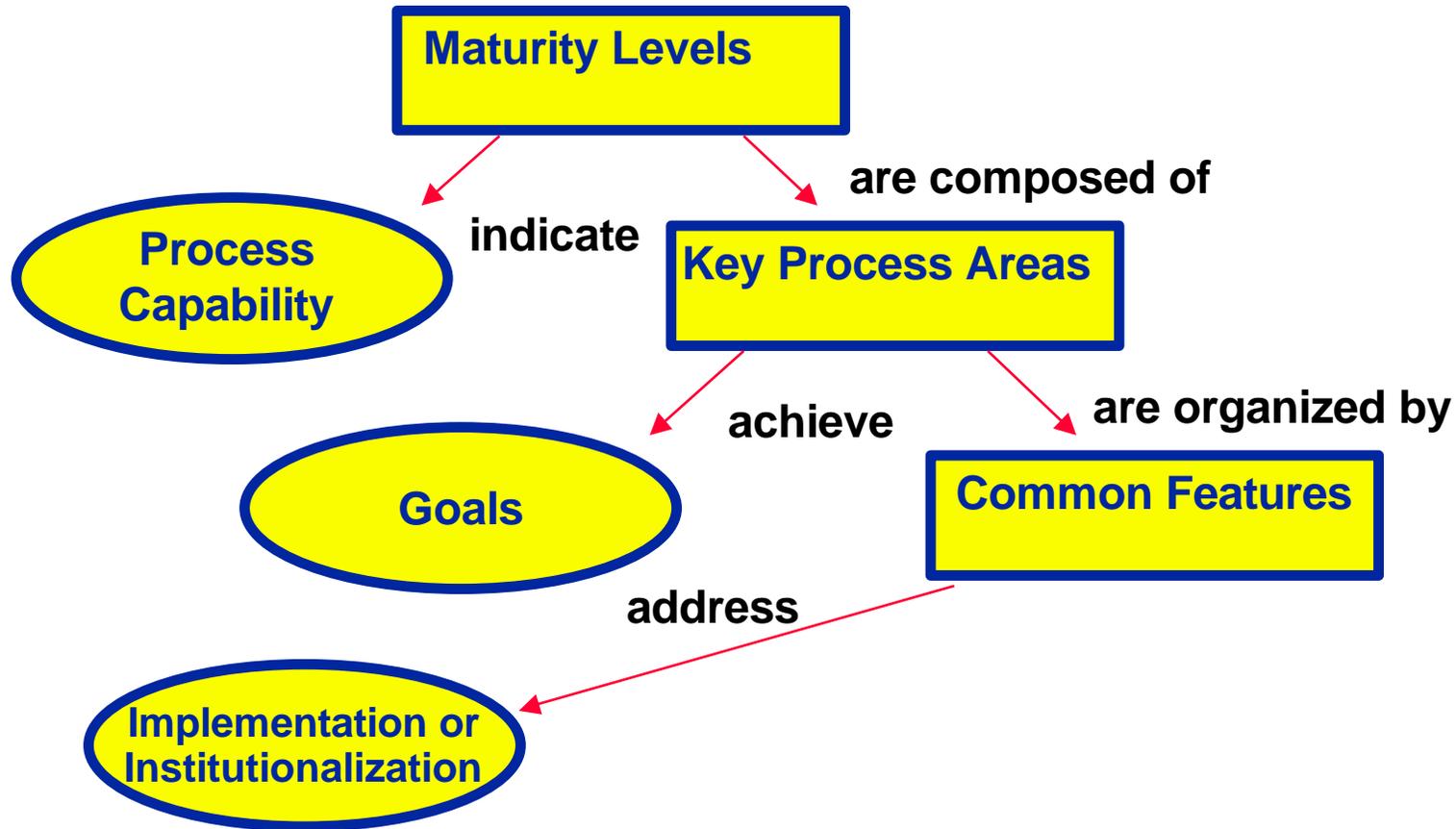
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## **Verifying Implementation**

- **Describes the steps to ensure that the activities are performed in compliance with the established process.**
- **Typically encompasses reviews and audits by management and software quality assurance.**

