SOFTWARE TESTING

Software Testing

Software Quality Criteria (2)

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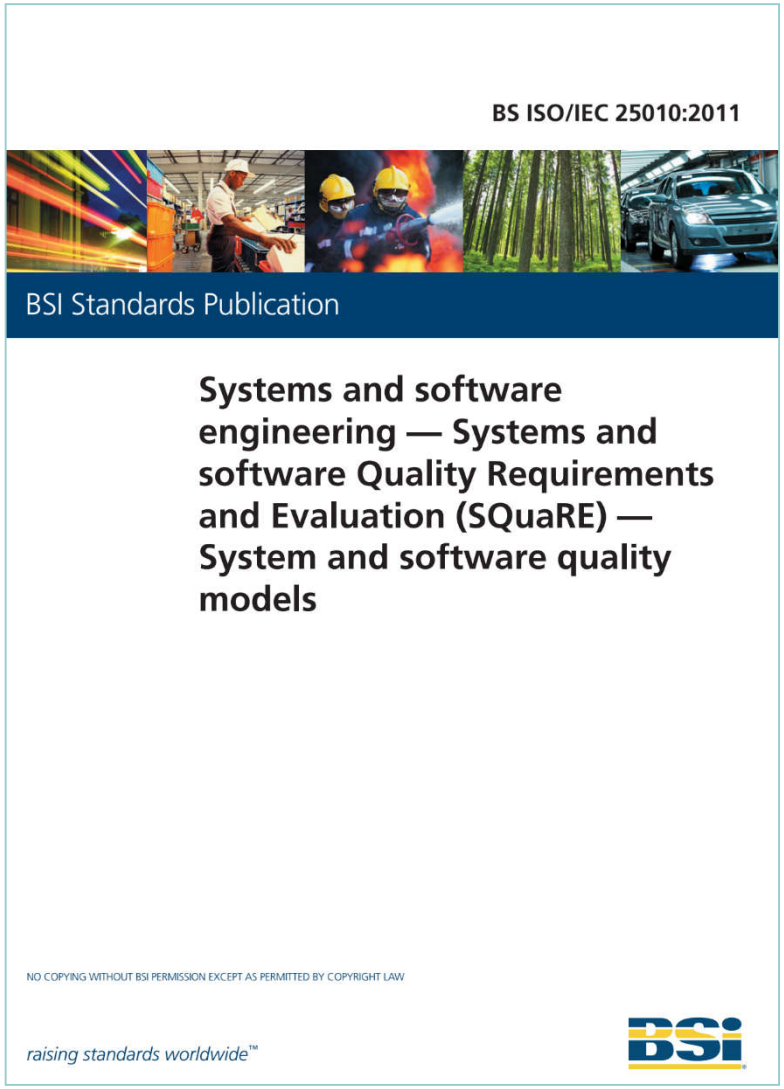
Approaches & Technologies

中山大學
SUN YAT-SEN UNIVERSITY

OUTLINE

- 1.1 软件与软件危机
- 1.2 软件开发与软件工程
- 1.3 软件生命周期模型
- 1.4 软件质量标准
  - 软件质量的概念
  - *Boehm* 软件质量层次模型
  - *McCall* 软件质量模型
  - **ISO/IEC 9126-1:2001 软件质量模型
  - ISO/IEC 25010:2011 系统与软件质量要求和评价
- 1.5 敏捷开发
- 1.6 软件生命周期过程

ISO/IEC 25010:2011 系统与软件质量要求和评价



ISO/IEC 25010:2011 系统与软件质量要求和评价

- ISO/IEC 25010 revises ISO/IEC 9126-1:2001, and incorporates the same software quality characteristics with some amendments.
  - The *scope* of the quality models has been extended to include computer systems, and quality in use from a system perspective.
  - *Context coverage* (周境覆盖) has been added as a quality in use characteristic, with subcharacteristics *context completeness* and *flexibility*.
  - *Security* has been added as a characteristic, rather than a subcharacteristic of functionality, with subcharacteristics *confidentiality*, *integrity*, *non-repudiation*, *accountability* and *authenticity*.
  - *Compatibility* (including *interoperability* and *co-existence)* has been added as a characteristic.
  - The following *subcharacteristics* have been added: *functional completeness*, *capacity*, *user error protection*, *accessibility*, *availability*, *modularity* and *reusability*.

ISO/IEC 25010:2011 系统与软件质量要求和评价

- ISO/IEC 25010 revises ISO/IEC 9126-1:2001, and incorporates the same software quality characteristics with some amendments.
  - The *compliance* subcharacteristics have been removed, as compliance with laws and regulations is part of overall system requirements, rather than specifically part of quality.
  - The internal and external quality models have been combined as the *product quality* model.
  - When appropriate, generic *definitions* have been adopted, rather than using software-specific definitions (适当时采用一般通用的定义，而不是软件特定的定义).
  - Several characteristics and subcharacteristics have been given more *accurate* names.

ISO/IEC 25010:2011 系统与软件质量要求和评价

- Quality Models
  - 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 (质量是系统满足不同利益相关者明确的和隐含的需求，从而提供价值的程度).
    - *Stakeholder* - individual or organization having a right, share, claim or interest in a system or in its possession of characteristics that meet their needs and expectations.
  - These stated and implied needs are represented by *quality models* that categorize product quality into *characteristics* (质量特性), which in some cases are further subdivided into *subcharacteristics* (质量子特性). This hierarchical decomposition provides a convenient breakdown of product quality.
  - The measurable quality-related properties of a system are called *quality properties* (质量属性), with associated quality measures. Quality properties can be *directly* measured, or combined computationally to arrive at a *derived* quality measure.

