

CS350

Software Quality

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SW Quality Definitions

- The degree of conformance to explicit or implicit requirements and expectations.
- By IEEE
 - The degree to which a system, component, or process meets customer or user needs or expectations
- By ISTQB(Int'l Software Testing Qualifications Board)
 - The totality of functionality and features of a software product that bear on its ability to satisfy stated or implied needs

SQA and SQC

- SW Quality Assurance(SQA):
 - a set of activities for ensuring quality in software engineering processes
 - Project management, configuration management, requirements development/management, estimation, software design, testing,...
- SW Quality Control(SQC):
 - a set of activities for ensuring quality in software products
 - Reviews, Testing
- SQA oriented for **prevention**, SQC oriented for **detection**

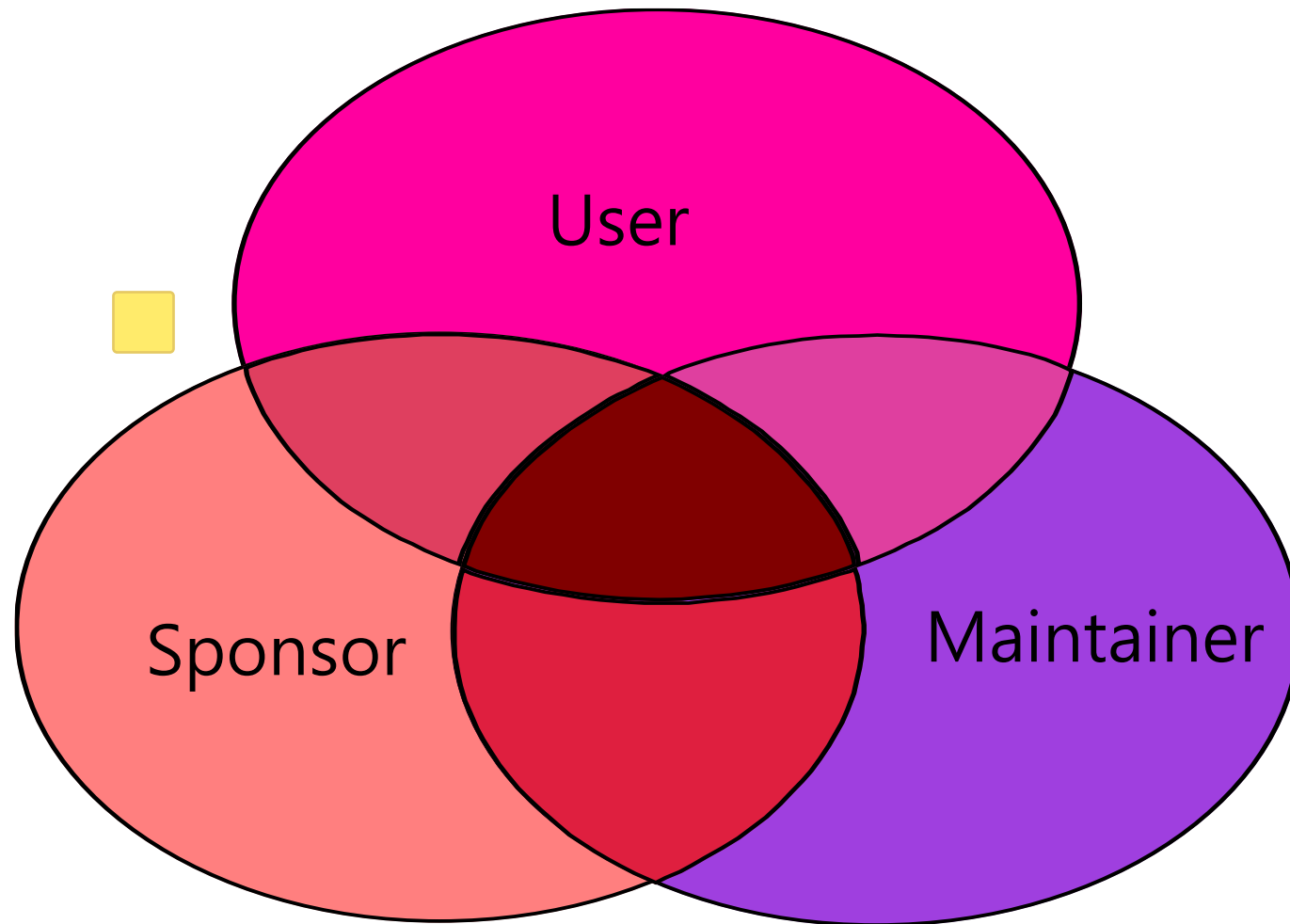
Why is software quality different from other types of quality (hardware)?

- Software has no physical existence.
- The lack of knowledge of client needs at the start.
- The change of client needs over time.
- The rapid rate of change in both h/w and s/w.
- The high expectation of customers, particularly w.r.t. adaptability.

