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software engineering dependability

Quality Management of Software and Systems:
Model Based Improvement Approaches

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ISO/IEC 9126

- Standard for software quality focusing on **software products** [1].
- It defines software product quality characteristics that can be applied to:
  - Specify functional and non-functional customer and user requirements.
  - Validate the completeness of a requirements definition.
  - Identify software design and testing objectives.
  - Identify quality assurance criteria.
- These characteristics are defined within a *two part quality model*.

- **Software Quality**: describes the degree in which all defined software requirements are fulfilled. There are three different points of view to determine this: user, developer and manager.

- **Quality Model**: describes causal relationships between not tangible views on quality and tangible software measures:
  - Hierarchical ordered quality aspects that in the end lead to software measures.

[1] ISO/IEC 9126, Software engineering – Product Quality. Parts 1 to 4, 2001- 2004

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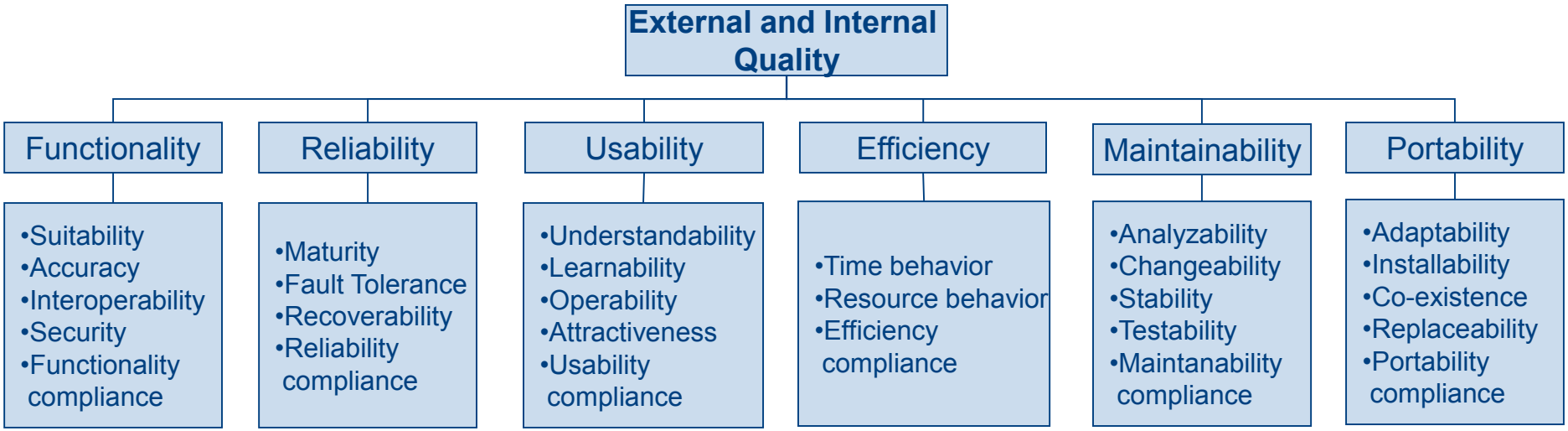
ISO/IEC 9126 – Quality Model part 1

- Two part quality model: Characteristics for Internal and External Quality:



- **Internal Quality:** describes characteristics of software from an internal point of view. It specifies characteristics of interim (intermediate) products.
- **External Quality:** describes characteristics of software from an external point of view. It is derived from the user's quality requirements.

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ISO/IEC 9126 – Quality Model part 2

- Two part quality model: Characteristics for Quality in use:

- **Quality in use:** depicts the *user's point of view* with respect to *software quality* in a *specific environment* and a *context of use*.

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ISO/IEC 12207:2008

- Provides a common framework for **software life cycle processes** with the purpose of:
  - Providing a standardization of terms to
  - Achieve a common understanding of concepts, thus
  - Facilitating communication among stakeholders in the life cycle of a software product.
- It consists of processes, activities and tasks:
  - 44 processes distributed among 7 process groups.
  - Each process has a defined *purpose* and *outcomes.*
  - Activities and tasks that are required to achieve the expected process *outcomes* are performed.
- It covers the complete software life cycle, starting from its conception until its removal from service.
- It can be performed in combination with the ISO/IEC 15288 standard (System life cycle processes).