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Quality Models

Hierarchical Structure of Quality Models

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- Quality in Use Model
  - The quality in use model defines five characteristics related to outcomes of interaction with a system:
    - Effectiveness 有效性
    - Efficiency 效率
    - Satisfaction 满意度
    - Freedom from risk 抗风险能力
    - Context coverage 周境覆盖.
  - Each characteristic can be assigned to different activities of stakeholders.
  - The quality in use of a system characterizes the impact that the product (system or software product) has on stakeholders.
    - It is determined by the quality of the software, hardware and operating environment, and the characteristics of the users, tasks and social environment.
    - All these factors contribute to the quality in use of the system.

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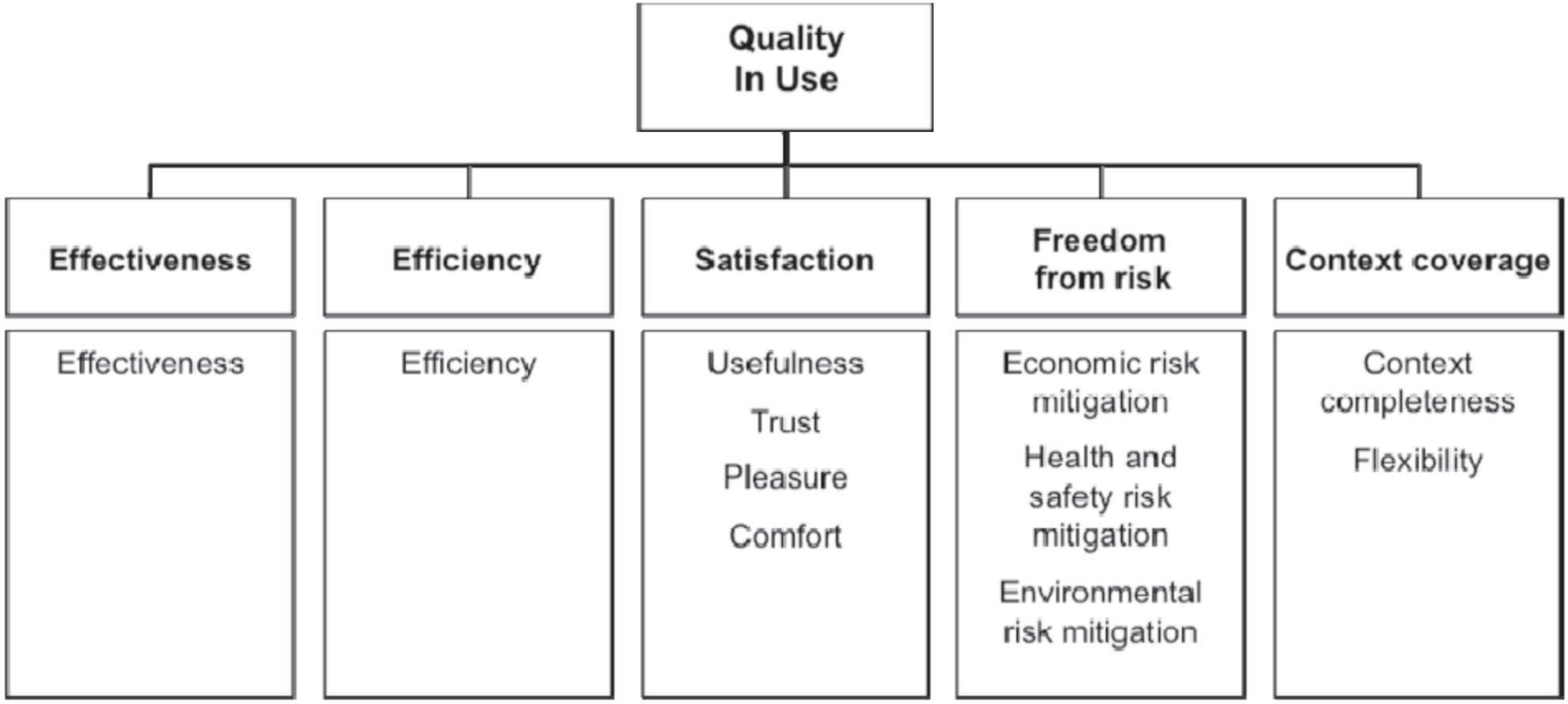
Quality in Use Model



Quality in Use Model

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- Product Quality Model
  - The product quality model categorizes system/software product quality properties into eight characteristics
    - Functional suitability 功能适合性
    - Performance efficiency 性能效率
    - Compatibility 兼容性
    - Usability 易用性
    - Reliability 可靠性
    - Security 保密安全性
    - Maintainability 维护性
    - Portability 可移植性.
  - Each characteristic is composed of a set of related subcharacteristics.
  - The product quality model can be applied to just a software product, or to a computer system that includes software, as most of the subcharacteristics are relevant to both software and systems.

