ISO/IEC 25000 (SQUARE):
Measurement of Product Quality (software, system, service, data)

Ohjelmistotuotannon ja järjestelmäkehityksen standardit nyt
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SFS seminaari 18.10.2017

What is SQuaRE?

- SQuaRE = Software Quality Requirements and Evaluation
  - Brand name for ISO product quality standard (Software, Systems, Services, Data)
- SQuaRE contains framework, quality model and a candidate set of metrics
  - Generic, no specific content. Should be a starting point for all context and domain specific standards.

ISO/IEC JTC1/SC7/WG6 Responsibility and Structure

Title:

- Software Product and Systems Quality

Scope:

- Development of Standards and Technical Reports for Software Product and System Quality Requirements, Measurement and Evaluation

Organizational Structure:

- SQuaRE Series (ISO/IEC 25000 ~ 25099) => WG6
- Functional Size Measures => WG6/FSM SG
- CIF (ISO/IEC 25060 ~ 25069) => JWG => WG28

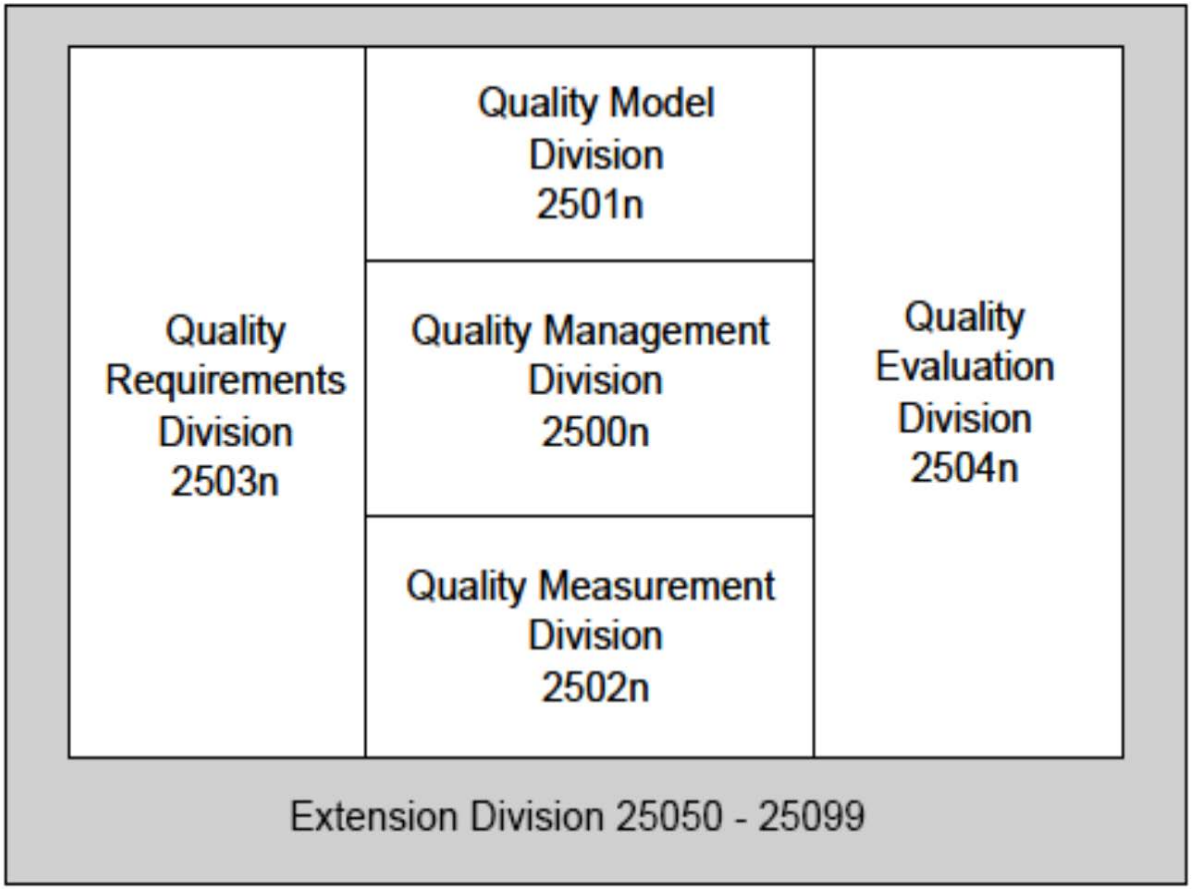
SC7 WG6 / ISO/IEC 25000 history

- **ISO/IEC 9126**: Software engineering - Product quality – (Part 1: Quality model, Part 2: External metrics, Part 3: Internal metrics, Part 4: Quality in use metrics)
- **ISO/IEC 14598**: Software Engineering - Product evaluation – (Part 1: General overview, Part 2: Planning and management, Part 3: Process for developers, Part 4: Process for acquirers, Part 5: Process for evaluators, Part 6: Evaluation module)

Note also following relevant standards (current and past):

- ISO/IEC 12207, software engineering lifecycle
- ISO/IEC 15288, systems engineering lifecycle
- ISO/IEC 15939 measurement (of software)
- ISO/IEC 20000, IT service management
- ISO/IEC 29119, software testing

Organization of SQuaRE series of International Standards



SQuaRE architecture

ISO/IEC 2503n: Quality Requirement Division

25030: Quality Requirements

ISO/IEC 2501n: Quality Model

25010: System and software quality models

25011: IT Service Quality Model

25012: Data Quality Model

ISO/IEC 2500n: Product Quality General

25000: Guide to SQuaRE

25001: Planning and Management

ISO/IEC 2502n: Quality Measurement

25020: Measurement Reference Model

25021: Quality Measure Elements

25022: Measurement of Quality in Use

25023: Measurement of Sys. & SWP Quality

25024: Measurement of Data Quality

ISO/IEC 2504n: Quality Evaluation Division

25040: Quality Evaluation Process

25041: Evaluation Guide for Developers, Acquirers and Independent Evaluators

25045: Evaluation Module for Recoverability

ISO/IEC 25050 - 25099: SQuaRE Extension Division

25051: Requirements for quality of Ready to Use Software Product (RUSP) and instructions for testing

ISO/IEC 25060 - 25069:
Common Industry Format for Usability Reports
Joint between JTC1/SC7 and ISO/TC159/SC4

Software product quality management division

- This division states the general requirements, overview of the SQuaRE and how to manage the technologies necessary for the use of SQuaRE.
- This division consists of two parts:
- ISO/IEC 25000: Guide to SQuaRE
  - The purpose of this Guide is to provide a general overview of SQuaRE contents, common reference models and definitions, as well as the relationship among the documents.
- ISO/IEC 25001: Planning and Management
  - Provides details about the planning and management requirements associated with software product quality requirements and evaluation. Aims to clarify the requirements which should be identified by the organization in order to ensure the success of specifying quality requirements and executing the evaluation.

