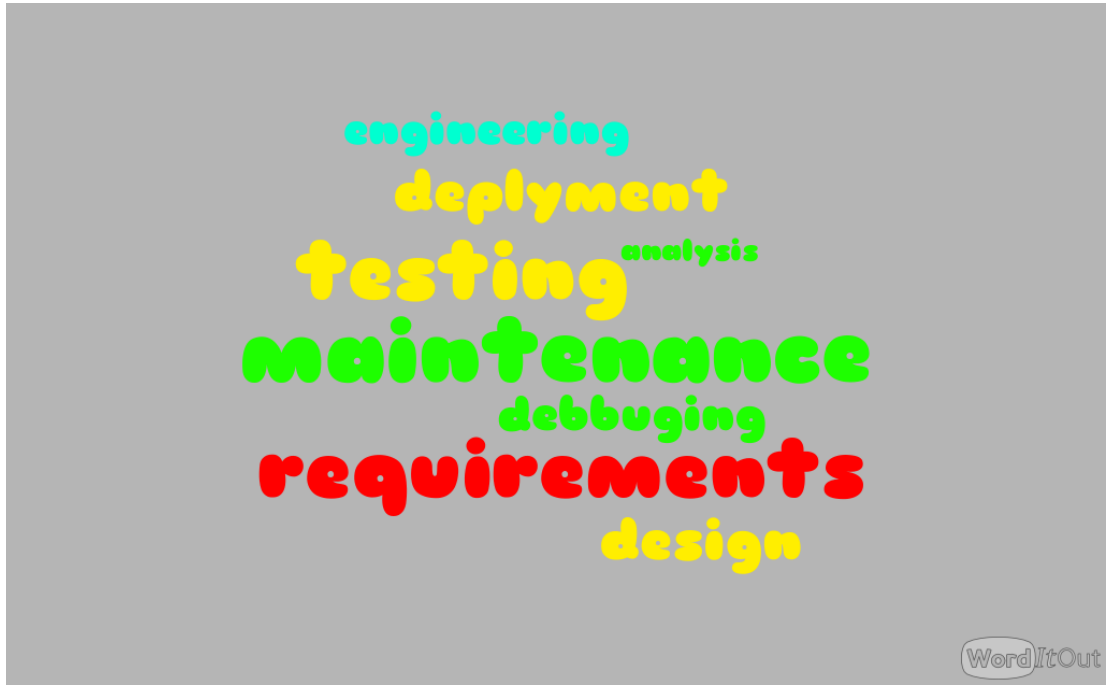
Course 9

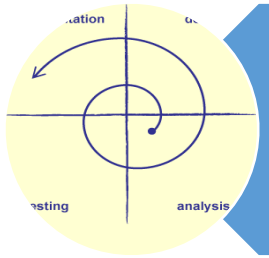
Software process quality

Software development processes

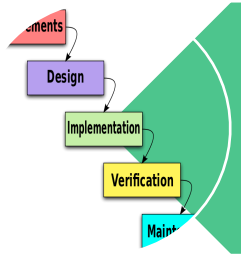
- Software process = set of related activities that lead to the production of software