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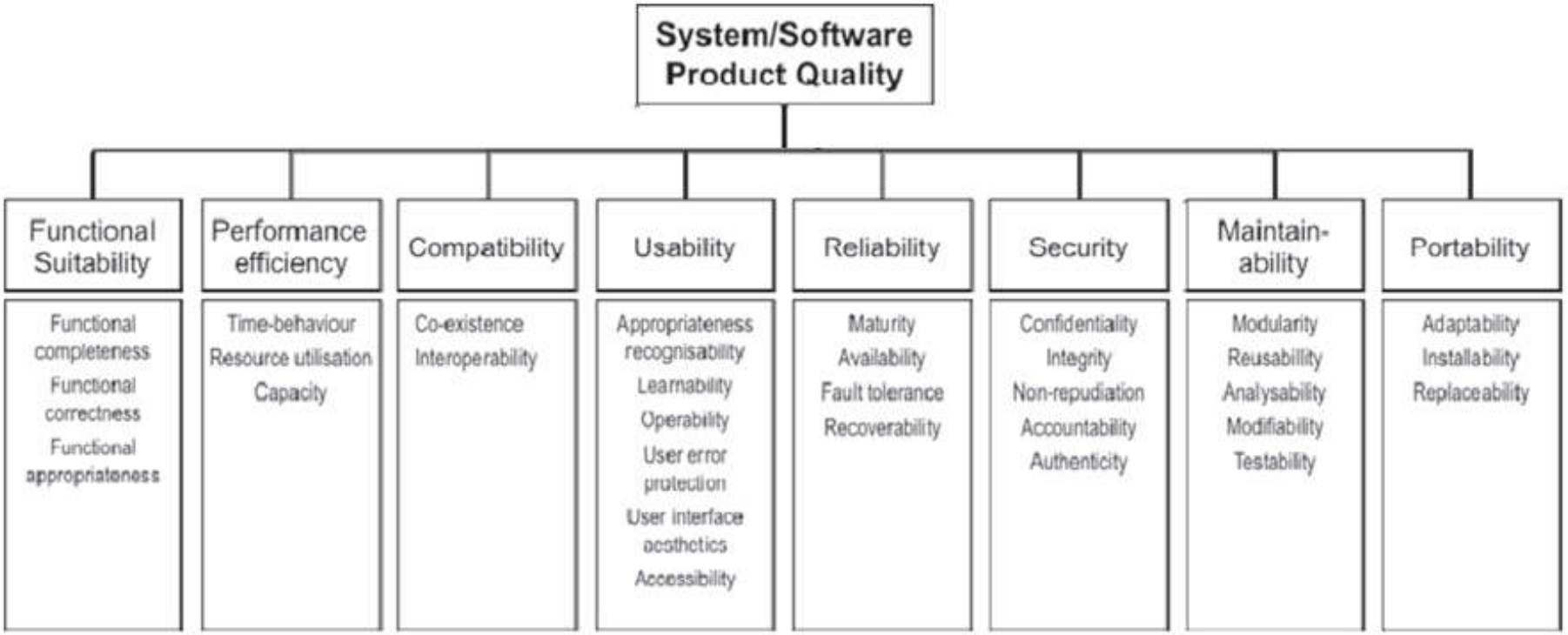
- Product Quality Model.



Product Quality Model

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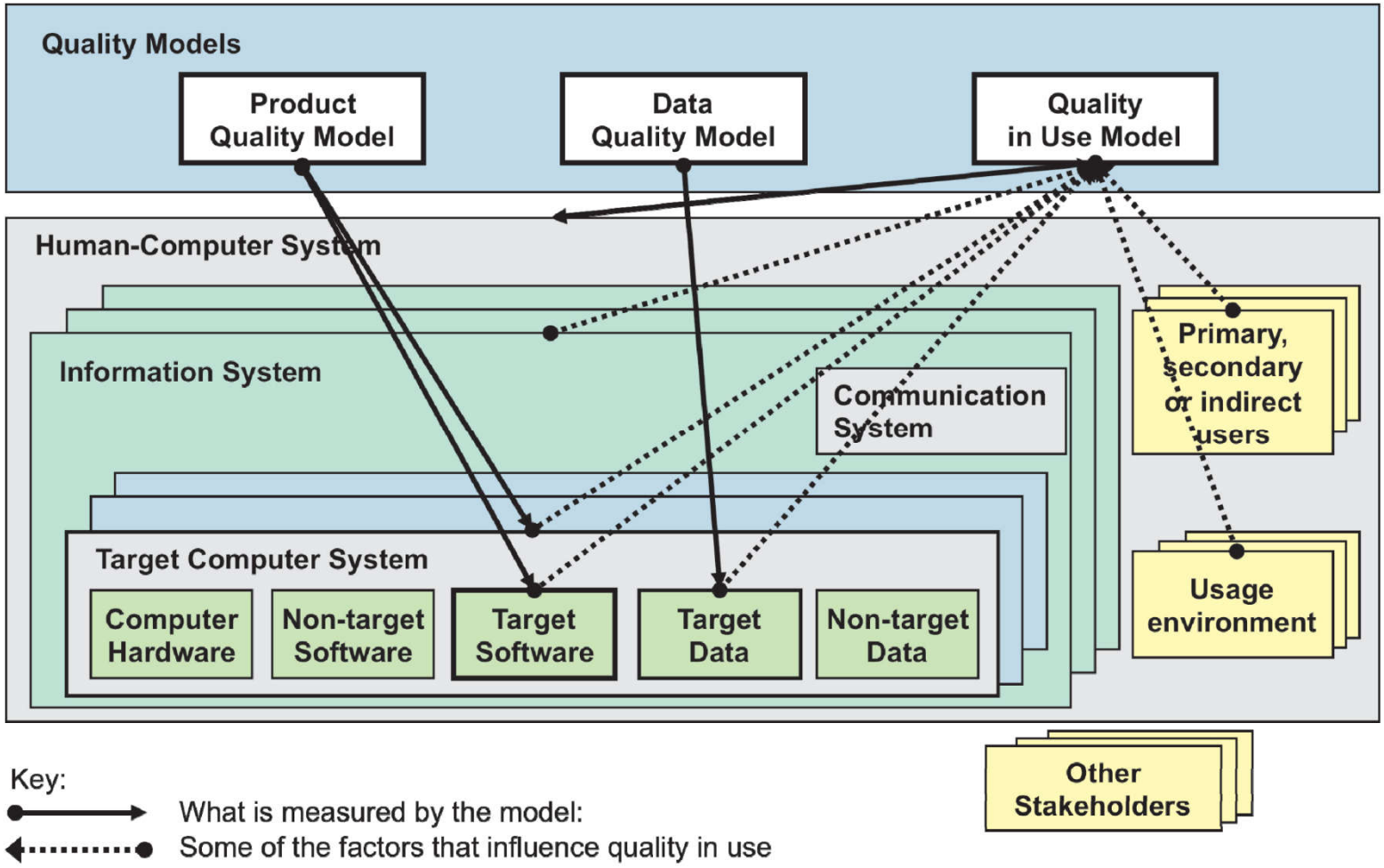
- Targets of the Quality Models.



