The Capability Maturity Model® for Software, Version 1.1

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xxx 1998

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A Myth: The Problems Are All Technical

Examined real cases
- **red teams**
- **assessment and evaluations**

Projects generally fail for management reasons
- **Defense Science Board Task Force on Military Software report, 1987**
- **"Bugs in the Program" report, 1989**

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

The Process Management Premise

The quality of a (software) system is largely governed by the quality of the process used to develop and maintain it.
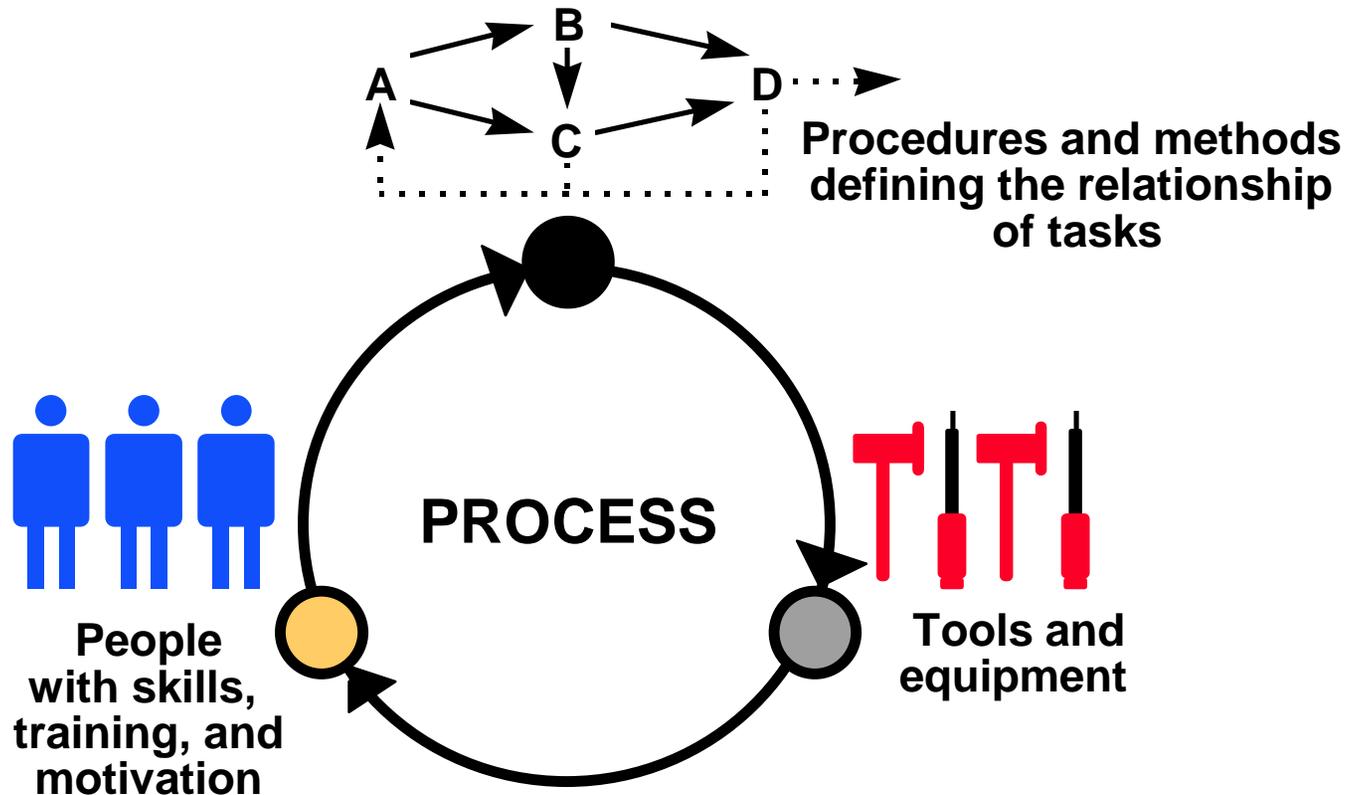
This premise implies focus on process as well as product.