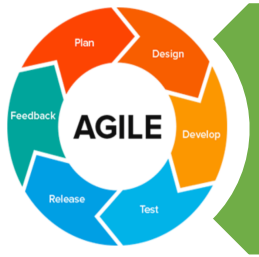
Software development methodologies



Spiral



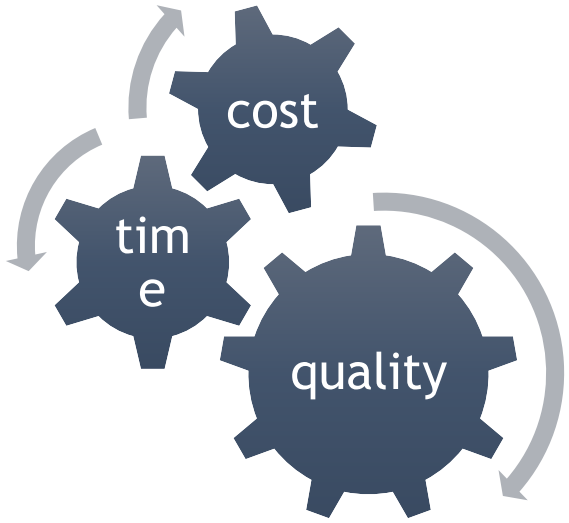
Waterfall



Agile

Pro

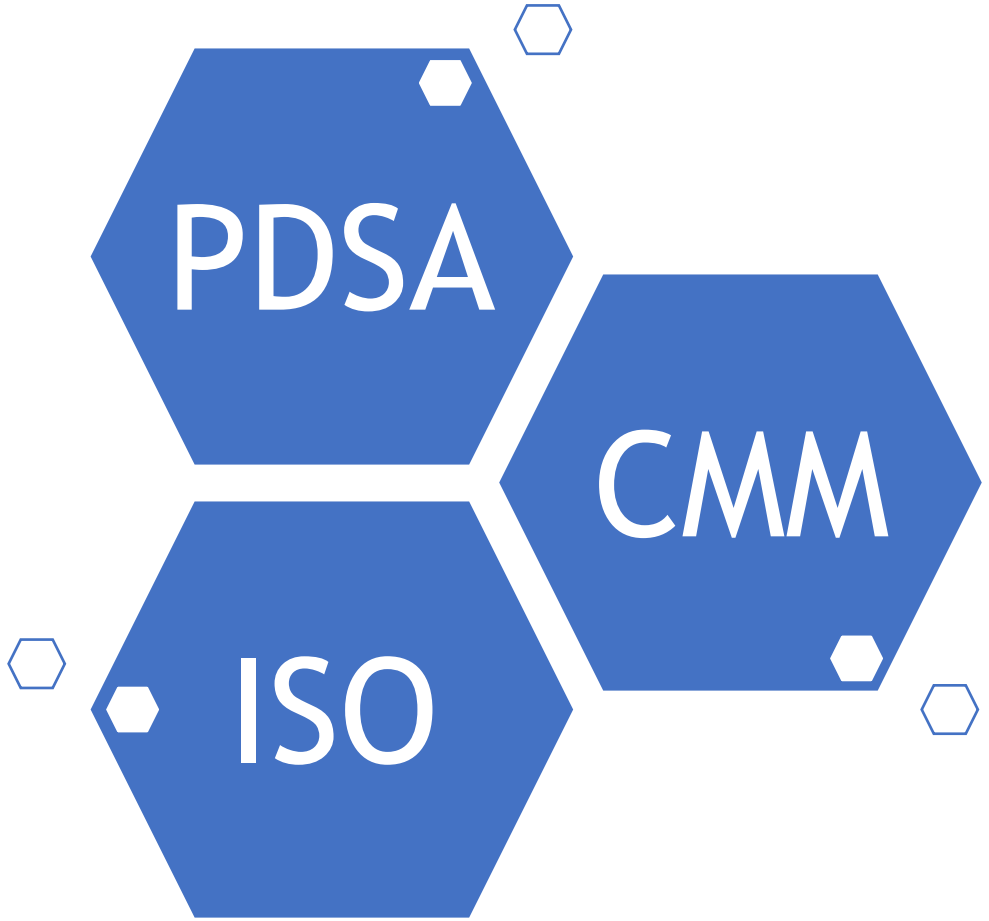
- Estimation
- Deliver
- Control



Cons

- Success = people + technology + manager
- Introduce bureaucracy
- Introduce extra costs
- Only for large projects and companies

Achieve quality processes / improve processes



ISO

- WHY:
  - Software development and maintenance – highest quality
  - Better communication and understanding between:
    - Development & maintenance
    - Developers & external contributors
    - Providers & customers
  - Better management of complex projects

ISO 9000

•ISO 9000: requirements a quality system must meet; addresses quality management and quality assurance standards. NOT how

•ISO 9001: what quality standards should be followed. NOT how

•ISO 9000:2000: serie - 8 key principles: Customer Focus, Leadership, Involvement of People, Process Approach, System Approach to Management, Continual improvement, Factual Approach to Decision Making and Mutually Beneficial Supplier Relationships

ISO 9000 documentation

Level 1: approach and responsibilities – Quality Manual

Level 2: who, what, when - Procedures

Level 3: how - Work / job instructions

Level 4: results – Records, documentation

ISO 9001: 2000 Structure

Quality Management System

Management Responsibility

Resource Management

Product Realization

Measurement , Analysis & Improvement

Procedure

- Certification based

- Valid 3 years
- Requires a working system of Quality Management (regular internal audits, external audits)

CMM

CMM (Capacity – Maturity - Model)
CMMI (CMM Integration)

- Developed by SEI (Software Engineering Institute) from Carnegie Mellon Univ.

- Maturity = degree of formality to:
  - Define steps
  - Manage result metrics
  - Optimize processes

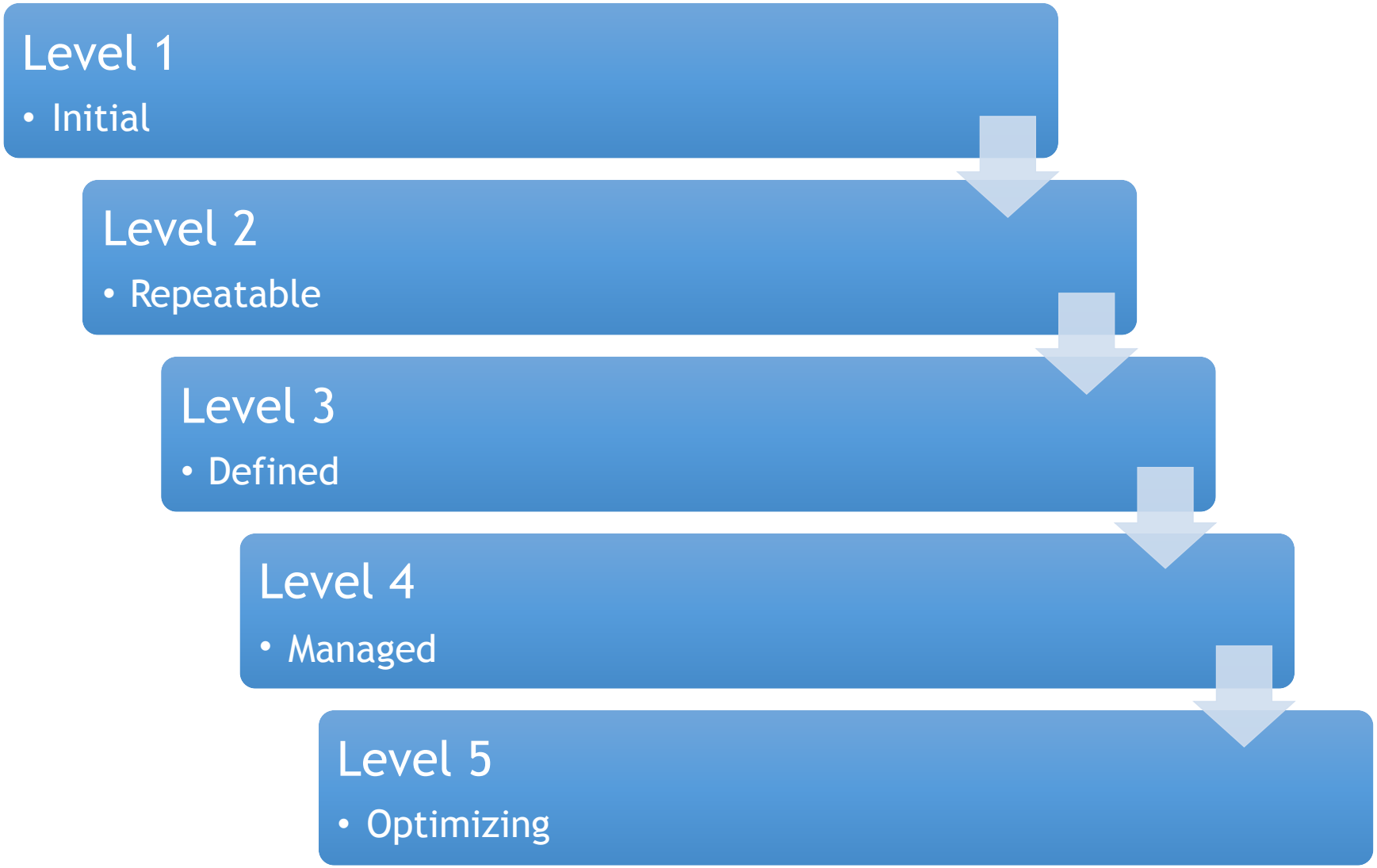
CMMI terms

1. Maturity levels – increased performance
2. KPA (Key Process Area): identify & group activities to achieve goals
3. Goals: scope + intend + range for each KPA
   - Indicates *capability* of org. for a *maturity* level
4. Common features: practices assoc. to a KPA
5. Key practices: implementation and adoption of KPA