Quality model division

- This division states the general requirements for a quality model, recommended model, and guides to customize and use the model.
- This division consists of two parts:
- **ISO/IEC 25010: System and software quality models**
  - A quality in use model composed of five characteristics (11 subc.).
  - A product quality model composed of eight characteristics (31 subc.).
- **ISO/IEC 25012: Data quality model**
  - The data quality model defined in this International Standard categorizes quality attributes into fifteen characteristics (22 views) considered by two points of view: inherent and system dependent.
- New model released in 2017: **25011 Service quality model**

Quality measurement division

- This division consists of general requirements for quality metrics, the lists of recommended metrics, and guide for use the metrics.
- This division consists of five parts:
- **ISO/IEC 25020: Measurement reference model and guide**
  - The scope of this International Standard is the selection and construction of software product quality measures.
- **ISO/IEC 25021: Quality measure elements**
  - define and/or design an initial set of Quality Measure Elements (QME) to be used throughout the product life.
- **ISO/IEC 25022: Quality in use measures**
- **ISO/IEC 25023: Measurement of system and software product quality**
- **ISO/IEC 25024: Measurement of data quality**

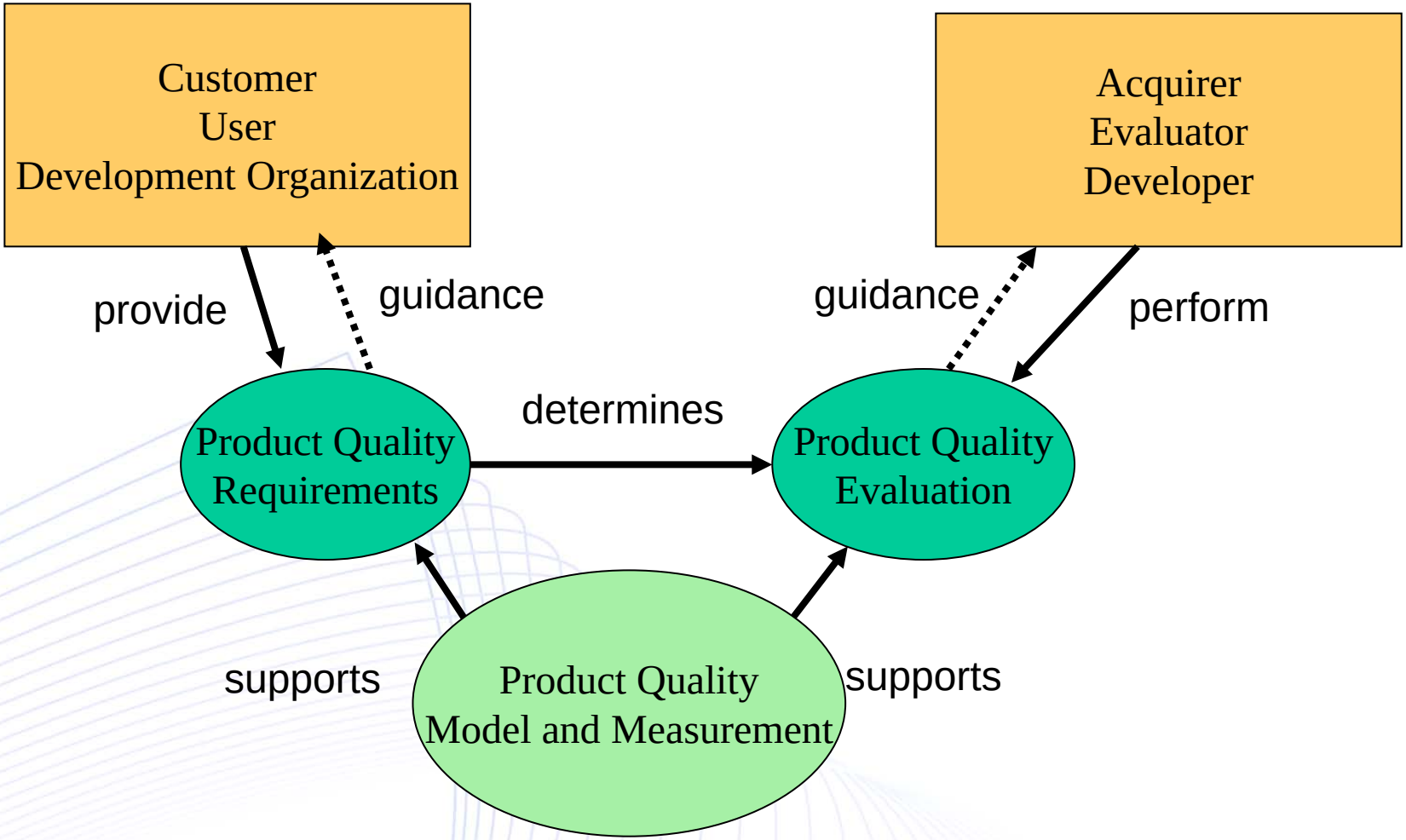
Quality requirements division

- Enables software product quality to be specified as quality requirements.
- The requirements are to be tracked, validated and managed with evaluation from different perspectives by those associated with acquisition, requirements analysis, development, use, evaluation, support, maintenance, quality assurance and audit of software.
- Also includes guide to use the model and metrics for requirement definition.
- This division consists of one part:
- **ISO/IEC 25030**: Quality requirements
  - Provides requirements and recommendations for the specification of software product quality requirements.