The value of this premise is visible world-wide in the Total Quality Management movements in the manufacturing and service industries.

A Definition of Process

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

Procedures and methods defining the relationship of tasks

PROCESS

People with skills, training, and motivation

Tools and equipment

What Is the Software CMM?

A **common-sense** application of process management and quality improvement concepts to software development and maintenance

A **community-developed** guide for evolving toward a culture of engineering excellence

A model for **organizational** improvement

The underlying structure for **reliable and consistent** software process assessments and software capability evaluations

Total Quality Management

Total Quality Management (TQM) is the application of quantitative methods and human resources to improve:

- **the material and services supplied to an organization**
- **all the processes within an organization**
- **the degree to which the needs of the customer are met, now and in the future**

Department of Defense, *Total Quality Management Master Plan*, August 1988.

Applying TQM to Software
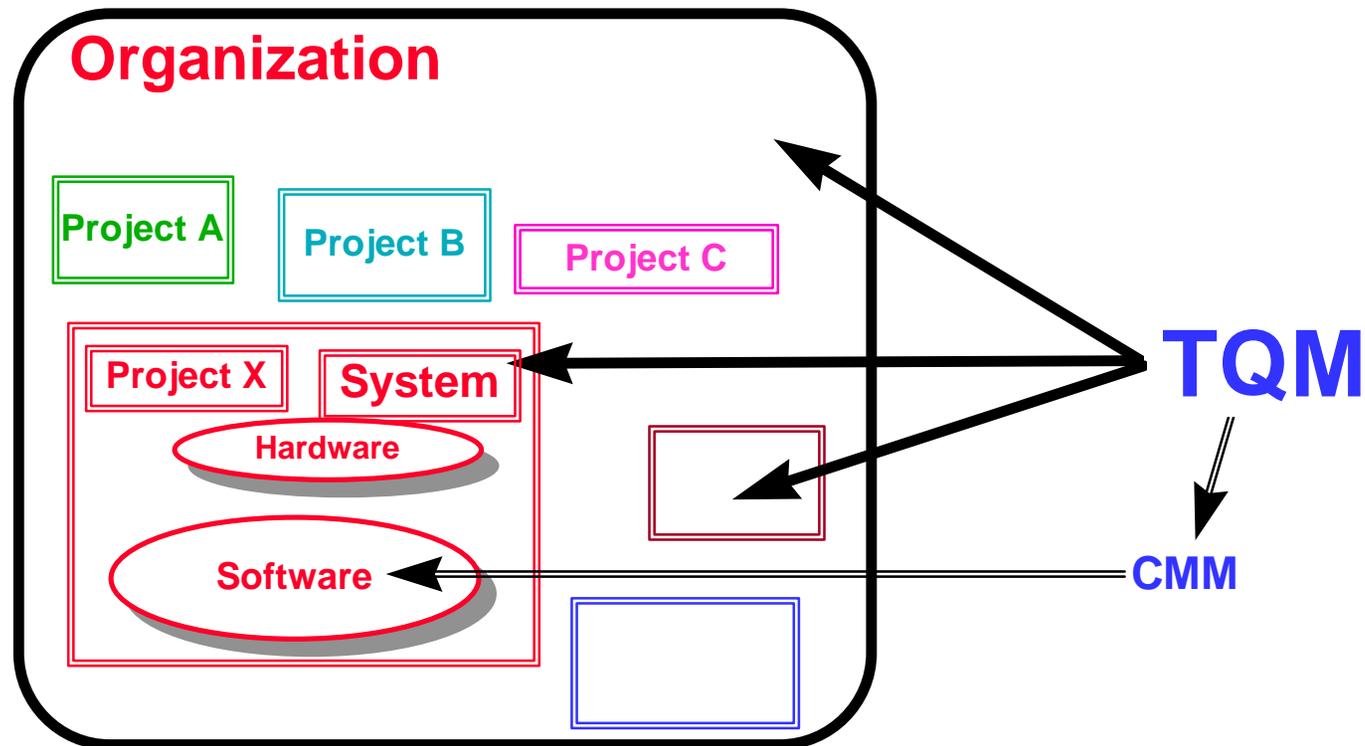
Process improvement fits in an overall business context – CMM applies to software.