Process Areas

- Requirements Management
- Organizational Process Definition
- Project Planning
- Organizational Training
- Project Monitoring & Control
- Integrated Project Management
- Supplier Agreement Management
- Risk Management
- Measurement & Analysis
- Integrated Teaming
- Process & Product Quality Assurance
- Integrated Supplier Management
- Configuration Management
- Decision Analysis & Resolution
- Requirements Development
- Organizational Environment for Integration
- Technical Solution
- Organizational Process Performance
- Product Integration
- Quantitative Project Management
- Verification
- Organizational Innovation & Deployment
- Validation
- Causal Analysis & Resolution
- Organizational Process Focus

Maturity levels & KPAs



CMM Maturity Level 1: Initial

- No project management in place
- Ad hoc practices
- Activities are not preplanned – not pro-active, but reactive - respond to crisis
- Unpredictable process
- Cannot predict time and cost of development

Initiate project management

CMM Maturity Level 2: Repeatable

- Basic SE management practices
- Planning and management are based on experience (repeatable)
- Track costs and schedules
- Identify problems as arise and take immediate corrective action

Standardized process:
- *Peer review*
- *Software product engineering: methods, technologies*
- *Integrated software management*
- *Organization-level: training, process definition*

CMM Maturity Level 3: Defined

- ➢ Process for development fully documented
- ➢ Reviews used to achieve software quality
- ➢ Introduce CASE Tools

- *Software quality management*
- *Quantitative process management*:

- Statistical process management: quantify quality and cost parameters
- Assess relative quality of each product

CMM Maturity Level 4: Managed

- ➢ Organization sets quality and productivity goals for each project
- ➢ Continuous measurement
- ➢ Statistical quality control in place

- *Automatically collect process data*
- *use data to analyze and improve*
- *Defect prevention*

CMM Maturity Level 5: Optimizing

- Statistical quality and process control techniques
- Process has positive feedback loop
- To maintain level: Continue improvement and optimization of the process

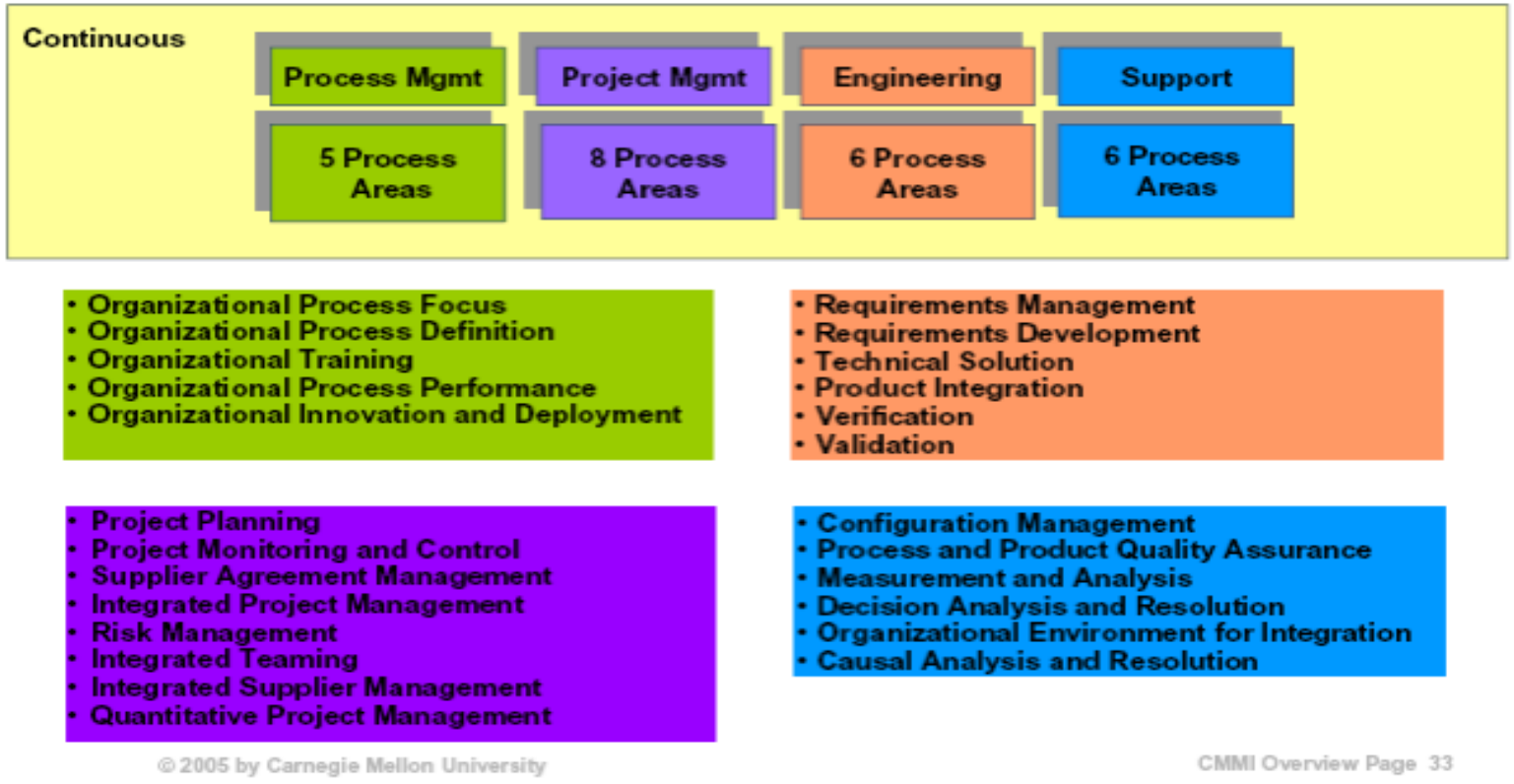
2 representations of CMMI

Continuous	Staged
• Allows to select the order of changes	• Given sequence of improvements
• Predefined sets of PA to define improvement	• Allows to select PA and improve it
• Focuses on improvements within PA	• Focuses on organization improvement