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Influence of the Quality Characteristics.

Software product properties	Computer system properties	Product quality characteristic	Influence on quality in use for primary users	Influence on quality in use for maintenance tasks	Information system quality concerns of other stakeholders
➥	➥	Functional suitability	❋		
➥	➥	Performance efficiency	❋		❋
➥	➥	Compatibility		❋	
➥	➥	Usability	❋		
➥	➥	Reliability	❋		❋
➥	➥	Security	❋		❋
➥	➥	Maintainability		❋	
➥	➥	Portability		❋	

Key: ➥ These properties influence product quality.
❋ Product quality influences quality in use for these stakeholders.

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- Definitions for Quality in Use Model.

Effectiveness
Efficiency
Satisfaction
Usefulness
Trust
Pleasure
Comfort
Freedom from risk
Economic risk mitigation
Health and safety risk mitigation
Environmental risk mitigation
Context coverage
Context completeness
Flexibility

context of use (使用周境)
users, tasks, equipment (hardware, software and materials), and the physical and social environments in which a product is used.

- 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.

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- Definitions for Quality in Use Model.
  - Satisfaction
    - degree to which user needs are satisfied when a product or system is used in a specified context of use.
    - Usefulness 有用性
      - degree to which a user is satisfied with their perceived achievement of pragmatic goals, including the results of use and the consequences of use.
    - Trust 可信性
      - degree to which a user or other stakeholder has confidence that a product or system will behave as intended.
    - Pleasure 愉悦性
      - degree to which a user obtains pleasure from fulfilling their personal needs.
    - Comfort 舒适性
      - degree to which the user is satisfied with physical comfort.

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- Definitions for Quality in Use Model.
  - Freedom from risk
    - degree to which a product or system mitigates the potential risk to economic status, human life, health, or the environment.
    - Economic risk mitigation 经济风险缓解能力
      - degree to which a product or system mitigates the potential risk to financial status, efficient operation, commercial property, reputation or other resources in the intended contexts of use.
    - Health and safety risk mitigation 健康和安全风险缓解能力
      - degree to which a product or system mitigates the potential risk to people in the intended contexts of use.
    - Environmental risk mitigation 环境风险缓解能力
      - degree to which a product or system mitigates the potential risk to property or the environment in the intended contexts of use.

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- Definitions for Quality in Use Model.
  - Context coverage
    - degree to which a product or system can be used with effectiveness, efficiency, freedom from risk and satisfaction in both specified contexts of use and in contexts beyond those initially explicitly identified.
    - Context completeness 使用周境完备性
      - degree to which a product or system can be used with effectiveness, efficiency, freedom from risk and satisfaction in all the specified *contexts of use* (including users, tasks, equipment, and the physical and social environments in which a product is used).
    - Flexibility 灵活性
      - 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.

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- Definitions for Product Quality Model.

(Sub)Characteristic
Functional suitability
Functional completeness
Functional correctness
Functional appropriateness
Performance efficiency
Time behaviour
Resource utilization
Capacity
Compatibility
Co-existence
Interoperability
Usability
Appropriateness recognizability
Learnability
Operability
User error protection
User interface aesthetics
Accessibility

Reliability
Maturity
Availability
Fault tolerance
Recoverability
Security
Confidentiality
Integrity
Non-repudiation
Accountability
Authenticity
Maintainability
Modularity
Reusability
Analysability
Modifiability
Testability
Portability
Adaptability
Installability
Replaceability

ISO/IEC 25010:2011 系统与软件质量要求和评价

- Definitions for Product Quality Model.
  - Functional suitability
    - degree to which a product or system provides functions that meet stated and implied needs when used under specified conditions.
    - Functional completeness 功能完整性
      - degree to which the set of functions covers all the specified tasks and user objectives.
    - Functional correctness 功能正确性
      - degree to which a product or system provides the correct results with the needed degree of precision.
    - Functional appropriateness 功能适当性
      - degree to which the functions facilitate the accomplishment of specified tasks and objectives.

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- Definitions for Product Quality Model.
  - Performance efficiency
    - performance relative to the amount of resources used under stated conditions.
    - Time behavior 时间特性
      - degree to which the response and processing times and throughput rates of a product or system, when performing its functions, meet requirements.
    - Resource utilization 资源利用率
      - degree to which the amounts and types of resources used by a product or system, when performing its functions, meet requirements.
    - Capacity 容量
      - degree to which the maximum limits of a product or system parameter meet requirements.