Quality evaluation division

- Contains general *requirements* for specification and evaluation of software quality and clarifies the general concepts.
- This part provides a framework for evaluating the quality of all types of software products and states the *requirements* for methods of software product measurement and evaluation.
- This division consists of two parts:
- **ISO/IEC 25040: Quality evaluation process**
  - Provides a process description for evaluating software product quality and states the requirements for the application of this process.
- **ISO/IEC 25041: Evaluation guide for developers, acquirers and independent evaluators**
  - Provides requirements, recommendations and guidelines for product quality evaluation specifically for developers, acquirers and independent evaluators.

Overview of using SQuaRE



QUALITY MODEL 25010

Quality of a system

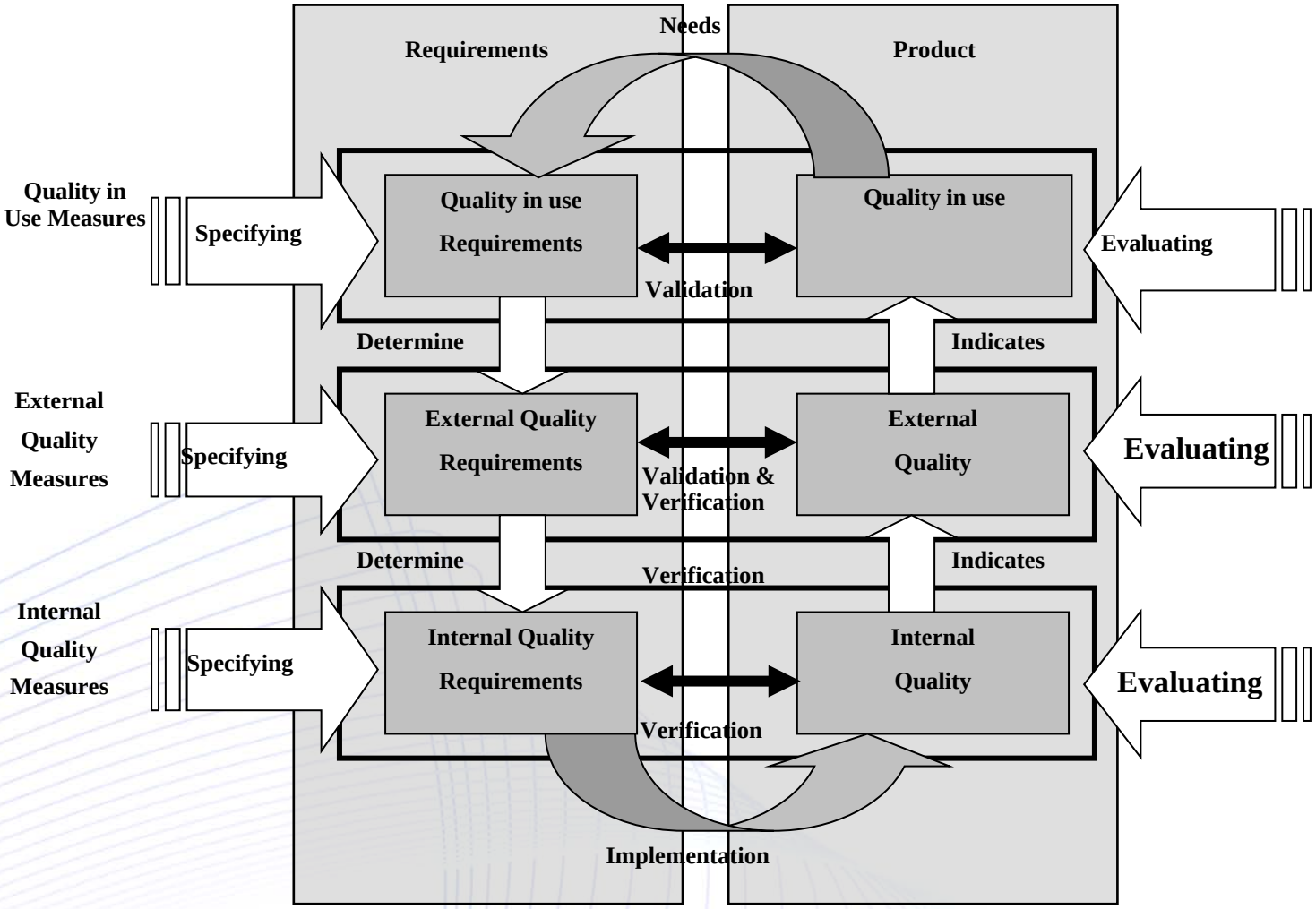
- The quality of a system is the degree to which the system satisfies the stated and implied needs of its various stakeholders, and thus provides value.
- These stated and implied needs are represented in the SQuaRE series of standards by quality models that categorise product (inherent) quality into characteristics which in some cases are further subdivided into subcharacteristics. (…sub-subcharacteristics.)
- This hierarchical decomposition provides a convenient breakdown of product quality.
- However, the set of subcharacteristics associated with a characteristic have been selected to be representative of typical concerns without necessarily being exhaustive.