Carnegie Mellon
Software Engineering Institute

CMMI

Continuous View of CMMI



Capability Levels

- Incomplete
- Performed
- Managed
- Defined
- Quantitatively Managed
- Optimizing

Carnegie Mellon
Software Engineering Institute

CMMI

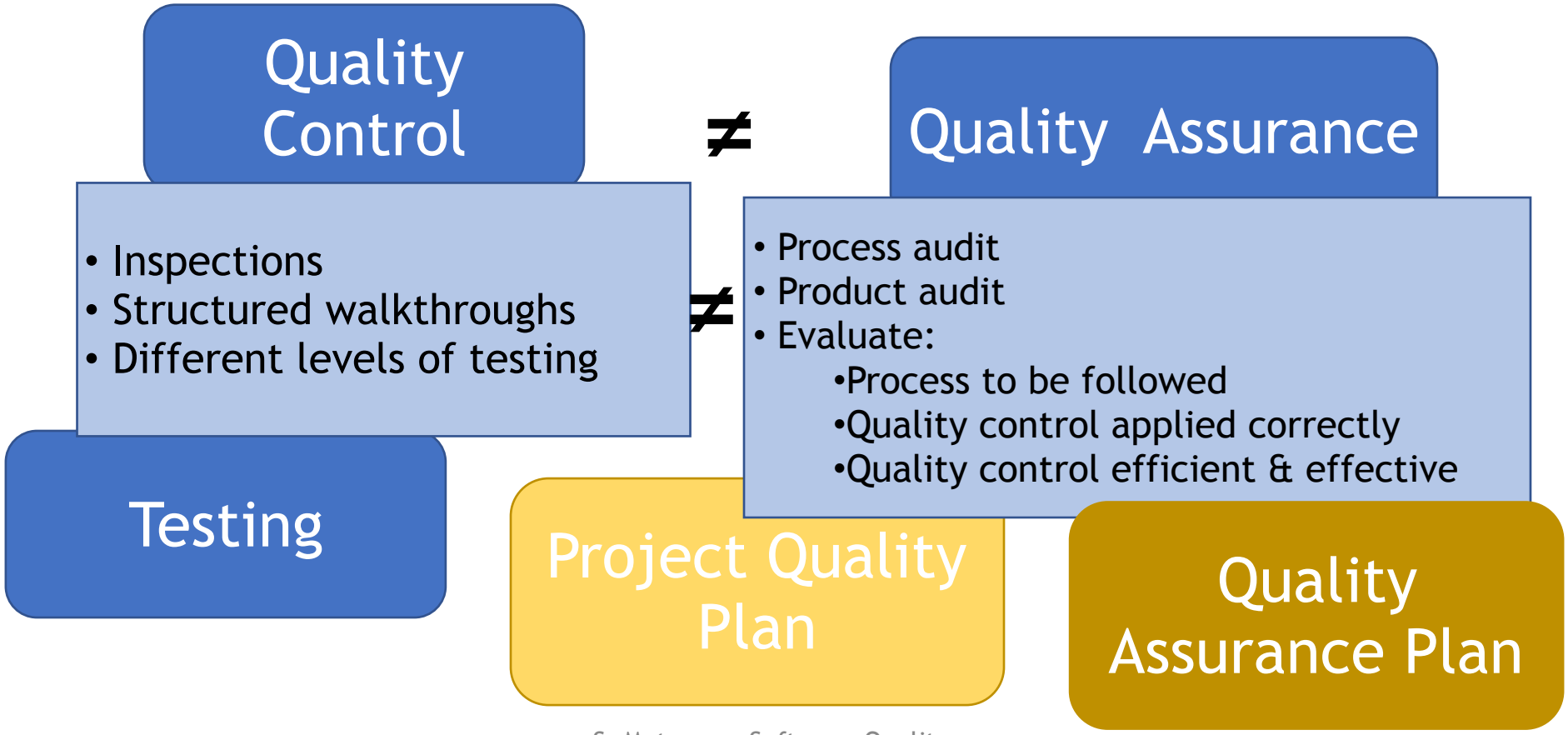
Staged View of CMMI

Capability Levels

- Initial
- Managed
- Defined
- Quantitatively managed
- Optimizing

PPQA (Process and product Quality Assurance)