Maturity Model Inspirations

Process management concepts – Crosby, Deming, Juran, ...

Experience
- **30 years of similar software problems**
- **commonly known software problems**
- **solutions exist**

Application of common-sense engineering

Critical Process Maturity Concepts

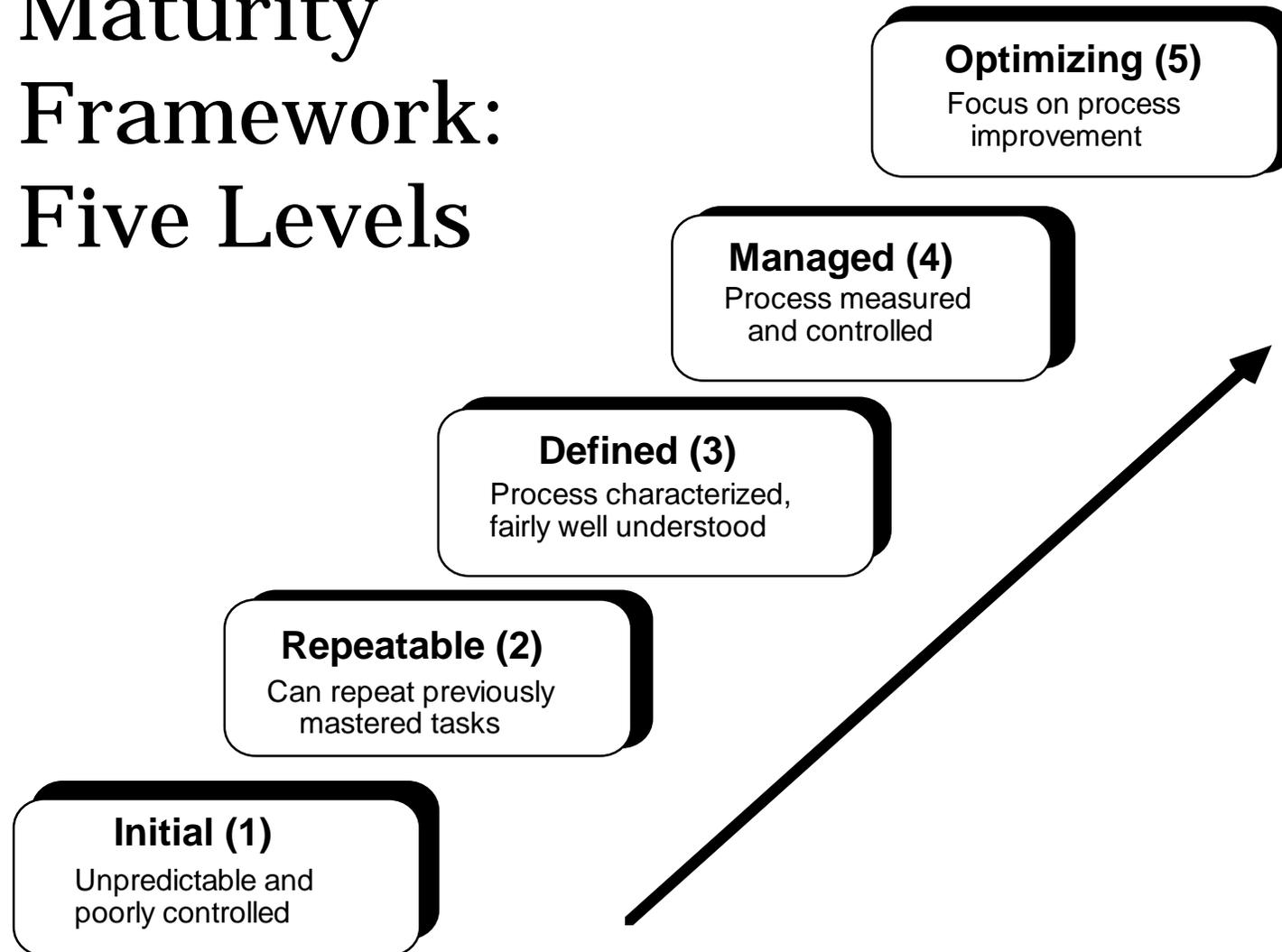**PROCESS CAPABILITY — the range of expected results that can be achieved by following a process, a predictor of future project outcomes**