ISO/IEC 25010 System and software **quality models**

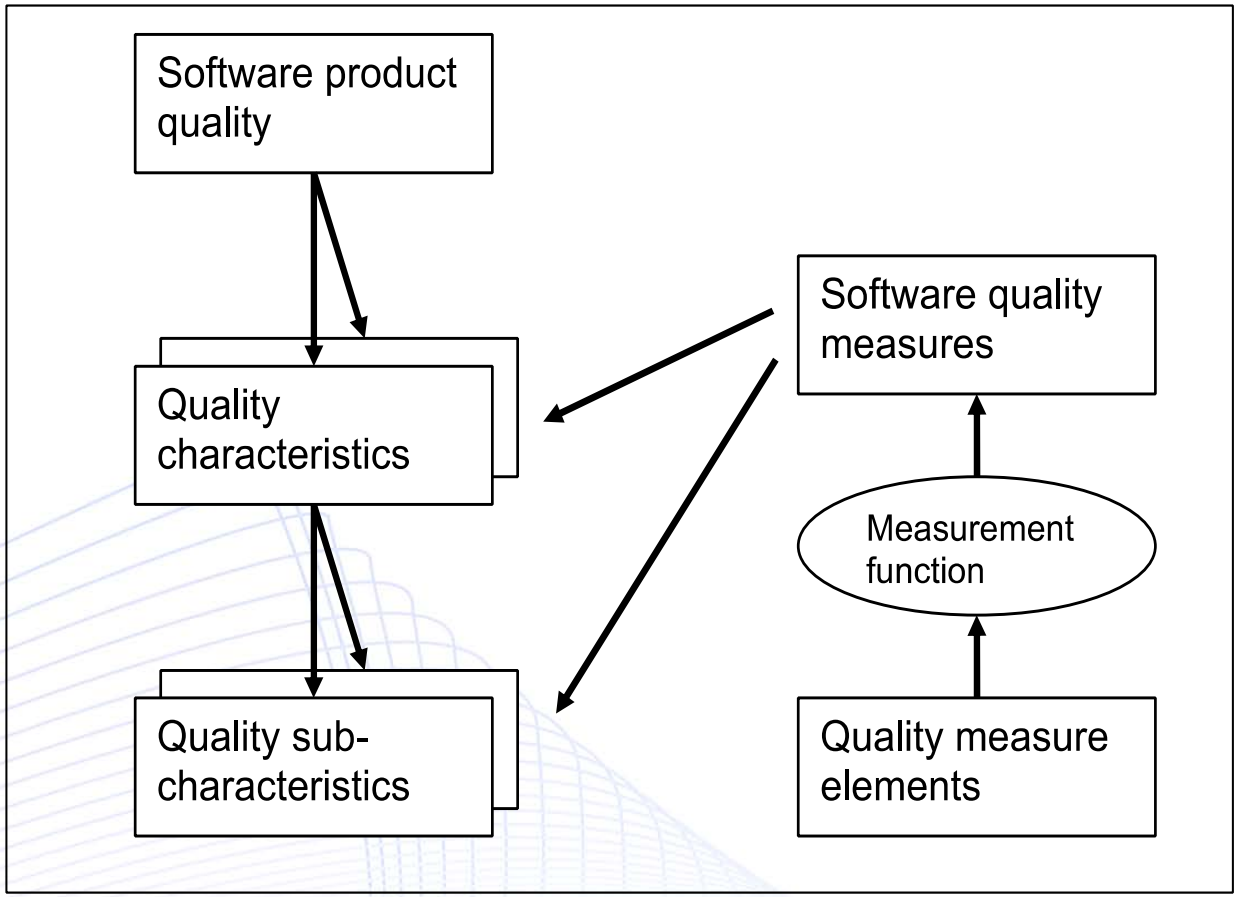
- A **quality in use model** composed of five characteristics (some of which are further subdivided into subcharacteristics) that relate to the outcome of interaction when a product is used in a particular context of use. This system model is applicable to the complete human-computer system, including both computer systems in use and software products in use.

- A product quality model composed of eight characteristics (which are further subdivided into subcharacteristics) that relate to static properties of software and dynamic properties of the computer system. The model is applicable to both computer systems and software products. Terms in use are **internal and external product quality.**

Lifecycle View of product quality, three quality models



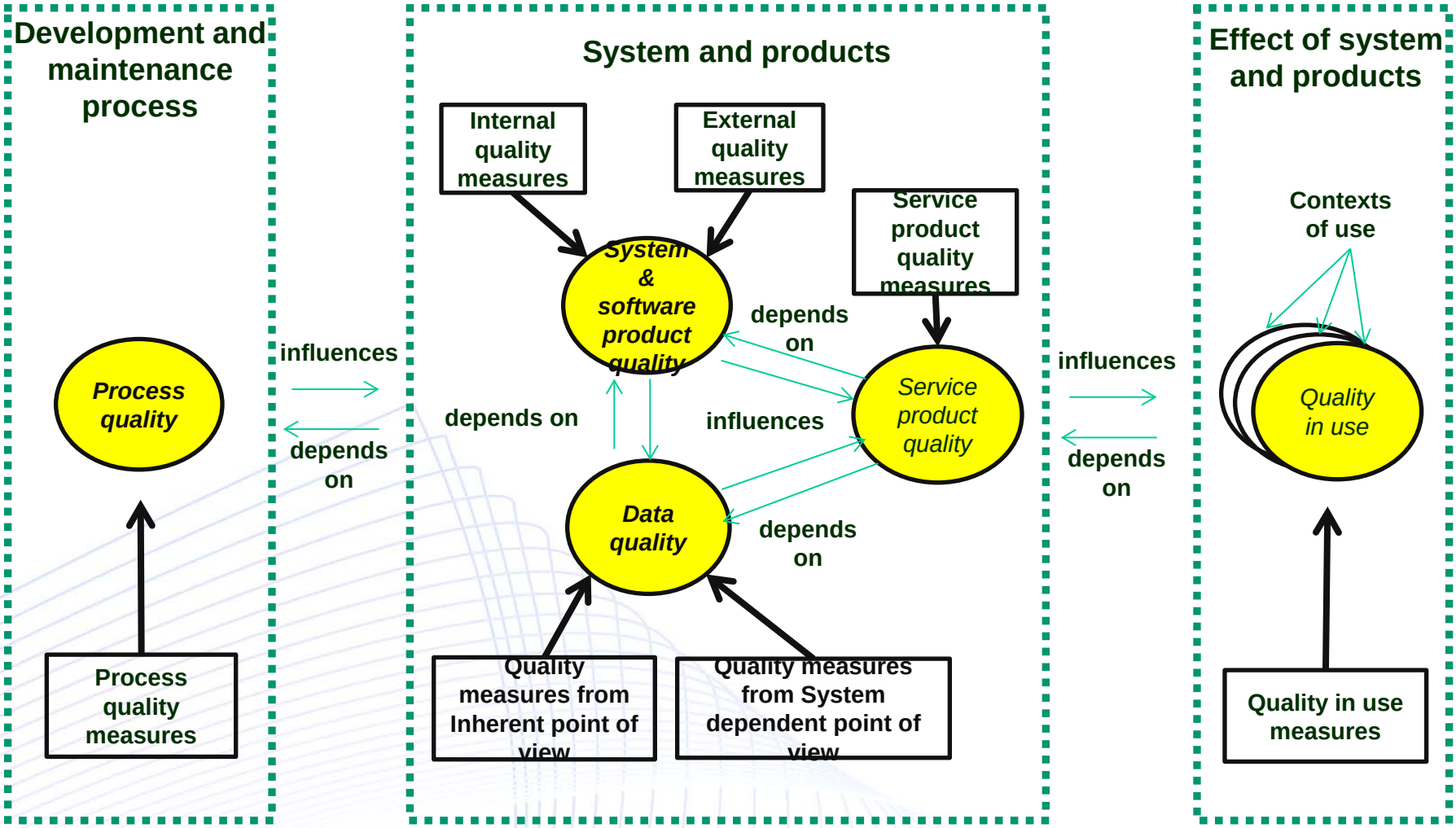
How to measure software quality?