- Project management OR quality management

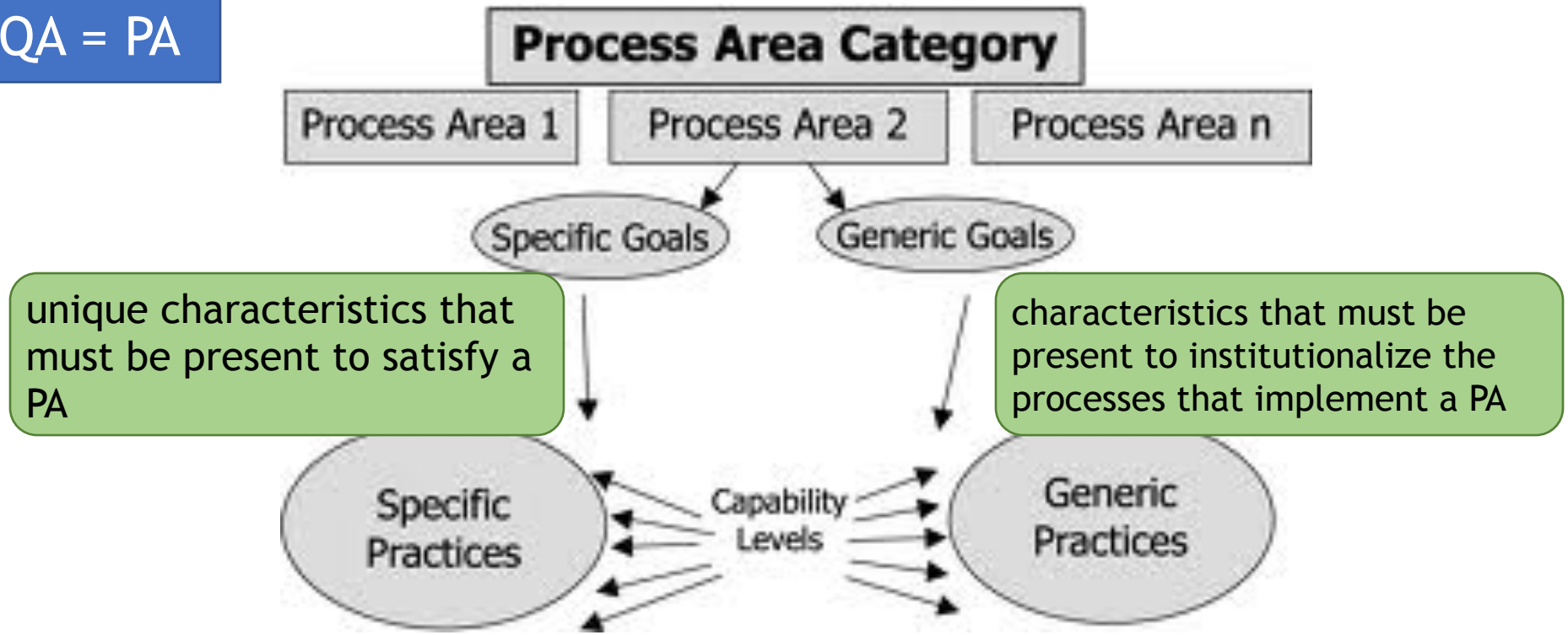


PPQA in CMMI

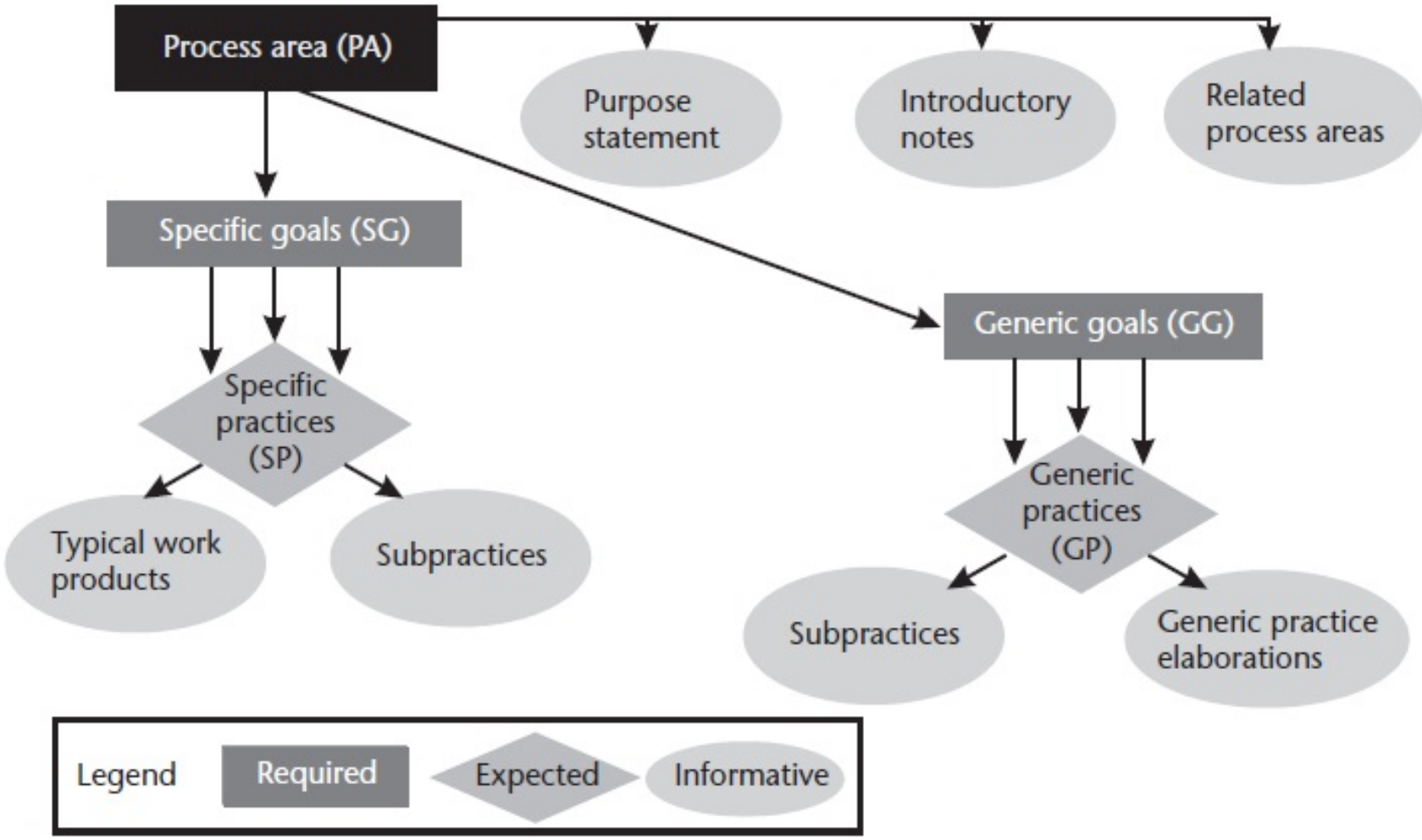
- Is a Process Area (PA) - components
  - Required
    - What an organization must achieve to satisfy a process area
    - Specific + generic goals
  - Expected
    - what an organization may implement to achieve a required component
    - Specific + generic practices
  - Informative
    - how to approach the required and expected components