PROCESS PERFORMANCE — a measure of the actual results achieved from following a process

PROCESS MATURITY — the extent to which a specific process is explicitly defined, managed, measured, controlled, and effective

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Maturity Framework: Five Levels

Optimizing (5)
Focus on process improvement

Managed (4)
Process measured and controlled

Defined (3)
Process characterized, fairly well understood

Repeatable (2)
Can repeat previously mastered tasks

Initial (1)
Unpredictable and poorly controlled

Evolution of Process Capability

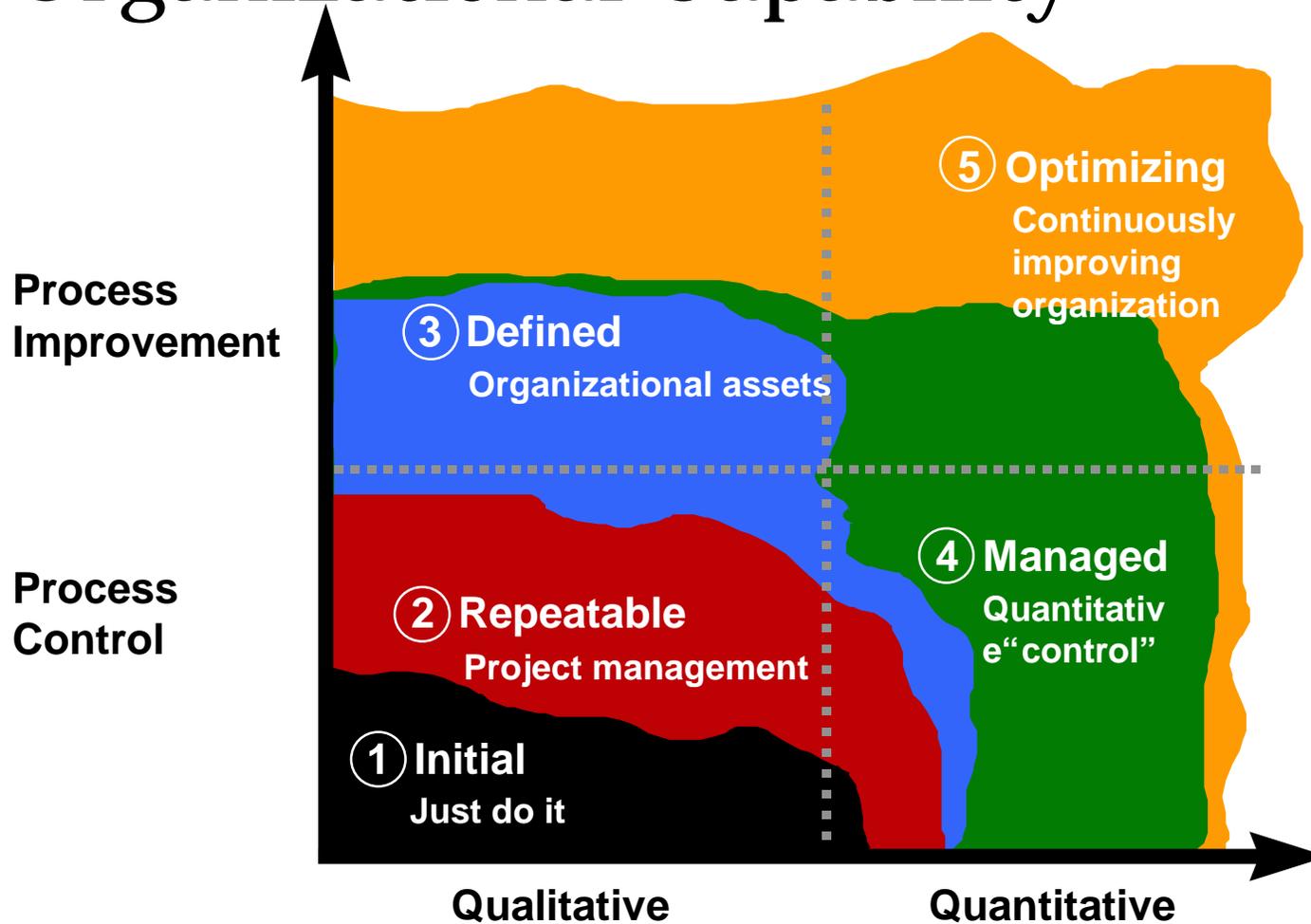| Level	Process Characteristics	Predicted Performance
5 **Optimizing**	**Process improvement is institutionalized**	
4 **Managed**	**Product and process are quantitatively controlled**	
3 **Defined**	**Software engineering and management processes defined and integrated**	
2 **Repeatable**	**Project management system in place; performance is repeatable**	
1 **Initial**	**Process is informal and ad hoc; performance is unpredictable**	