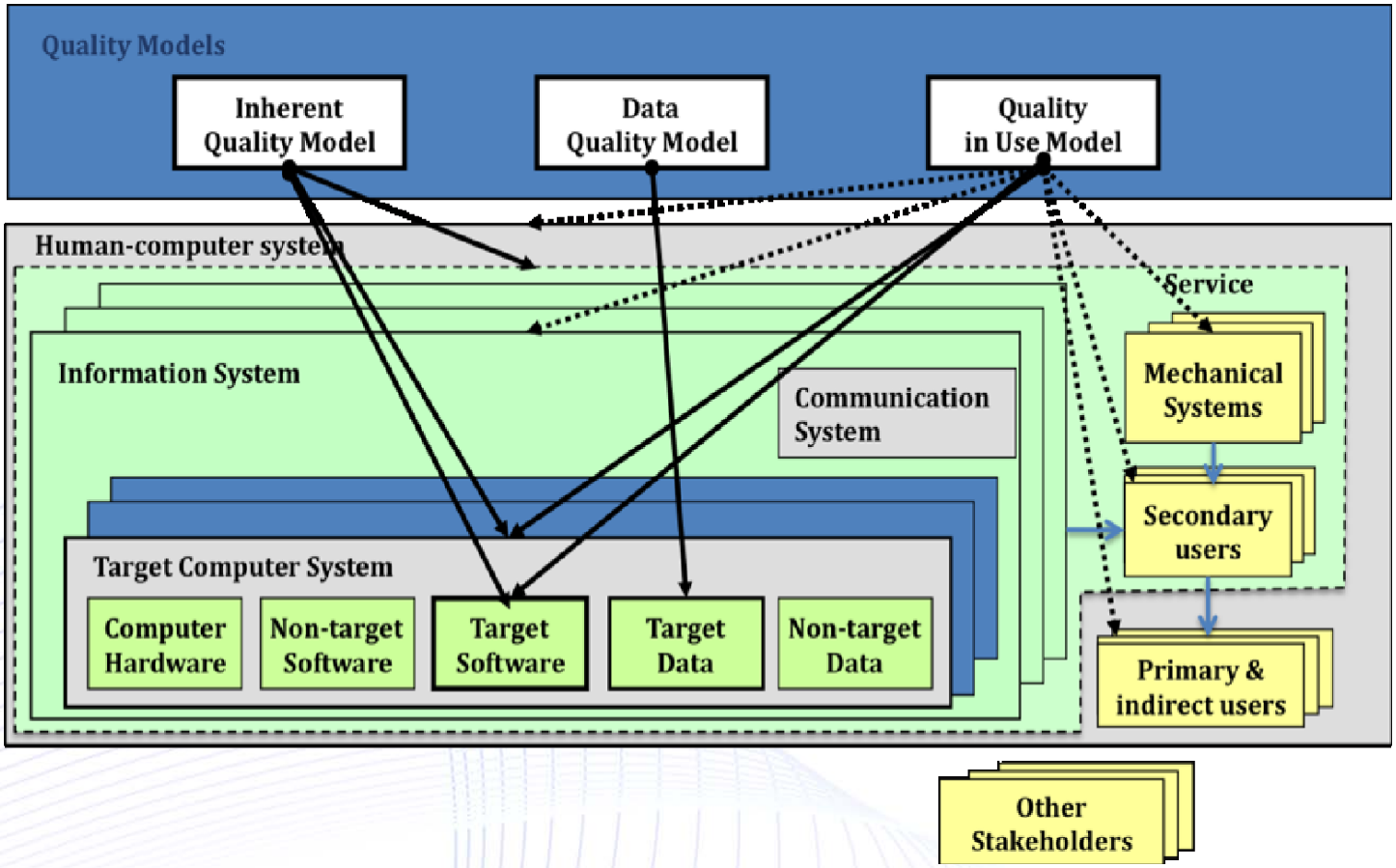
Terms and definitions

- quality attribute = measurable component of quality
- stakeholder = individual or organisation having a right, share, claim or interest in a system or in its possession of characteristics that meet their needs and expectations (e.g. software developers, system integrators, acquirers, owners, maintainers, contractors and end users)
- user = individual or group that benefits from a system during its utilization
- direct user = person who interacts with the product