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- Definitions for Product Quality Model.
  - 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.
    - Co-existence 共存性
      - degree to which a product can perform its required functions efficiently while sharing a common environment and resources with other products, without detrimental impact on any other product.
    - Interoperability 互操作性
      - degree to which two or more systems, products or components can exchange information and use the information that has been exchanged.

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- Definitions for Product Quality Model.
  - 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.
    - Appropriateness recognizability 系统适当性的可辨识性
      - degree to which users can recognize whether a product or system is appropriate for their needs.
    - Learnability 易学性
      - degree to which a product or system can be used by specified users to achieve specified goals of learning to use the product or system with effectiveness, efficiency, freedom from risk and satisfaction in a specified context of use.
    - Operability 易操作性
      - degree to which a product or system has attributes that make it easy to operate and control.

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- Definitions for Product Quality Model.
  - Usability (cont.)
    - User error protection 用户差错防御能力
      - degree to which a system protects users against making errors.
    - User interface aesthetics 用户界面舒适性
      - degree to which a user interface enables pleasing and satisfying interaction for the user.
    - Accessibility 易访问性
      - degree to which a product or system can be used by people with the widest range of characteristics and capabilities to achieve a specified goal in a specified context of use.

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- Definitions for Product Quality Model.
  - Reliability
    - degree to which a system, product or component performs specified functions under specified conditions for a specified period of time.
    - Maturity 成熟度
      - degree to which a system, product or component meets needs for reliability under normal operation.
    - Availability 可用性
      - degree to which a system, product or component is operational and accessible when required for use.
    - Fault tolerance 容错能力
      - degree to which a system, product or component operates as intended despite the presence of hardware or software faults.

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- Definitions for Product Quality Model.
  - Reliability (cont.)
    - Recoverability 易恢复性
      - degree to which, in the event of an interruption or a failure, a product or system can recover the data directly affected and re-establish the desired state of the system.

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- Definitions for Product Quality Model.
  - 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 authorization
    - Confidentiality 保密性
      - degree to which a product or system ensures that data are accessible only to those authorized to have access.
    - Integrity 完整性
      - degree to which a system, product or component prevents unauthorized access to, or modification of, computer programs or data.
    - Non-repudiation 抗可抵赖性
      - degree to which actions or events can be proven to have taken place, so that the events or actions cannot be repudiated later.

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- Definitions for Product Quality Model.
  - Security (cont.)
    - Accountability 可问责能力/可审计性
      - degree to which the actions of an entity can be traced uniquely to the entity.
    - Authenticity 认证能力
      - degree to which the identity of a subject or resource can be proved to be the one claimed.

ISO/IEC 25010:2011 系统与软件质量要求和评价

- Definitions for Product Quality Model.
  - Maintainability
    - degree of effectiveness and efficiency with which a product or system can be modified by the intended maintainers.
    - Modularity 模块化程度
      - degree to which a system or computer program is composed of discrete components such that a change to one component has minimal impact on other components.
    - Reusability 可重用性
      - degree to which an asset can be used in more than one system, or in building other assets.
    - Analysability 易分析性
      - degree of effectiveness and efficiency with which it is possible to assess the impact on a product or system of an intended change to one or more of its parts, or to diagnose a product for deficiencies or causes of failures, or to identify parts to be modified.

ISO/IEC 25010:2011 系统与软件质量要求和评价

- Definitions for Product Quality Model.
  - Maintainability (cont.)
    - Modifiability 易修改性
      - degree to which a product or system can be effectively and efficiently modified without introducing defects or degrading existing product quality.
    - Testability 易测试性
      - degree of effectiveness and efficiency with which test criteria can be established for a system, product or component and tests can be performed to determine whether those criteria have been met.

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- Definitions for Product Quality Model.
  - 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.
    - Adaptability 易适应性
      - degree to which a product or system can effectively and efficiently be adapted for different or evolving hardware, software or other operational or usage environments.
    - Installability 易安装性
      - degree of effectiveness and efficiency with which a product or system can be successfully installed and/or uninstalled in a specified environment.
    - Replaceability 易替换性
      - degree to which a product can replace another specified software product for the same purpose in the same environment