Using Higher Level Practices

Processes at higher maturity levels may be performed, although perhaps ineffectively, even by Level 1 organizations.

Peer reviews can help even a Level 1 project.

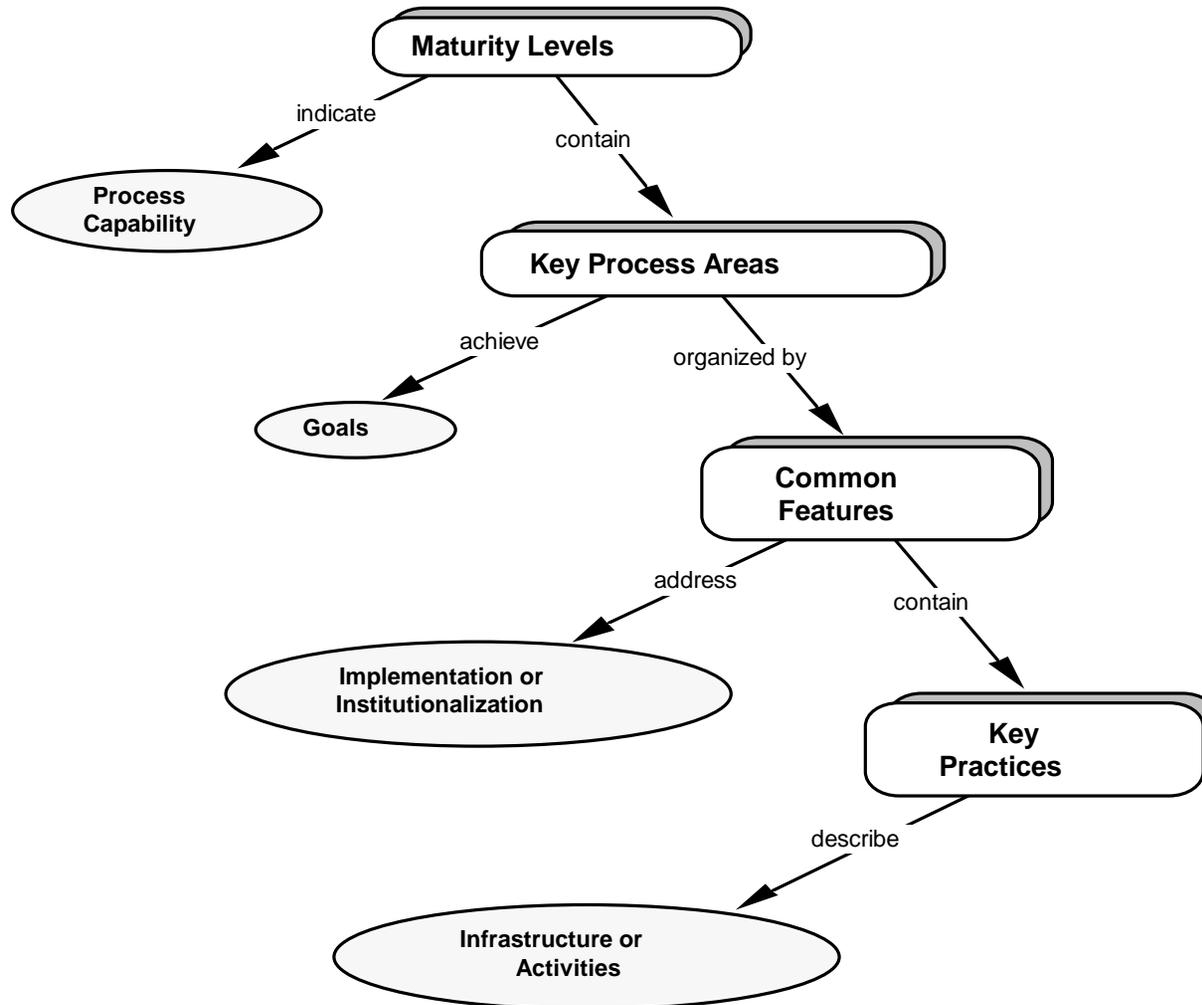**Building an organizational capability means institutionalizing good practices on a firm foundation.**