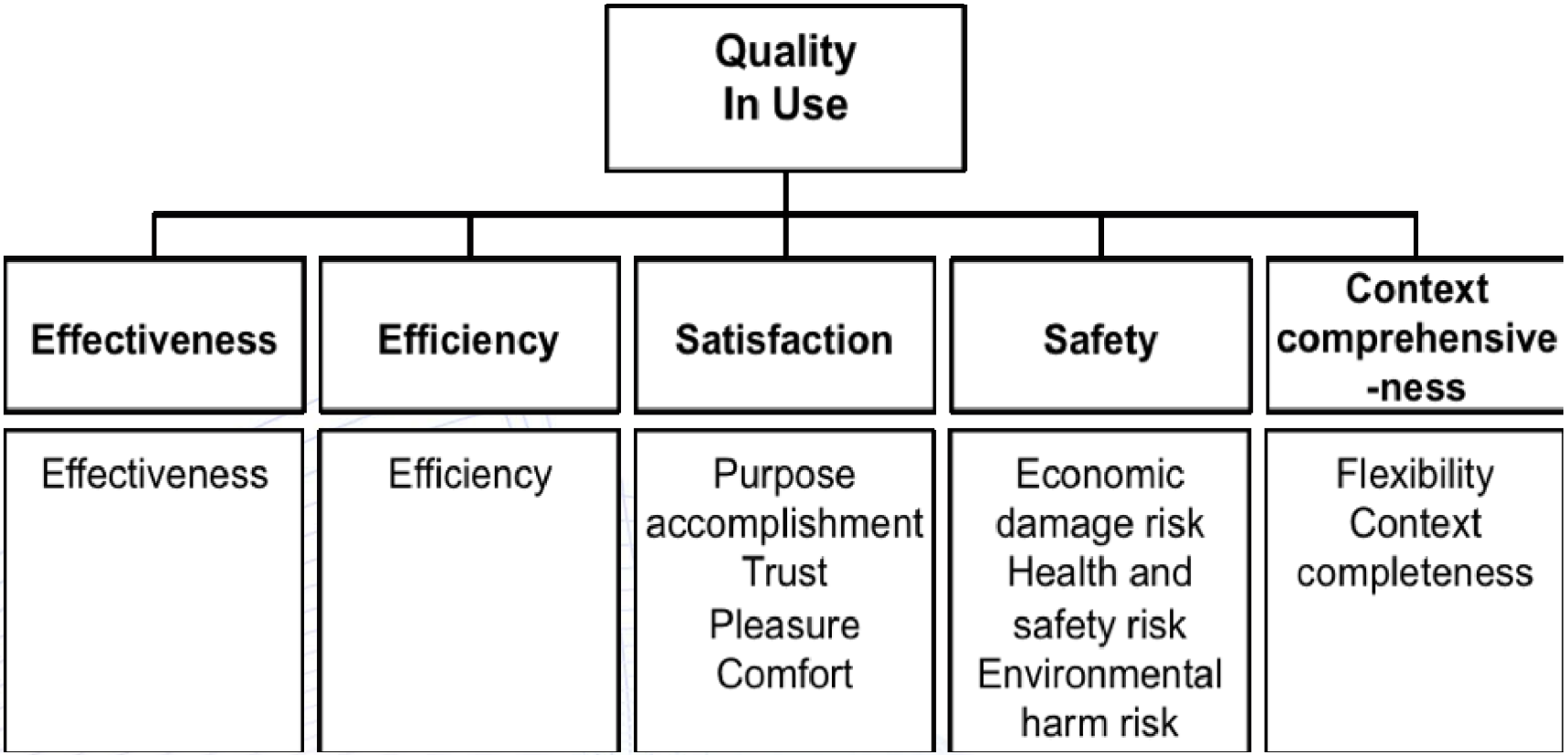
Putting all together



Target of quality models



Quality in use model



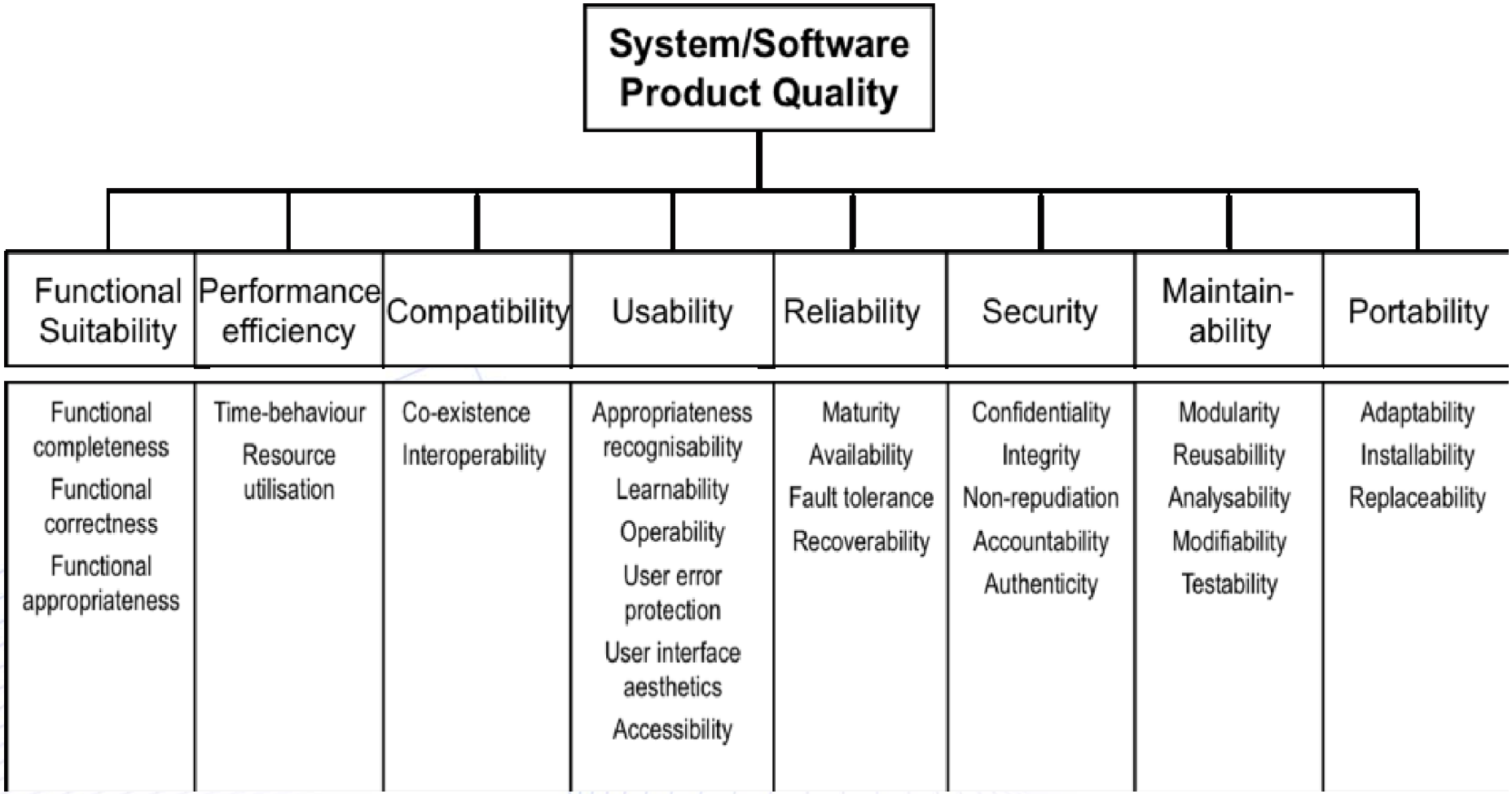
Quality in use characteristics, short description