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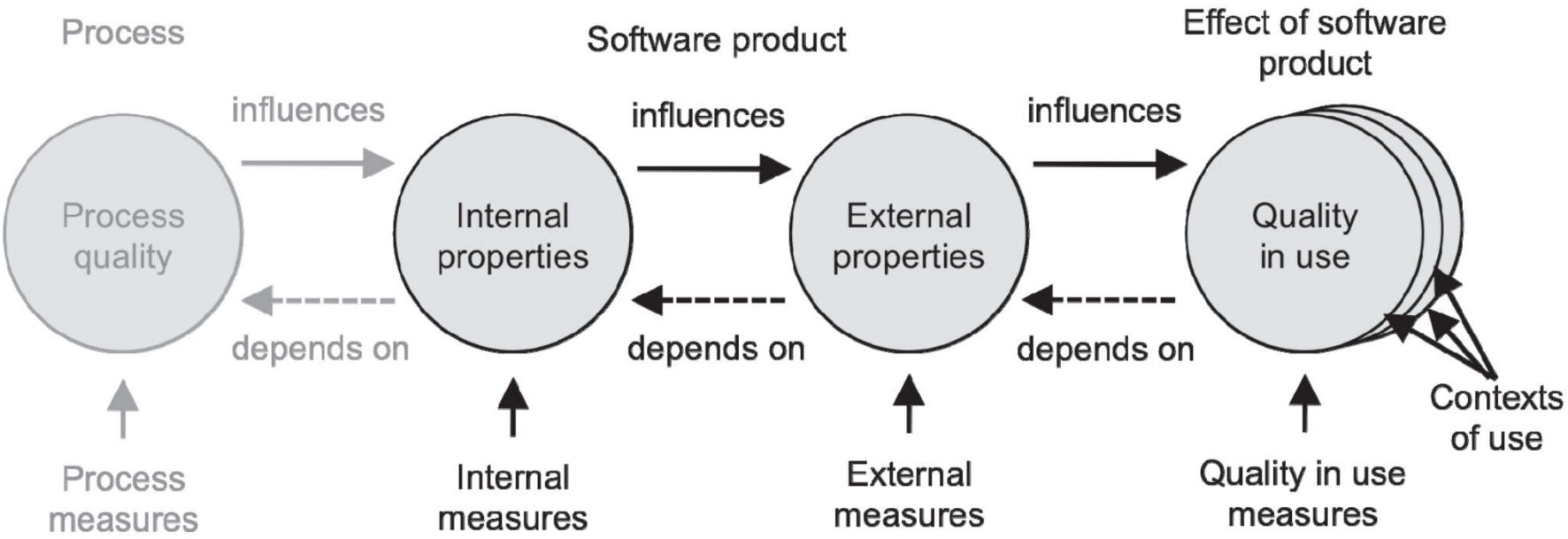
- Quality in the Lifecycle.



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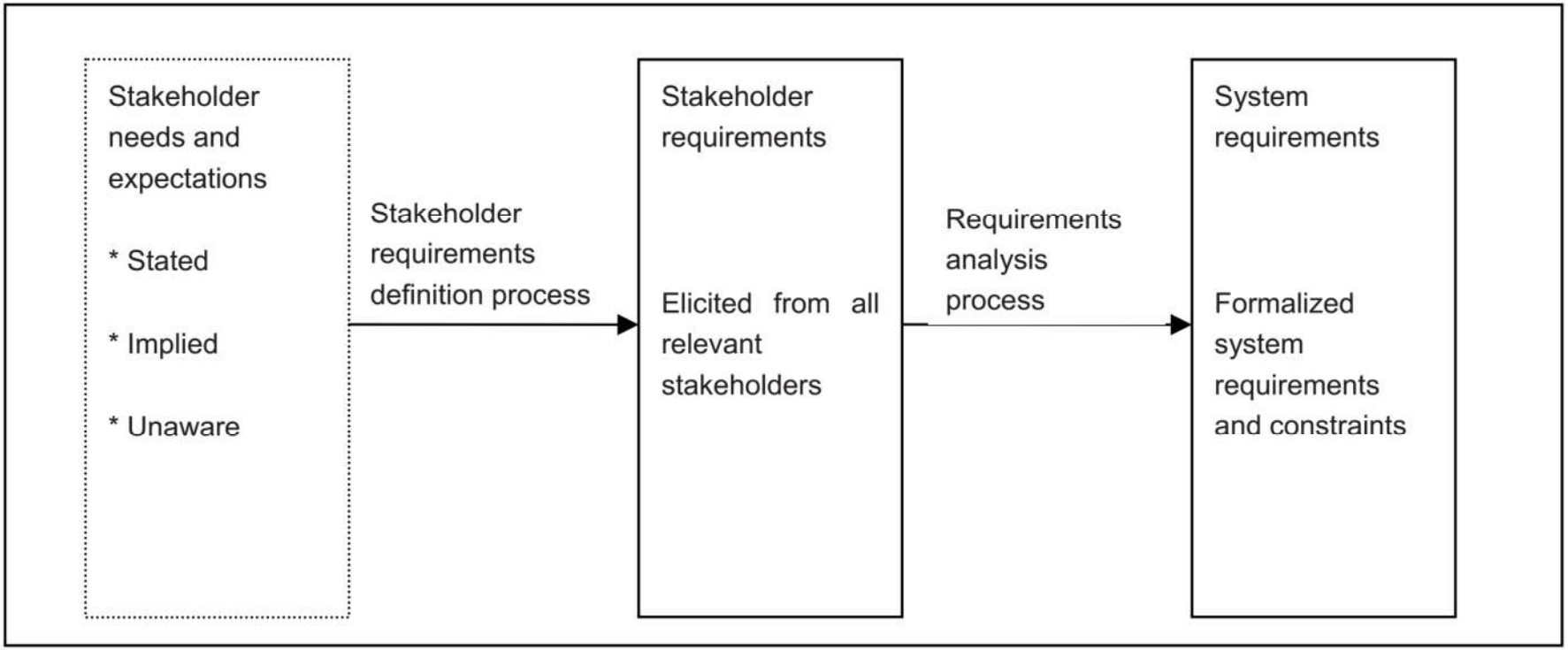
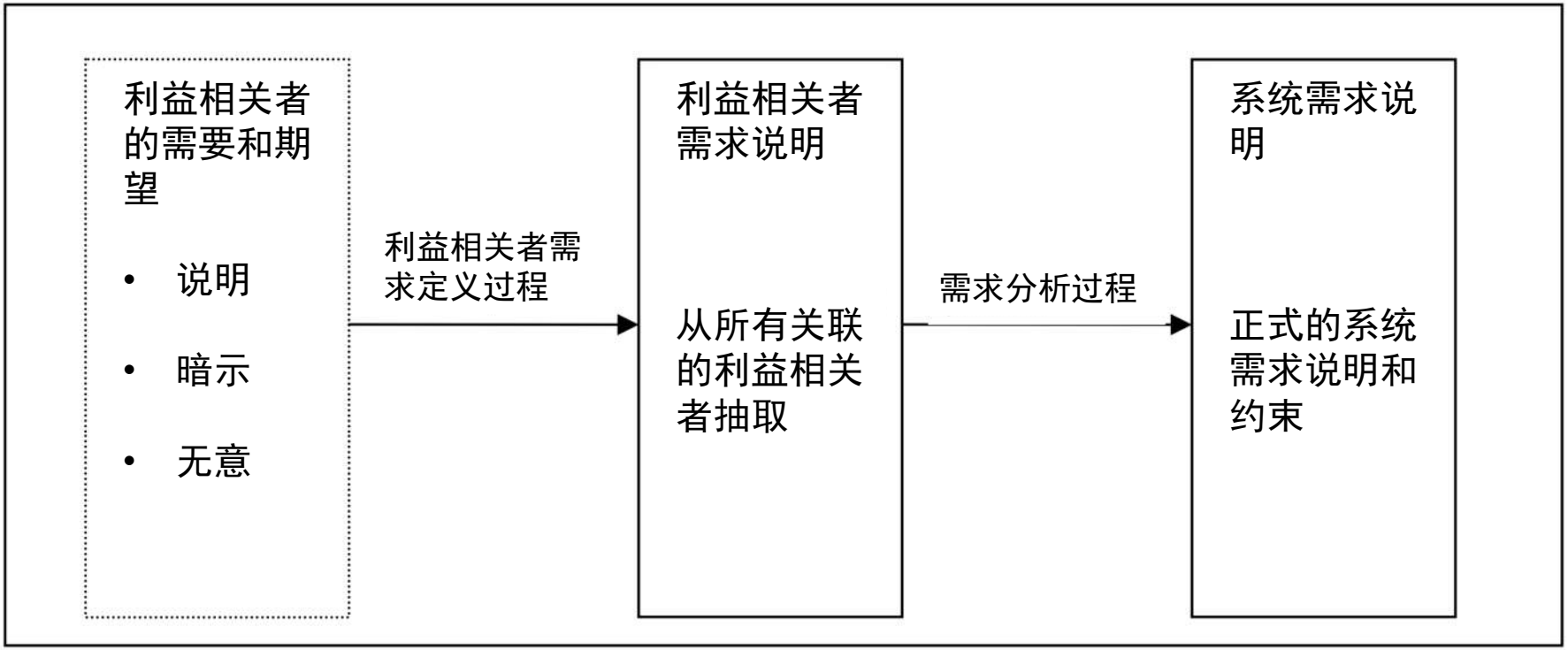
- Stakeholder Requirements Definition and Analysis.