The CMM Structure

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The Five Maturity Levels

Continuously
improving
process → **Optimizing (5)**

Predictable
process → **Managed (4)**

Standard,
consistent
process → **Defined (3)**

Disciplined
process → **Repeatable (2)**

Initial (1)
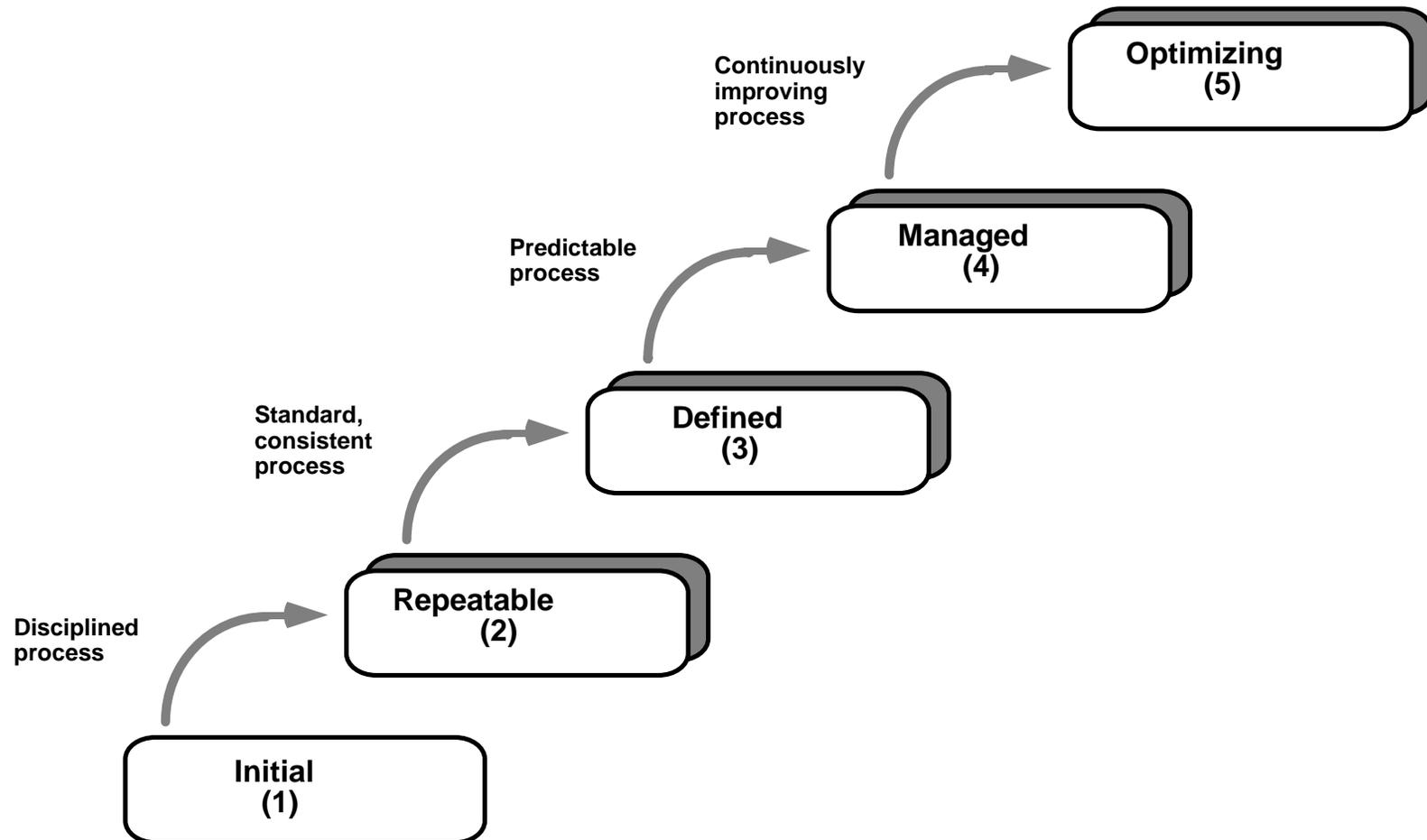
Key Process Areas

Identify a cluster of related activities that, when performed collectively, achieve a set of goals considered important for enhancing process capability

Defined to reside at a single maturity level

Identify the issues that must be addressed to achieve a maturity level

SW-CMM v1.1 Key Process Areas

Level	Focus	Key Process Areas
5 Optimizing	*Continual process improvement*	Defect Prevention Technology Change Management Process Change Management
4 Quantitatively Managed	*Product and process quality*	Quantitative Process Management Software Quality Management
3 Defined	*Engineering processes and organizational support*	Organization Process Focus Organization Process Definition Training Program Integrated Software Management Software Product Engineering Intergroup Coordination Peer Reviews
2 Repeatable	*Project management processes*	Requirements Management Software Project Planning Software Project Tracking & Oversight Software Subcontract Management Software Quality Assurance Software Configuration Management
1 Initial	*Competent people and heroics*	

Quality
Productivity

Risk
Waste

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Scope of the CMM: Using "Key"

The CMM is not exhaustive.

There are software management and engineering processes and practices that are not described in the CMM.

KEY indicates a focus on the major leverage points.

Goals Criteria

All the CMM goals primarily address process end-states

Minimal use of subjective wording (e.g., "effective")

Each key practice maps to one or more goals

Each goal and its associated practices can be considered as a "subprocess area"

Goals and subprocess areas support rating key process areas and maturity levels

Common Features

Attributes that indicate whether the implementation and institutionalization of a key process area is effective, repeatable, and lasting

Used to organize the key practices in each key process area

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

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Key Practices

The infrastructures and activities that contribute most to the effective implementation and institutionalization of a key process area

What are the Benefits of Model-Based Improvement?