- Effectiveness
  - accuracy and completeness with which users achieve specified goals
- Efficiency
  - resources expended in relation to the accuracy and completeness with which users achieve goals
- Satisfaction
  - degree to which user needs are satisfied when a product or system is used in a specified context of use (includes attitudes towards use of the product)
- Freedom from risk
  - degree to which a product or system mitigates the potential risk to economic status, human life, health, or the environment
- Flexibility
  - degree to which a product or system can be used with effectiveness, efficiency, freedom from risk and satisfaction in contexts beyond those initially specified in the requirements

Examples of user needs for quality in use and product quality

User needs	Primary user	Secondary users		Indirect user
		Content provider	Maintainer	
	Interacting	Interacting	Maintaining or porting	Using output
Effectiveness	How effective does the user need to be when using the system to perform their task?	How effective does the content provider need to be when updating the system?	How effective does the person maintaining or porting the system need to be?	How effective does the person using output from the system need to be?
Efficiency	How efficient does the user need to be when using the system to perform their task?	How efficient does the content provider need to be when updating the system?	How efficient does the person maintaining or porting the system need to be?	How efficient does the person using the output from the system need to be?

Product quality model in 25010

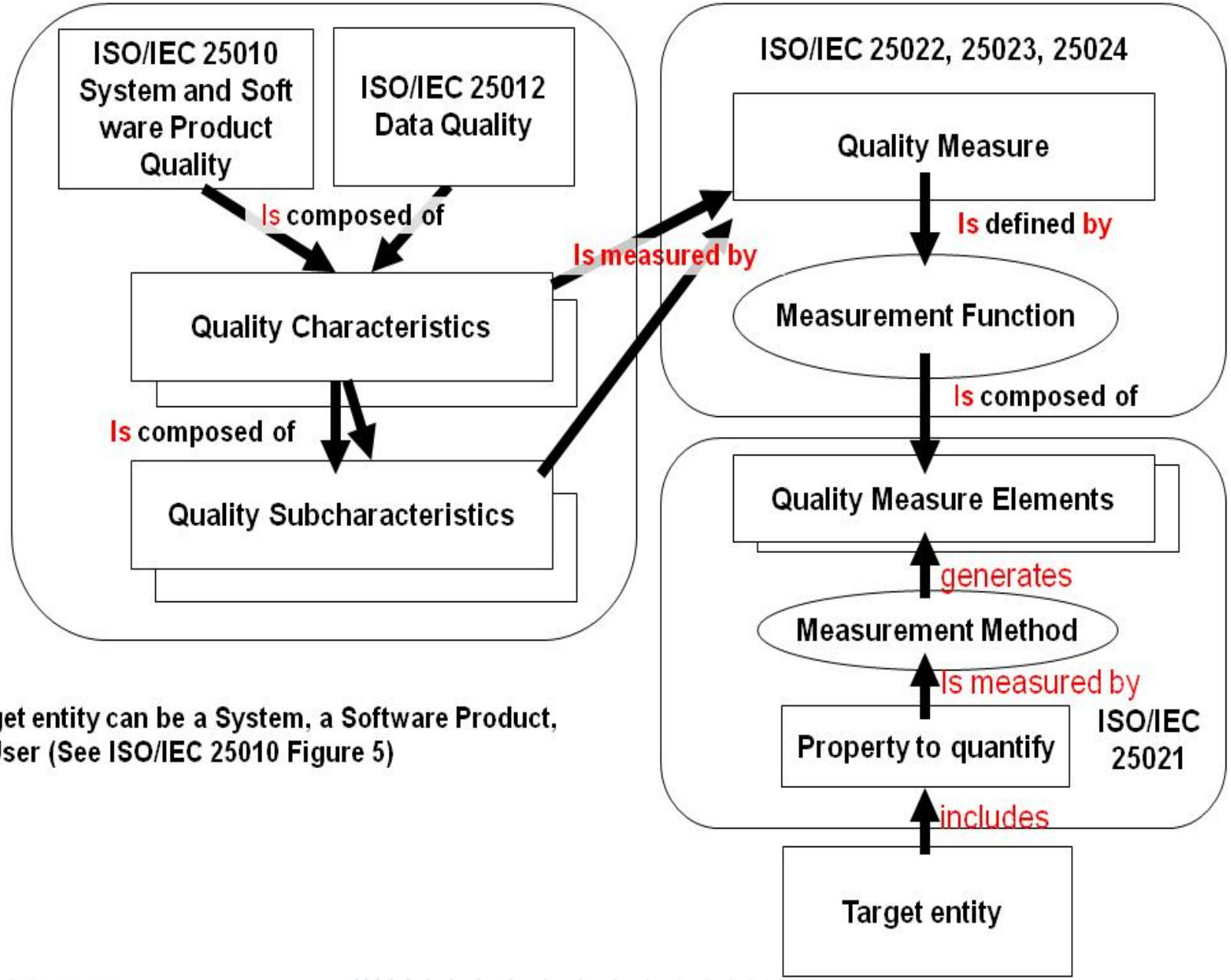


Product quality characteristics, short description (1)

- Functional suitability
  - degree to which a product or system provides functions that meet stated and implied needs when used under specified conditions
- Performance efficiency
  - performance relative to the amount of resources used under stated conditions
- Compatibility
  - degree to which a product, system or component can exchange information with other products, systems or components, and/or perform its required functions, while sharing the same hardware or software environment
- Usability
  - degree to which a product or system can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.