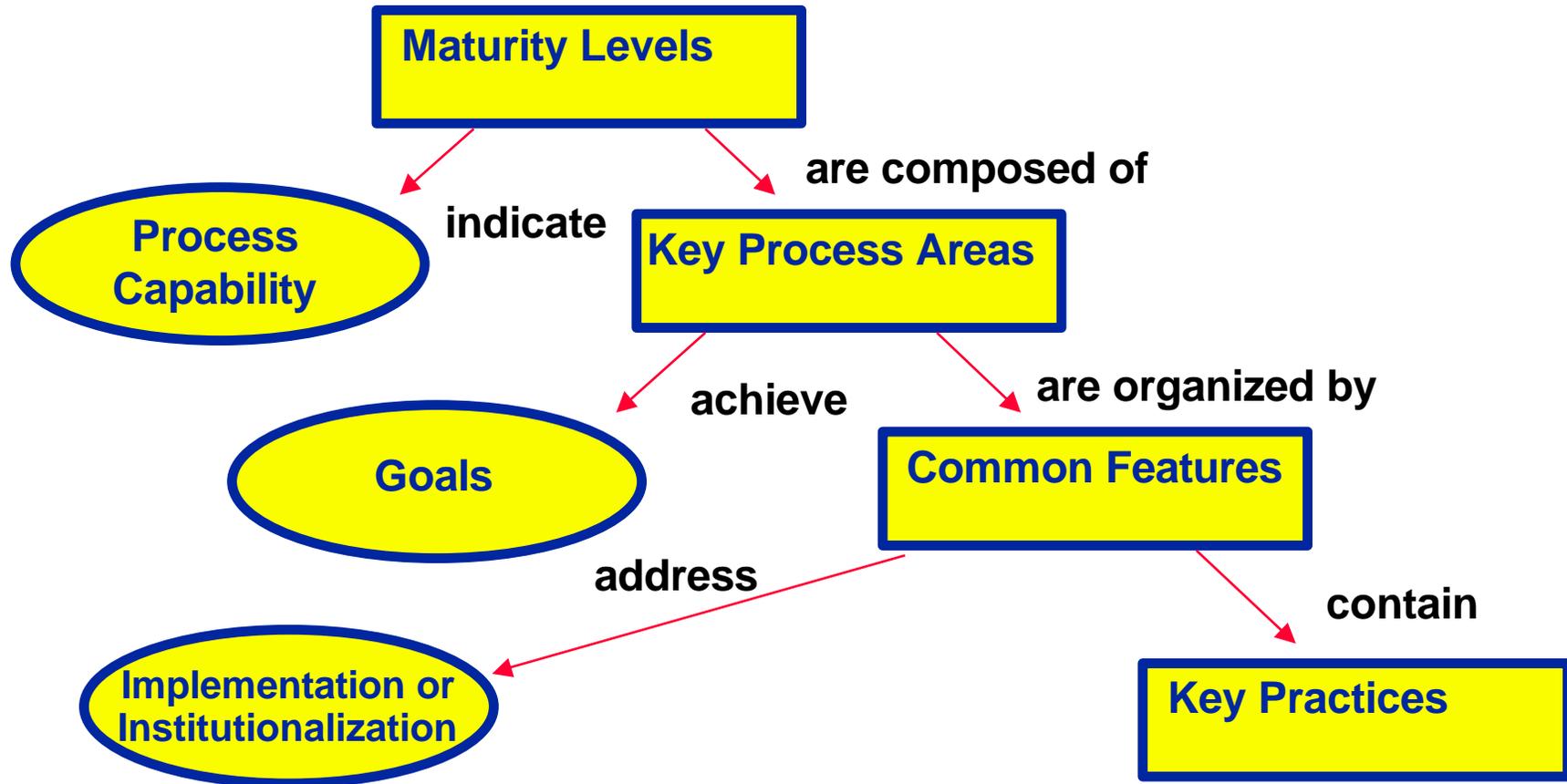
# The Capability Maturity Model

## The CMM Structure



# The Capability Maturity Model

## The CMM Structure





# *The Capability Maturity Model*

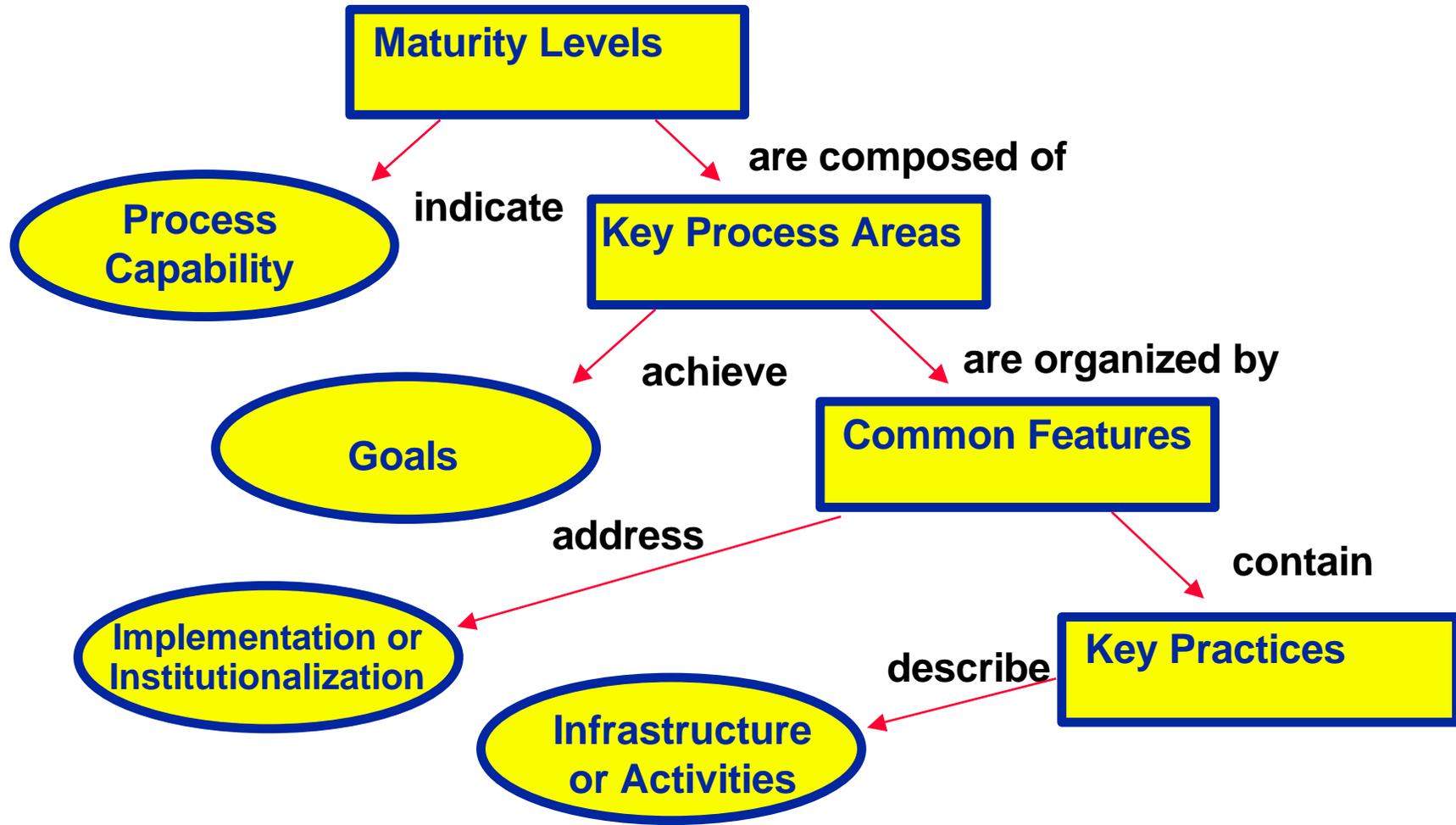
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## **Key Practices**

***Key practices* are the policies, procedures, and activities that contribute most to the effective institutionalization and implementation of the key process area.**

# The Capability Maturity Model

## The CMM Structure



# *The Capability Maturity Model*

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## **An Example Key Practice: Size Estimating**

### **Software Project Planning**

**Activity 9** Estimates for the size of the software work products (or changes to the size of software work products) are derived according to a documented procedure:

**This procedure typically specifies that ....**



# *The Initial Maturity Level*

## **Understanding the Initial Maturity Level**

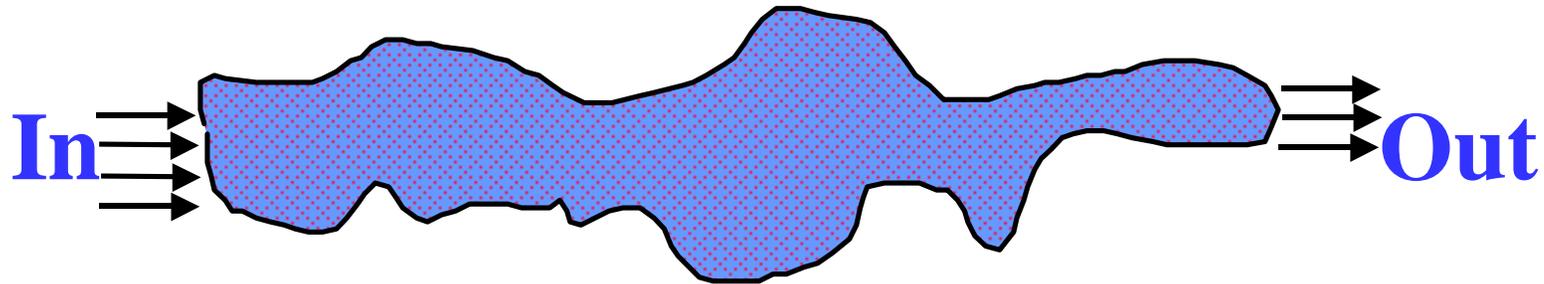
**Performance driven by the competence and heroics of the people doing the work.**

**Consistency and compliance to standards driven by management priorities - usually schedule is the top priority.**

**High quality and exceptional performance possible so long as the best people can be hired.**

# *The Initial Maturity Level*

## **The Management View of the Software Process at Level 1**



**Requirements flow in.**

**A software product is (usually) produced by some amorphous process.**

**The product flows out and (hopefully) works.**



# *The Repeatable Maturity Level*

## **Understanding the Repeatable Maturity Level**

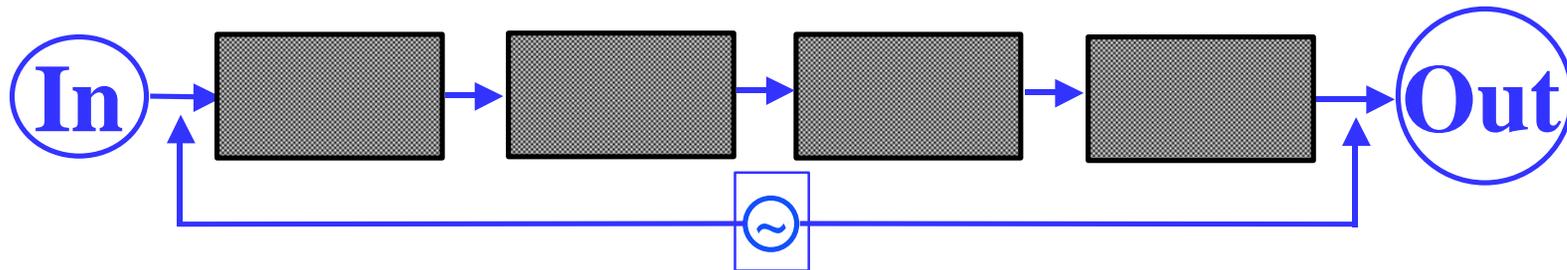
**The major problems in software development are managerial - not technical.**

**Management must “walk their talk” to initiate an improvement effort.**

**Without management discipline, good software engineering practices typically are abandoned in the crunch.**

# The Repeatable Maturity Level

## The Management View of the Software Process at Level 2



Requirements and resources flow in.

The production of the software product is visible at defined points.

Artifacts of the process are controlled.

# *The Repeatable Maturity Level*

## **The Key Process Areas for the Repeatable Level (2)**

### **Repeatable (2)**

- Software configuration management**
- Software quality assurance**
- Software subcontract management**
- Software Project Tracking and Oversight**
- Software Project Planning**
- Requirements Management**