ISO/IEC 25010:2011 系统与软件质量要求和评价

- Stakeholder Requirements Definition and Analysis.



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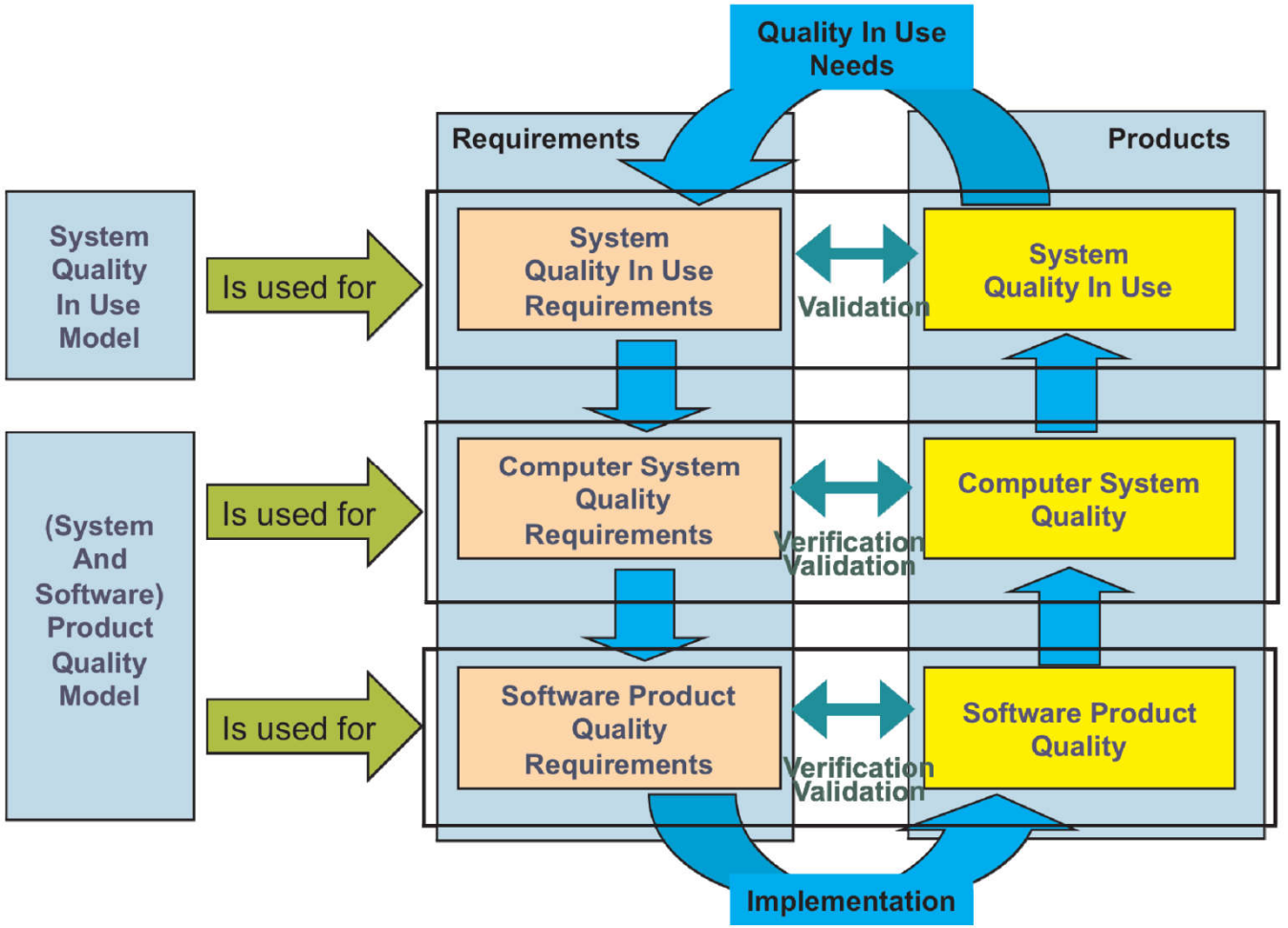
- System/Software Quality Life Cycle Model.