[1] ISO/IEC 12207, Systems and software engineering – Software life cycle processes. 2008

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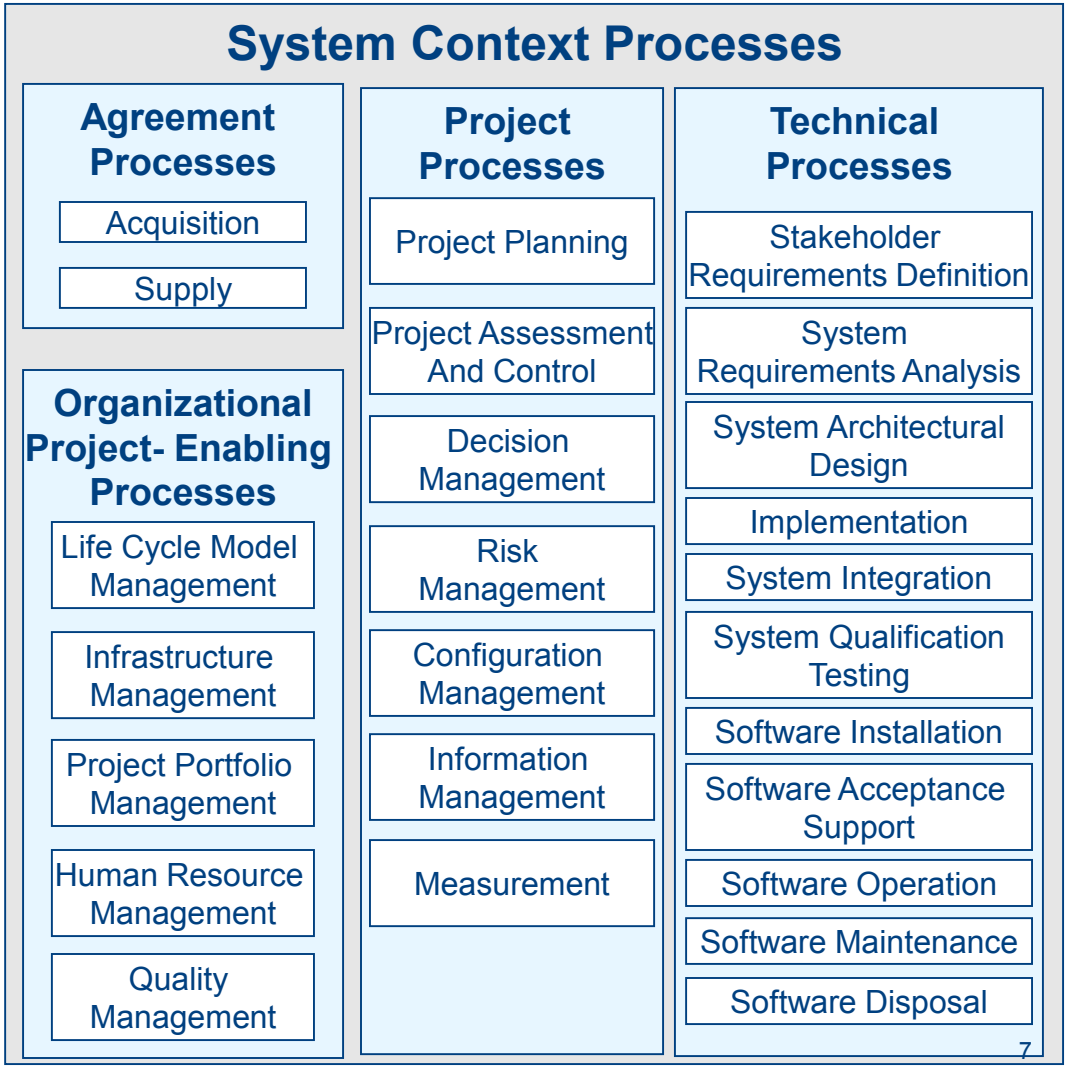
ISO/IEC 12207:2008 – Processes 1

- **System context processes** are organized into 4 groups:
  - Agreement
  - Organizational Project-Enabling
  - Project
  - Technical