# Group Activity





# *The Defined Maturity Level*

## **Understanding the Defined Maturity Level**

**To control a process, it must be well understood.**

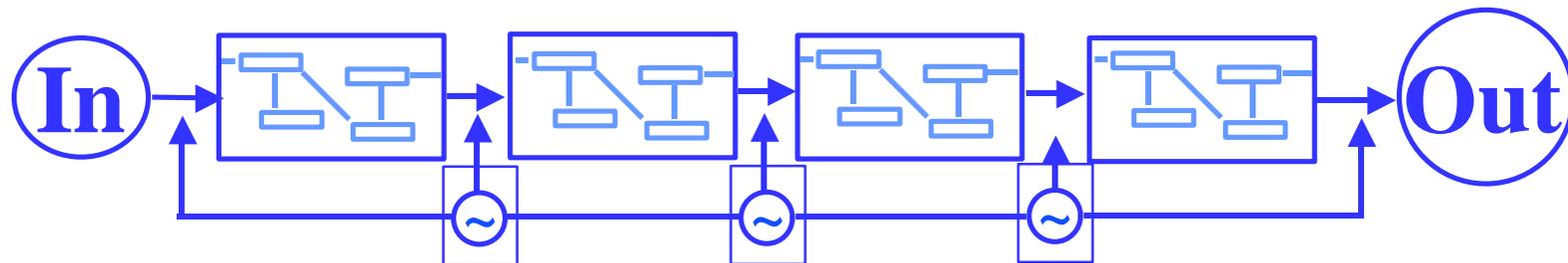
**Identify the inputs, how they will affect the process, and their readiness criteria.**

**Identify the outputs and the completion criteria for the outputs.**

**Establish a shared understanding of how the process works and the role of each participant.**

# The Defined Maturity Level

## The Management View of the Software Process at Level 3



**Roles and responsibilities in the process are understood.**

**The production of the software product is visible throughout the software process.**

# *The Defined Maturity Level*

## **The Key Process Areas for the Defined Level (3)**

### **Defined (3)**

- Peer Reviews**
- Intergroup coordination**
- Software product engineering**
- Integrated software management**
- Training program**
- Organization process definition**
- Organization process focus**



# *The Managed Maturity Level*

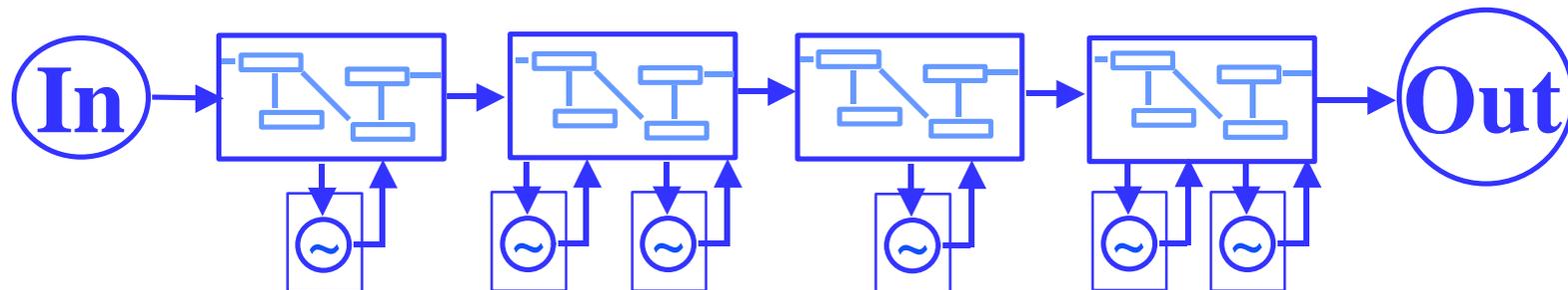
## **Understanding the Managed Maturity Level**

**Applying the principles of statistical process control, address special causes of process variation.**

**Quantitatively address the organization's, customer's and end user's quality goals as part of a philosophy of quality management.**

# The Managed Maturity Level

## The Management View of the Software Process at Level 4



The production of the software product is quantitatively understood throughout the software process.

# *The Managed Maturity Level*

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## **The Key Process Areas for the Managed Level (4)**