Establish a common language
- **forge a shared vision**

Build on a set of processes and practices developed with input from a broad section of the software community
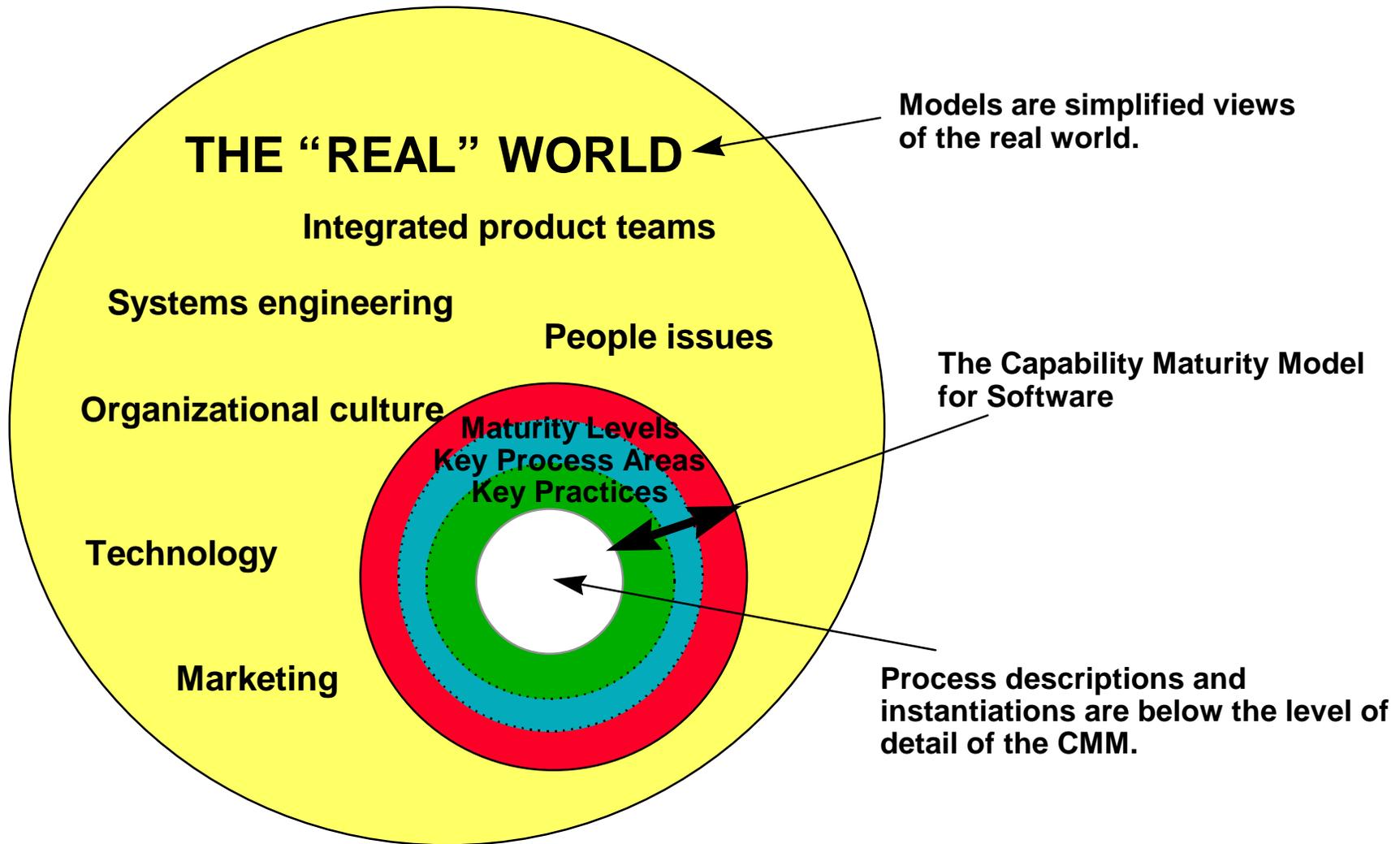
Provide a framework for prioritizing actions

Provide a framework for performing reliable and consistent appraisals

Support industry-wide comparisons

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"M" is for Model

THE "REAL" WORLD

Integrated product teams

Systems engineering

People issues

Organizational culture

Maturity Levels
Key Process Areas
Key Practices

Technology

Marketing

Models are simplified views of the real world.

The Capability Maturity Model for Software

Process descriptions and instantiations are below the level of detail of the CMM.

What are the Risks of Model-Based Improvement?

Models are simplifications of the real world.

Models are not comprehensive.

Interpretation and tailoring must be aligned to business objectives.

Judgement is necessary to use models correctly and with insight.

Using the CMM in Context

The key practices in the CMM are expressed in terms of a large government contracting organization.

When the business environment differs from that template, an appropriate interpretation of the practices should be made.

The true CMM "requirements" are the goals for achieving the key process areas.

Process Improvement Is Continual 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.

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For Additional Information

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