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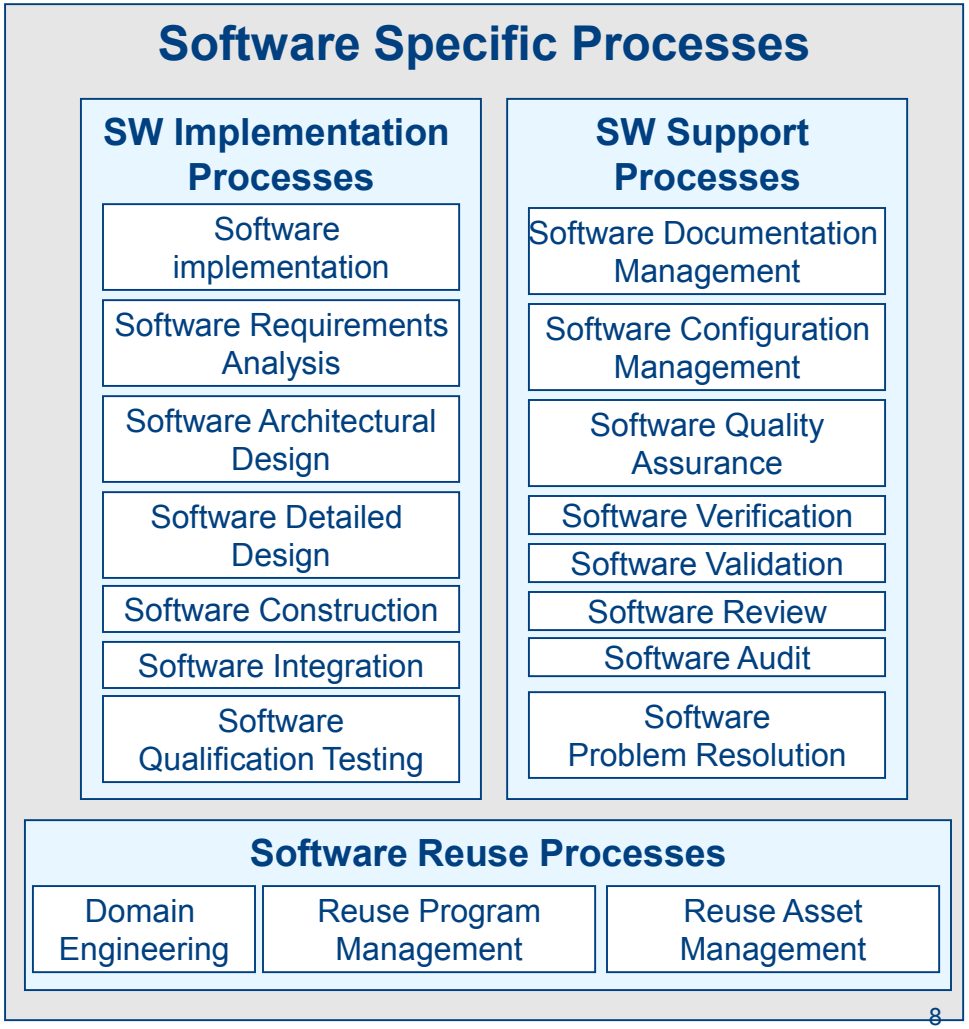
ISO/IEC 12207:2008 – Processes 2

- **Software specific processes** are organized into 3 groups:
  - Implementation
  - Support
  - Reuse



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EN ISO 9000 - Series

- Series of standards that define fundamentals for quality management systems.
- They represent an international consensus on good quality management practices.
- These standards can be applied within all industrial sectors. In particular, the ISO/IEC 90003:2004 standard is suitable for software.
- Set of standards corresponding to the ISO 9000 series:
  - EN ISO 9000:2005 - Quality management systems - Fundamentals and vocabulary
  - EN ISO 9001:2008 - Quality management systems - Requirements
  - EN ISO 9004:2009 - Managing for the sustained success of an organization - A quality management approach
  - EN ISO 19011:2011 - Guidelines for auditing management systems
  - ISO/IEC 90003:2004 - Software engineering. Guidelines for the application of ISO 9001:2000 to computer software

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Capability Maturity Model - CMM

- A framework for software process improvement [1]. It provides guidelines on how to select strategies toward process improvement, by:
  - Establishing the current level of process maturity in an organization.
  - Identifying drawbacks, which have to be improved in order to achieve a better maturity level.

- The CMM defines 5 maturity levels:
  1. Initial
  2. Repeatable
  3. Defined
  4. Managed
  5. Optimizing

- Each level includes a set of recommended practices in several key areas.

→It is believed that by performing these practices, an organization will improve its software process capability.

[1] Paulk, M.C. etal. The capability maturity model for software

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ISO/IEC 15504 (SPICE)

- International standard dedicated to the assessment and improvement of software processes in an organization.

- It consists out of 5 parts:
  - ISO/IEC 15504-1:2004 - Concepts and vocabulary
  - ISO/IEC 15504-2:2003 - Requirements to conduct process assessments
  - ISO/IEC 15504-3:2004 - Support for performing process assessments
  - ISO/IEC 15504-4:2004 - Assistance on use of this standard for process improvement and process capability determination
  - **ISO/IEC 15504-5:2006 – An exemplar process assessment model**

- Analogously to ISO/IEC 12207:1995, this standard defines three process categories within nine different groups.