### **Managed (4)**

**Software quality management**  
**Quantitative process management**



# *The Optimizing Maturity Level*

## **Understanding the Optimizing Maturity Level**

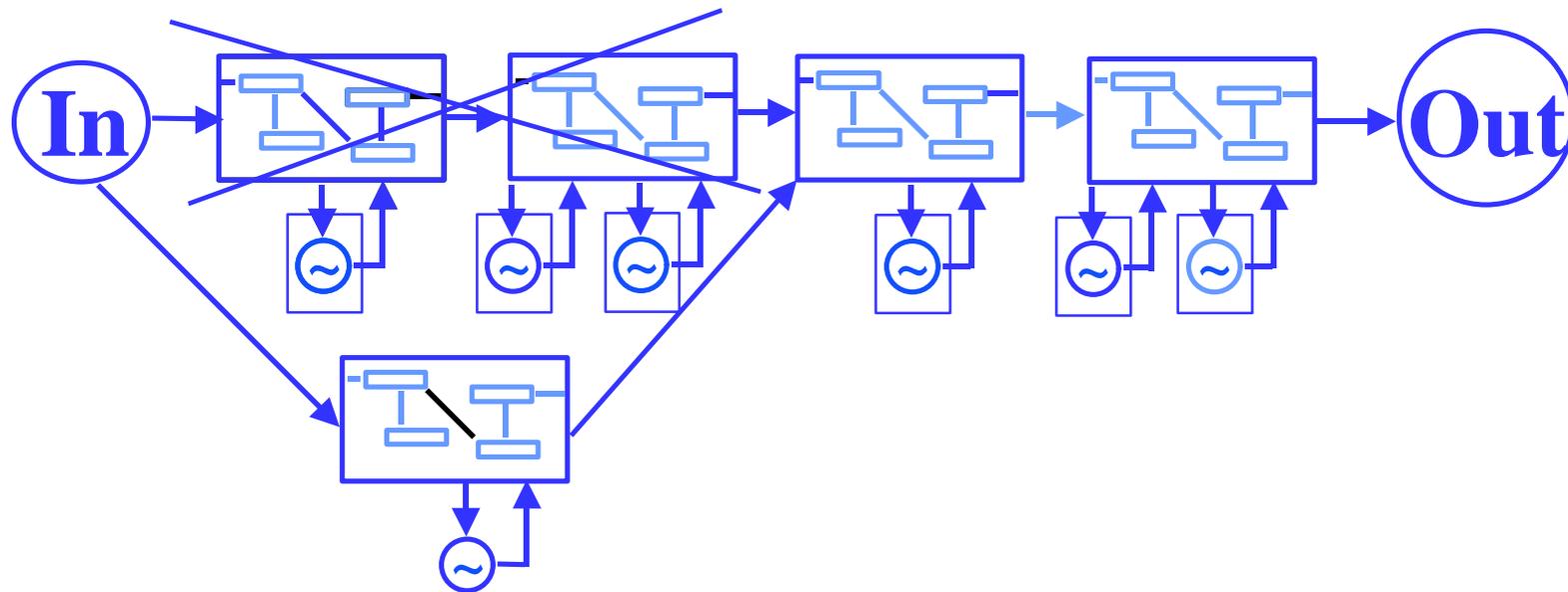
**Automation and trying new technologies**

**Identify and eliminate chronic causes of poor performance**

**Continually improve the software process**

# The Optimizing Maturity Level

## The Management View of the Software Process at Level 5



The software process is continuously improved in a controlled manner

# *The Optimizing Maturity Level*

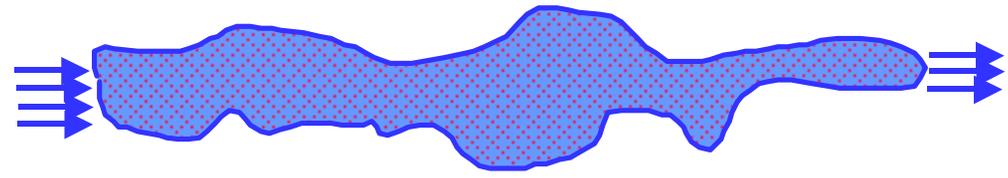
## **The Key Process Areas for the Optimizing Level (5)**

### **Optimizing (5)**

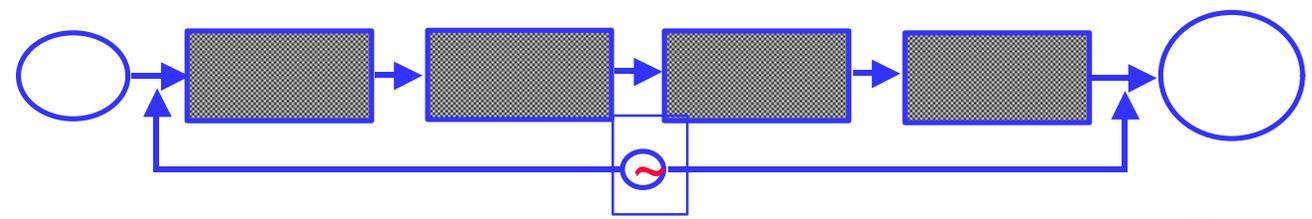
**Process change management  
Technology change management  
Defect prevention**