PPQA in CMMI

PPQA = PA



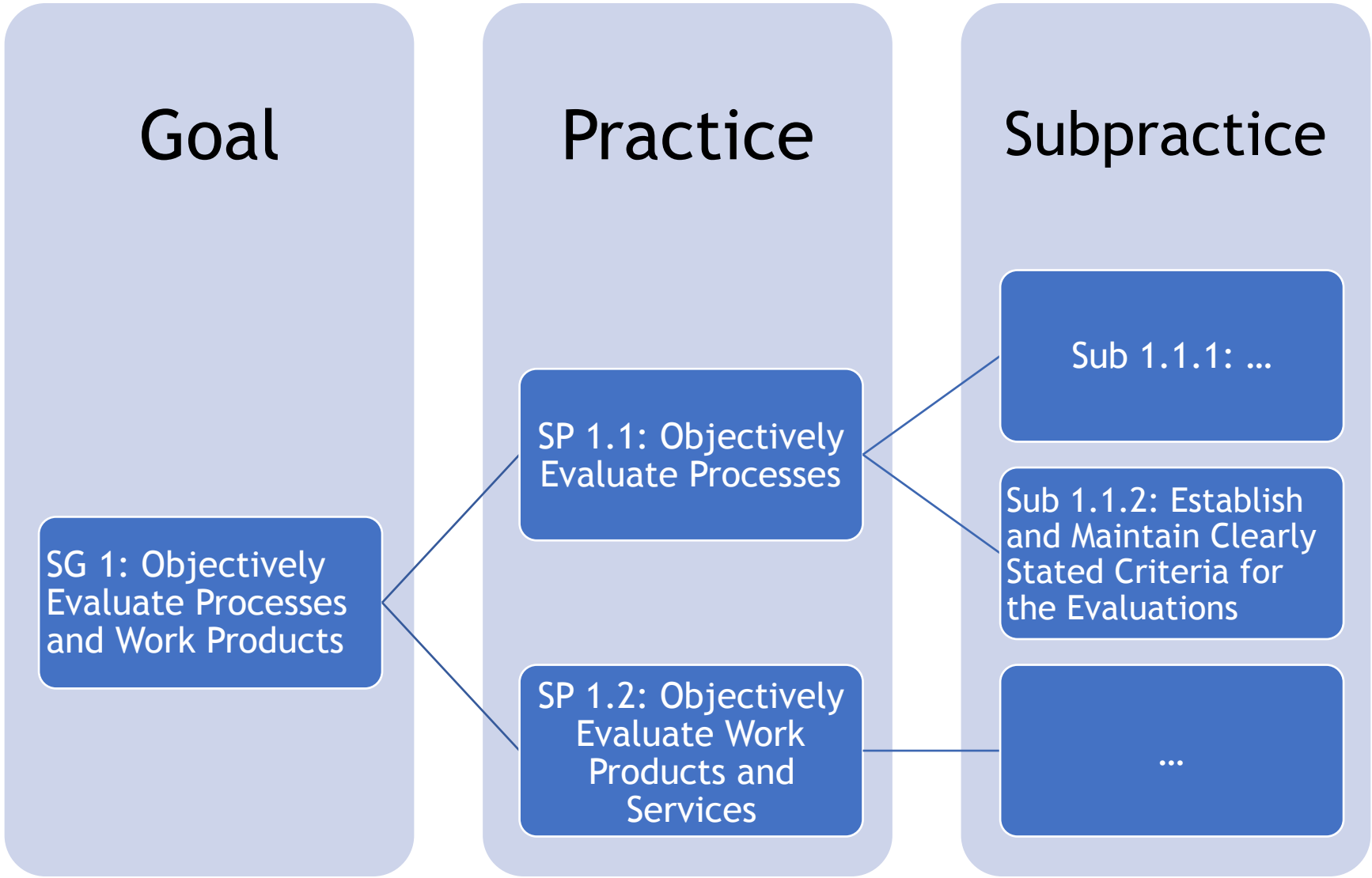
PPQA in CMMI


Process area (PA)
Purpose statement
Introductory notes
Related process areas
Specific goals (SG)
Generic goals (GG)
Specific practices (SP)
Typical work products
Subpractices
Generic practices (GP)
Subpractices
Generic practice elaborations
Legend
Required
Expected
Informative