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- System/Software Quality Life Cycle Model
  - The quality life cycle model addresses quality in three principal phases of the software product life cycle:
    - The product under *development phase* is the subject of internal measures of software quality;
    - The product in *testing phase* is the subject of external measures of software quality, and
    - The product in *use phase* is the subject of quality in use.

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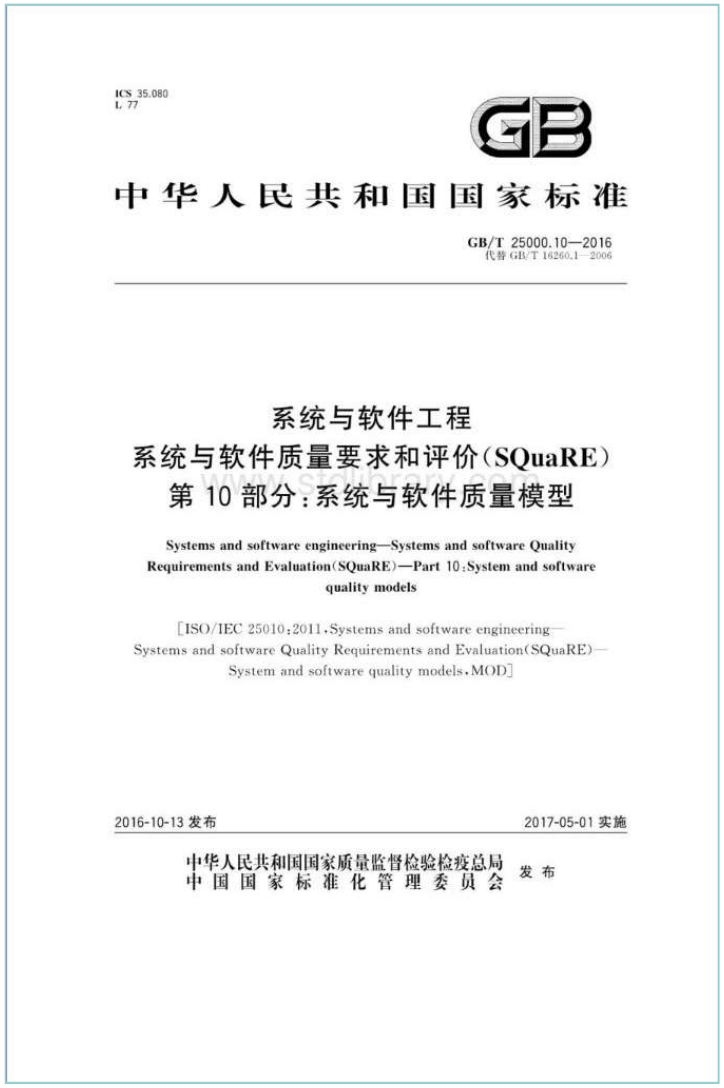
- Differences between Internal Quality Measures, External Quality Measures and Quality in Use Measures.

Type of properties measured	Software product properties	Computer system behaviour properties	Human-computer system impact properties
Type of quality measure	Internal: inspection of static properties	External: test or modelling of dynamic properties	Quality in use: test or observation of results of real or simulated use
Type of properties of software product	Inherent	Computer system-dependent	Human-computer system-dependent
Type of properties of computer system		Inherent	Human-computer system-dependent
Type of properties of human-computer system			Inherent

- GB/T 25000.10-2016 系统与软件质量要求和评价



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中华人民共和国国家标准

GB/T 25000.10—2016
代替 GB/T 16260.1—2006

系统与软件工程
系统与软件质量要求和评价(SQuaRE)
第 10 部分:系统与软件质量模型

Systems and software engineering—Systems and software Quality Requirements and Evaluation(SQuaRE)—Part 10:System and software quality models

[ISO/IEC 25010:2011,Systems and software engineering—Systems and software Quality Requirements and Evaluation(SQuaRE)—System and software quality models,MOD]

2016-10-13 发布　　2017-05-01 实施

中华人民共和国国家质量监督检验检疫总局
中国国家标准化管理委员会　发布

Lecture 5. Software Quality Criteria (2)

End of Lecture