# Management View of the Maturity Levels

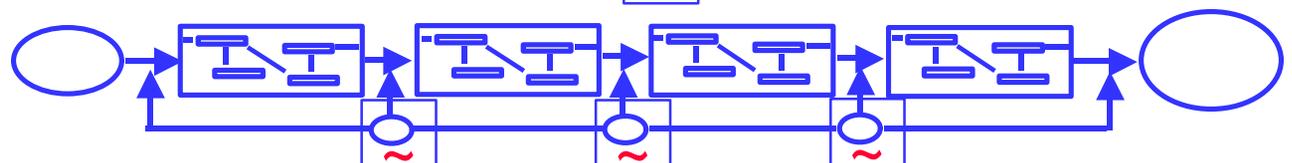
**ML 1**



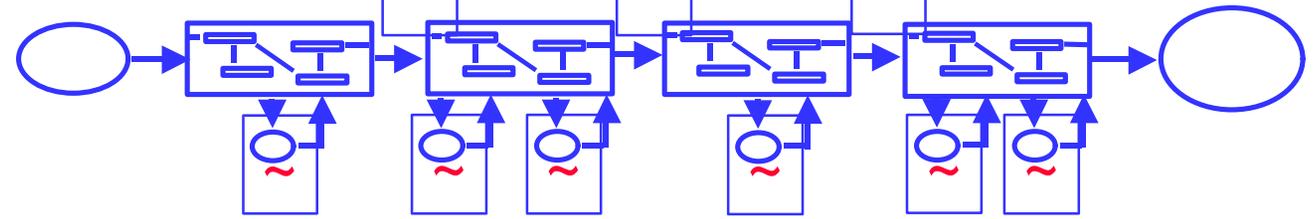
**ML 2**



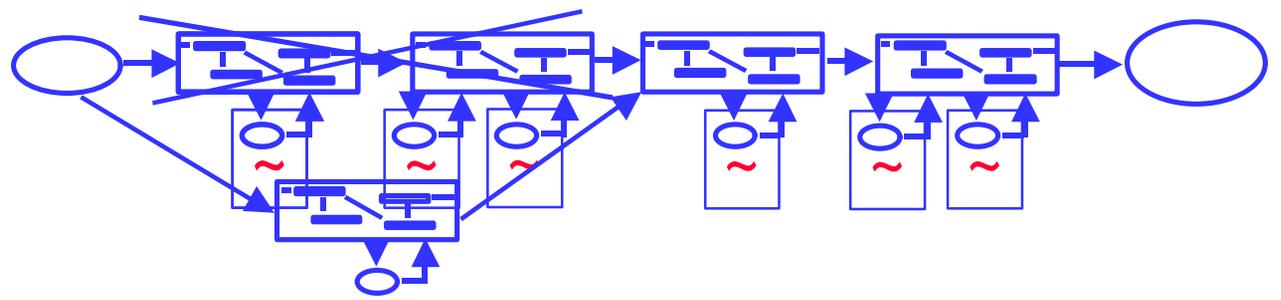
**ML 3**



**ML 4**

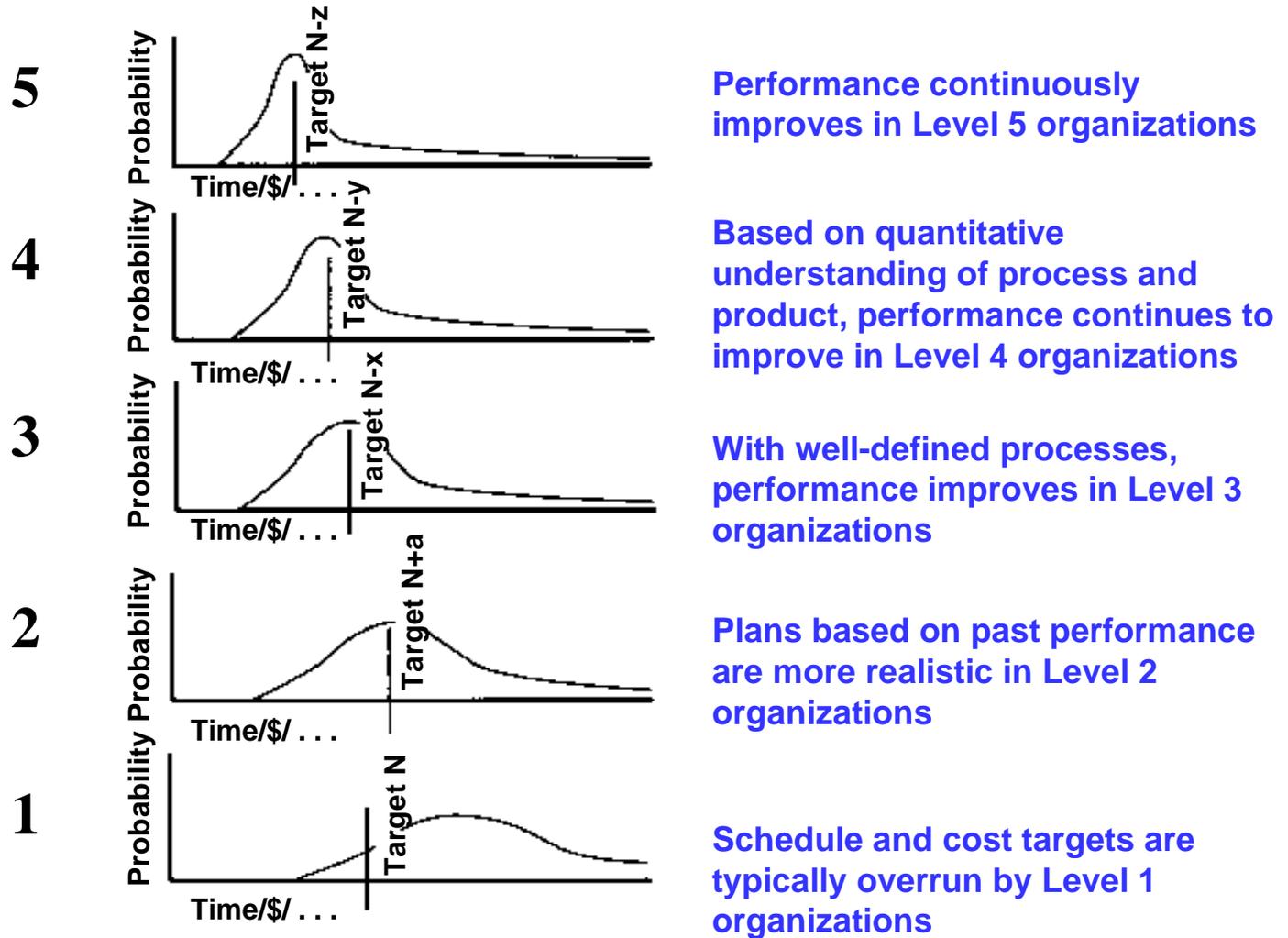


**ML 5**



# Process Capability as Indicated by Maturity Level

Levels



# Assessment vs Evaluation

## A Comparison

### Assessments

- Organization uses to improve the software process
- Results confidential
- Assesses current practice
- Acts as a catalyst for process improvement
- Provides input for improvement action plan
- Findings may include issues not explicit in maturity model
- Collaborative -- members of organization must be on the team
- Applies to organization, not individual projects, contracts

### Evaluations

- Used by DoD in source selection, contract monitoring
- Results known to DoD
- Substantiates current practice
- Assesses contractor commitment to improve
- Analyzes contract performance potential
- Findings restricted to CMM issues
- Audit oriented -- members of the organization not on team
- Applies to performance on one specific contract

-- Adapted from SEI Training

## *A Foundation, Not a Destination*

- **The optimizing level is not the destination of process management.**
- **The destination is better products for a better price: economic survival.**
- **The optimizing level is a foundation for building ever-improving capability**

*from SEI Training*

## *Process Improvement is Continuous Improvement*

- **We can never reach perfection.**
- **The CMM does not provide all the answers; it too is evolving and improving.**
- **Process management means constructive and continual improvement.**
- **The focus is on always doing better.**
- **Our reach should always exceed our grasp**

*from SEI Training*

## *Quality is NOT Free...*

**Improvement requires investment.**

- a vision of what you want
- commitment, planning and resources

**... but quality is cheaper than the alternatives**

**The capability maturity model provides a framework for  
continuous process improvement**

*from SEI Training*