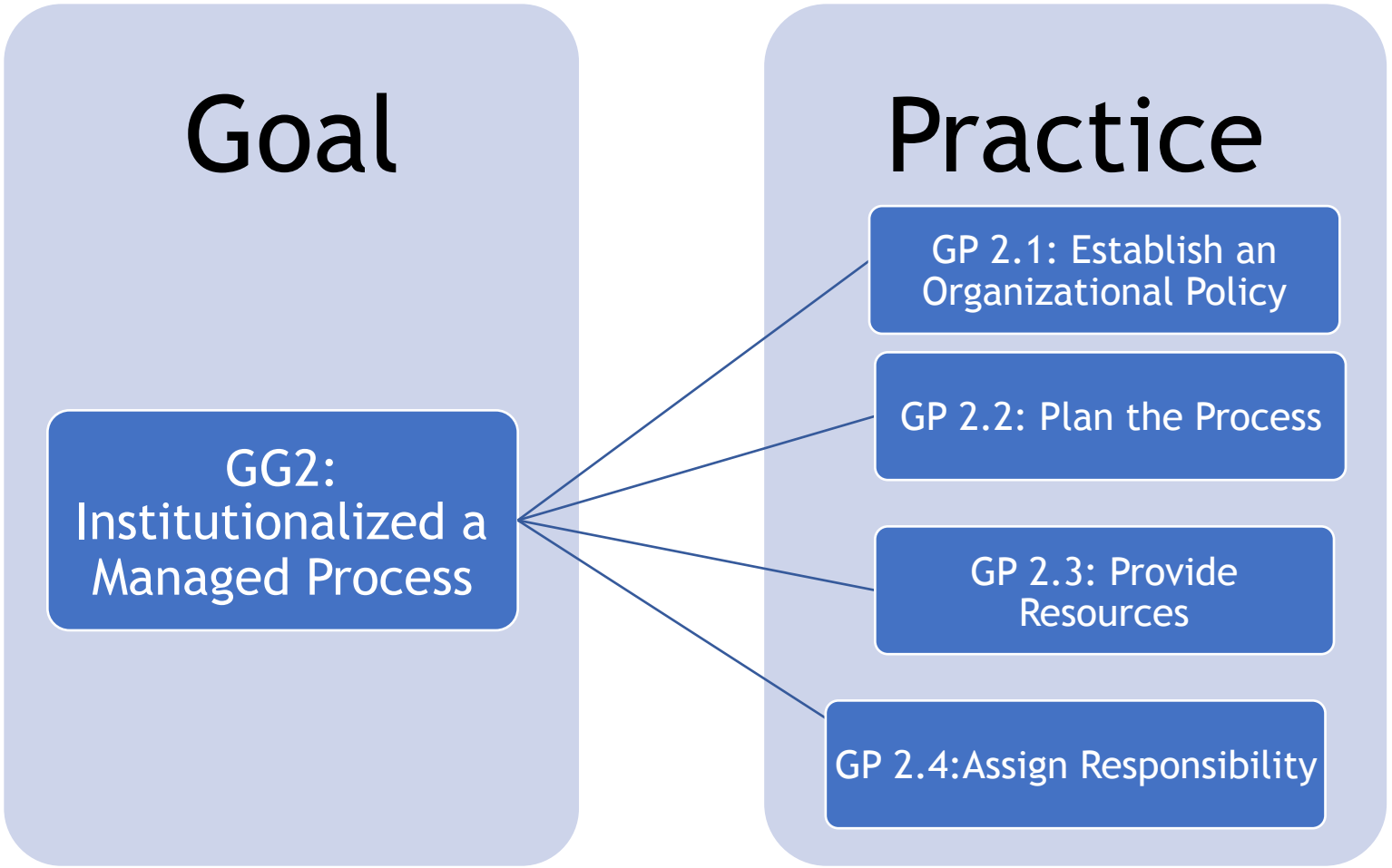
Specific goals & practices

- SG1—Objectively Evaluate Processes and Work Products:
  - Objectively Evaluate Processes;
  - Objectively Evaluate Work Products and Services.

- SG2—Provide Objective Insight:
  - Communicate and Ensure Resolution of Noncompliance Issues;
  - Establish Records.


Goal
Practice
Subpractice
SG 1: Objectively Evaluate Processes and Work Products
SP 1.1: Objectively Evaluate Processes
SP 1.2: Objectively Evaluate Work Products and Services
Sub 1.1.1: …
Sub 1.1.2: Establish and Maintain Clearly Stated Criteria for the Evaluations
…

Generic goals & practices



CMMI Appraisal

- Awarded a maturity level rating: 1-5
- 3 classes: A, B, C
- Standard CMMI Appraisal Method for Process Improvement (SCAMPI)

Success stories

- Boeing's Space Transportation Systems Software
- Tata Consultancy Services (TCS)
- Thales ATM
- CMMI level 5:
  - Romania 0
  - Germany 0
  - France 1
  - UK 3

According to official site – CMMI Appraisal Results:
https://sas.sei.cmu.edu/pars/pars.aspx

•A substantial shift in defect detection, from 89% late detection by testing to 83% early detection by application of various review methods.
• Earlier detection of defects caused a 31% decrease of rework efforts.
• Elimination of defects prior to version release increased from 94% to almost 100%.
• A 140% increase in general productivity.

Quality management maturity grid

[P. Crosby – Quality is free]

Measurem. Categ.	Stage I Uncertainty	Stage II Awakening	Stage III Enlightenment	Stage IV Wisdom	Stage V Certainty
Manag. Underst. & attitude					
Quality org. status					
Problem handling					
Costs of quality as % of sales	20	18	12	8	2.5
Q. improv. actions	We don't know why we have problems with quality				We know why we don't have problems with quality
Company quality pos.					

ISO – CMM Differences

ISO9001:2000	CMMI-DEV
International standard, applies to all types of organizations, supports both product and service oriented organizations	Written specifically for software development companies
A brief document – about 25 pages long, identifying the minimal requirements for a quality system	A detailed document – over 500 pages long
Emphasizes on a management of continuous improvement process, based on the PDCA (Plan-Do-Check-Act) model	Emphasizes on achieving “maturity” and improving its process continuously
One level of standard. The standard is based on recommendation	Defines 5 maturity levels of the organization, covering 25 process areas (PAs)

ISO – CMM Differences

ISO 9000	SW-CMMI
Outwardly focused	Inwardly focused
Minimum requirements with implied continuous improvements	Explicit continuous quality improvement
Registration Document	No documentation

Certification audit for a 50 employee organization will be executed by 1 -12 auditors during one day	Certification audit for a 50 employee organization will be executed by 4 auditors during 4-5 days