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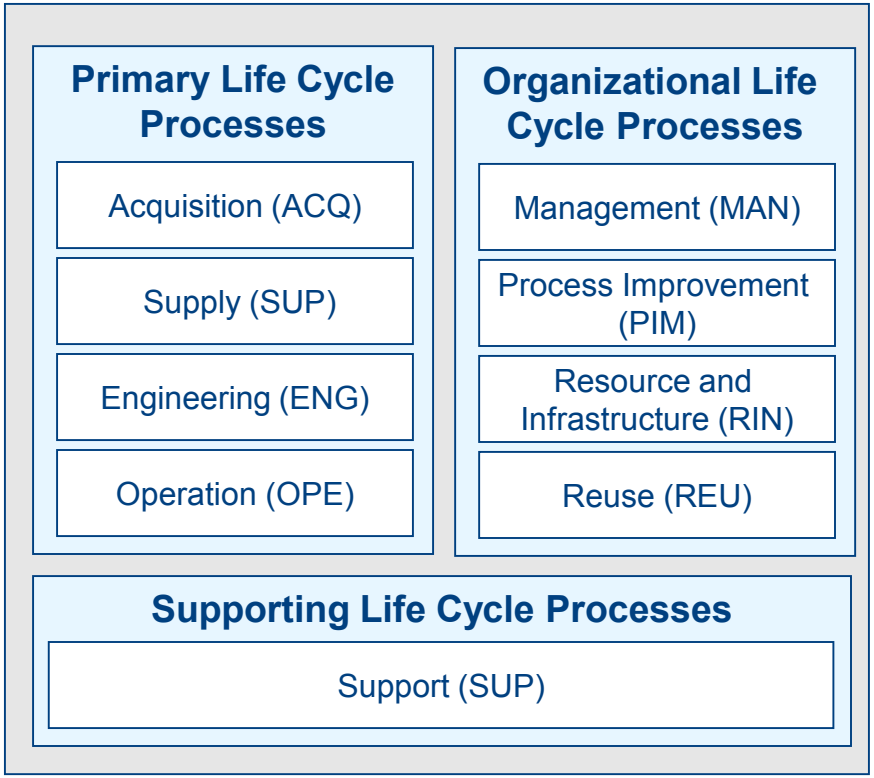
ISO/IEC 15504 (SPICE) - Processes

- Primary Life Cycle Processes:
  - ACQ: processes related to software consumers
  - SUP: processes related to software vendors
  - ENG: engineering processes used in software development
  - OPE: processes used for the operation of developed (built) software
- Organizational Life Cycle Processes
  - MAN: processes used in project management and related activities.
  - PIM: processes used to improve other processes
  - RIN: processes that supply the infrastructure required by other processes
  - REU: processes applied for the systematic reuse of software components
- Supporting life cycle processes
  - SUP: define cross-section processes for the primary life cycle processes e.g. quality assurance processes, and Validation & Verification.



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ISO/IEC 15504 (SPICE) - Assessments

- Assessments are performed by evaluating a chosen subset out of the 49 processes.
- SPICE identifies six capability levels:
  - Level 0: Incomplete
  - Level 1: Performed
  - Level 2: Managed
  - Level 3: Established
  - Level 4: Predictable
  - Level 5: Optimizing
- An assessment is conducted considering predefined *Process Attributes (PA)*, which a process has to fulfill in each of the aforementioned levels.
- For each process, SPICE defines a *Purpose*, its expected *Outcomes* and *Base Practices*.
- Capability grade of a process:
  - Determined by verifying that a process *outcomes* fulfill the *process attributes* of a specific capability level.

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IT Infrastructure Library (ITIL)

- Quasi-standard dedicated to manage the information technology (IT) services.
- Developed in 1989 by the *Office of Government Commerce (OGC)* in Great Britain.
- In particular, ITIL V3 describes a comprehensible IT-service management, which covers the planning, production and support for IT services:
  - Service Strategy
  - Service Design
  - Service Transition
  - Service Operation
  - Service Continual Service Improvement
- Unlike CMM or spice, the focus of ITIL is on production of services and not on systems development!

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CoBIT

- **C**ontrol **Ob**jectives for **I**nformation and Related **T**echnology (CoBIT), describes a widespread-controlling approach in the area of *IT-Governance*.
- *IT Governance* ensures that the IT-structures and processes of an organization are aligned with its strategies and goals (Business Alignment).
- This approach was first developed by the *Information Systems Audit and Control Association* (ISACA) and then transferred in 2000 to the *IT Governance Institute*.
- Another regulation proposed in the area of IT Governance:
  - Sarbanes-Oxley Act (SOC)

[1] ISACA, Control Objectives for Information and related technology (CoBIT®). www.isaca.org

Personal Software Process (PSP)

- Motivation: the achievement of higher quality in an organization depends:
  - On the performance of the development group.
  - In turn, the performance of the group depends on the performance delivered by each one of its members.
  - Finally, the performance of each of the development group's members depends on the practices they apply.
- The PSP is an improvement approach focused on the **performance improvement** of **single software developers**.
- PSP, organized as a self-improvement process (training program), includes a series of exercises that each developer should do (comparable to the CMM levels):
  - PSP0 – Baseline Process
  - PSP1 – Personal Planning Process
  - PSP2 – Personal Quality Management
  - PSP3 – Cyclic Personal Process

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