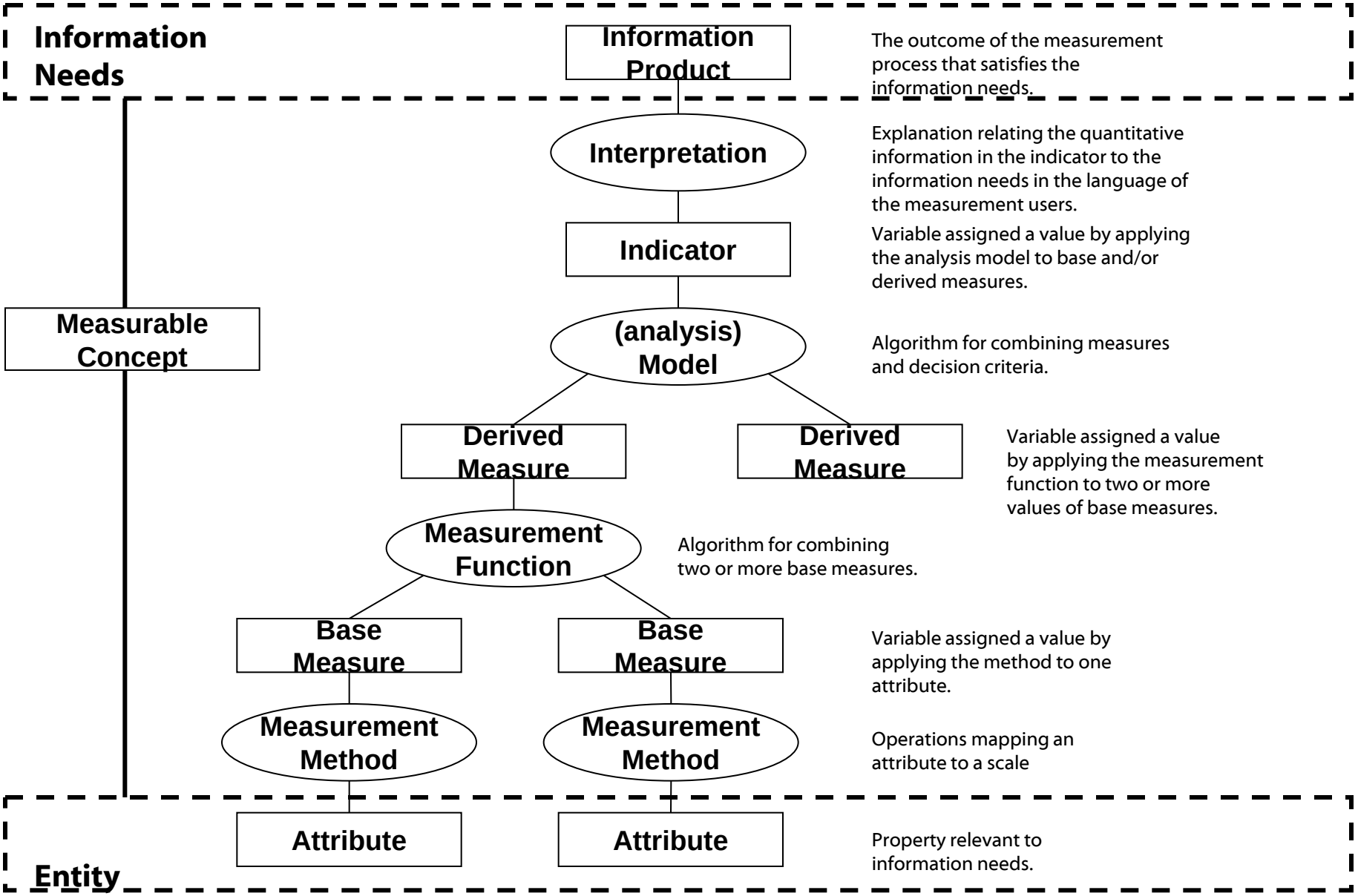
Product quality characteristics, short description (2)

- Reliability
  - degree to which a system, product or component performs specified functions under specified conditions for a specified period of time.
- Security
  - degree to which a product or system protects information and data so that persons or other products or systems have the degree of data access appropriate to their types and levels of authorisation
- Maintainability
  - degree of effectiveness and efficiency with which a product or system can be modified by the intended maintainers
- Portability
  - degree of effectiveness and efficiency with which a system, product or component can be transferred from one hardware, software or other operational or usage environment to another



Note: Target entity can be a System, a Software Product, Data or a User (See ISO/IEC 25010 Figure 5)

Key relationships in the Measurement Information Model (ISO/IEC 15939)



System requirements categorisation in SQUARE

<table>
<tr><td rowspan="5">System requirements</td><td rowspan="4">Software requirements</td><td rowspan="3">Software product requirements</td><td rowspan="2">Inherent property requirements</td><td colspan="2">Functional requirements</td></tr>
<tr><td rowspan="3">Software quality requirements</td><td>Quality in use requirements</td></tr>
<tr><td>External quality requirements</td></tr>
<tr><td>Internal quality requirements</td></tr>
<tr><td>Assigned property requirements</td><td colspan="2">Managerial requirements including for example requirements for price, delivery date, product future, and product supplier</td></tr>
<tr><td rowspan="2">Software development requirements</td><td colspan="3">Development process requirements</td></tr>
<tr><td colspan="3">Development organisation requirements</td></tr>
<tr><td>Other system requirements</td><td colspan="4">Include for example requirements for computer hardware, data, mechanical parts, and human business processes</td></tr>
</table>

Selecting Software Quality Measures (“shalls”)

- Criteria for selecting software quality measures and quality measure elements to fulfill those information needs shall be documented.
  - Initial set is in ISO/IEC 25030
- When using a modified or a new measure not identified in the ISO/IEC 25022, 25023 or 25024, the user shall specify how the measure relates to its corresponding quality model and how it is to be constructed from quality measure elements.

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QUESTIONS? COMMENTS? THANK YOU!