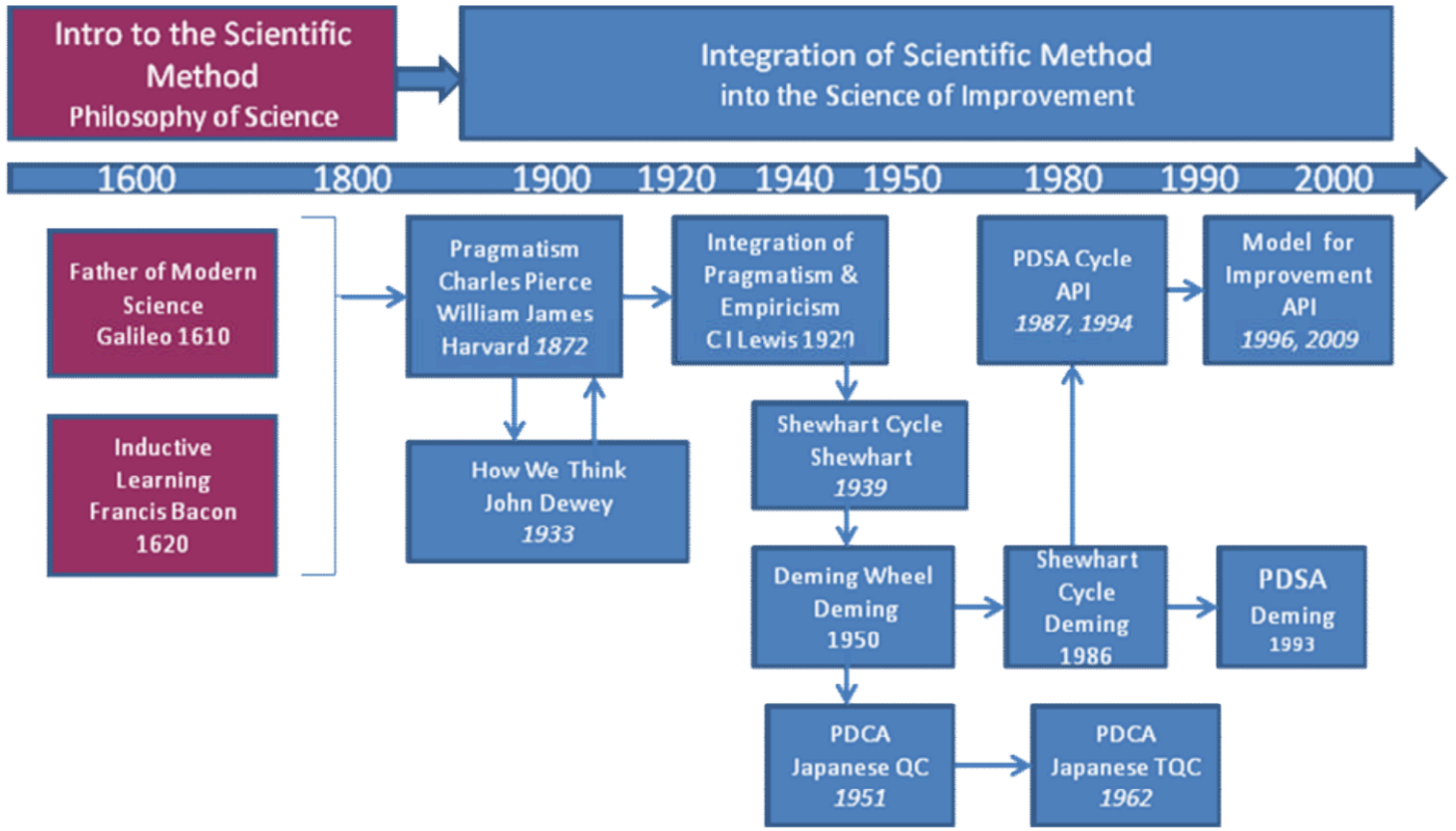
PDSA

- PDSA = Plan – Do – Study - Act

Former

- PDCA = Plan – Do – Check – Act / Adjust

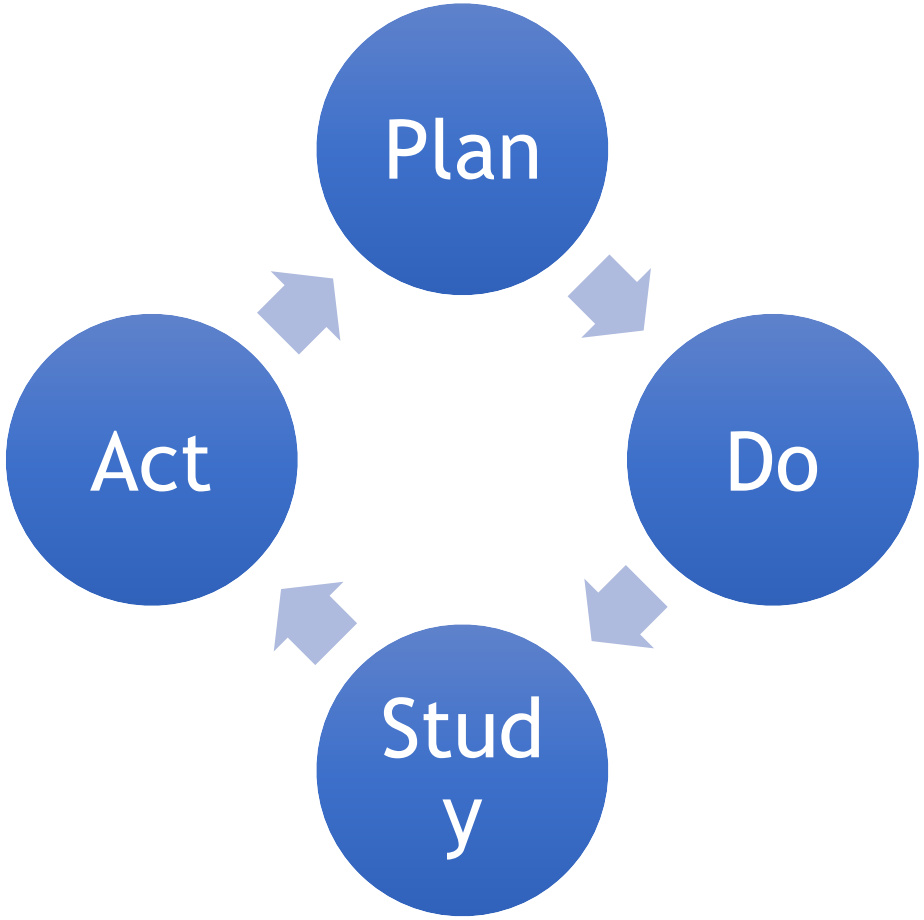
A little bit of history (R.Moen, C. Norman - Evolution of the PDCA Cycle)



W.A. ShewHart – father of statisctical quality control

W.E. Deming– father of modern quality control

1.1 Development of the Engine for the Scientific Method: Deductive and Inductive Logic



Iterative

Separation of phases

Plan

- Objectives
- Questions and predictions
- Plan to carry out

Do

- Carry out plan
- Document problems and unexpected observations
- Gather data
- Begin analysis of data

Stud
y

- Complete analysis of data
- Compare data to the predictions
- Summarize conclusions
- How: gap analysis, appraisals

Act

- Find root of issues
- Re-evaluate risk
- Determine changes to de made
- Implement changes in order to prepare next iteration

Conclusions:

- PDCA + 7 basic tools (see course 8) = foundation for improvement (kaizen) in Japan (‘50)

- Toyota: „Building people before building cars”

Who need / use SQA?