Some Insights about Quality

- Quality is not absolute
- Quality is multidimensional
- Quality is subject to constraints (people, money, time, tool)
- Quality is about acceptable compromises
- Quality criteria are not independent

Quality Factors: Various Perspectives



Software Quality and Business Mind

- Is it possible to produce 'defect-zero' software?
- A Japaness company's dilemma (revisited)
 - specialized in embedded products
 - not able to use MS windows
 - comparison with Microsoft

Internal and External Quality

- Distinction is not sharp
- External Quality:
 - Visible to the users of the system
- Internal Quality:
 - Concerns the developers of the system

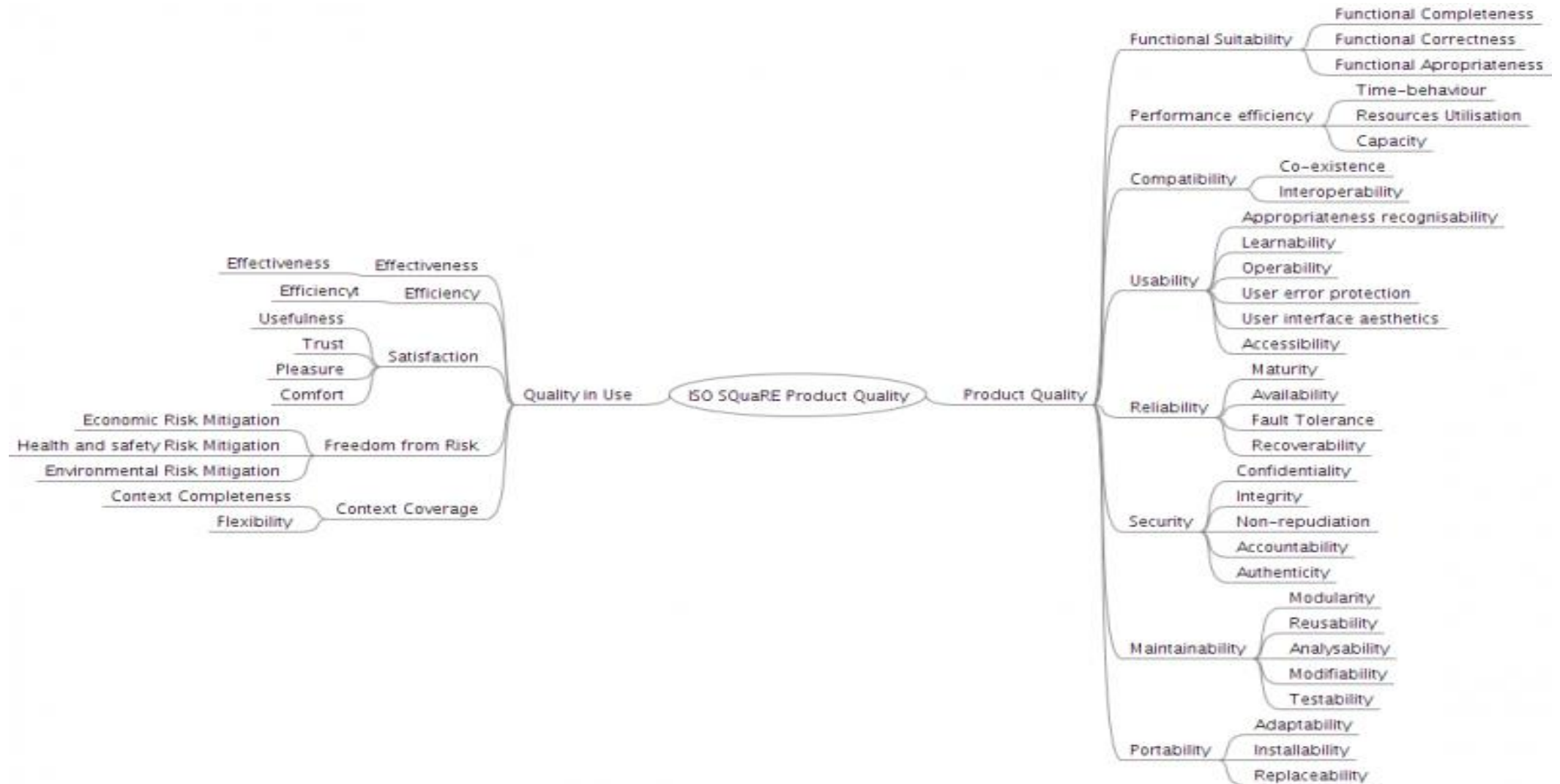
Product and Process Qualities

- Use a process to produce the s/w product.
 - Quality process helps to produce quality product
- Product quality: external
 - Functionality
 - Usability
 - Efficiency
 - Reliability, etc
- Process quality: internal
 - Effectiveness of methods, tools
 - Use of standards
 - Management, etc

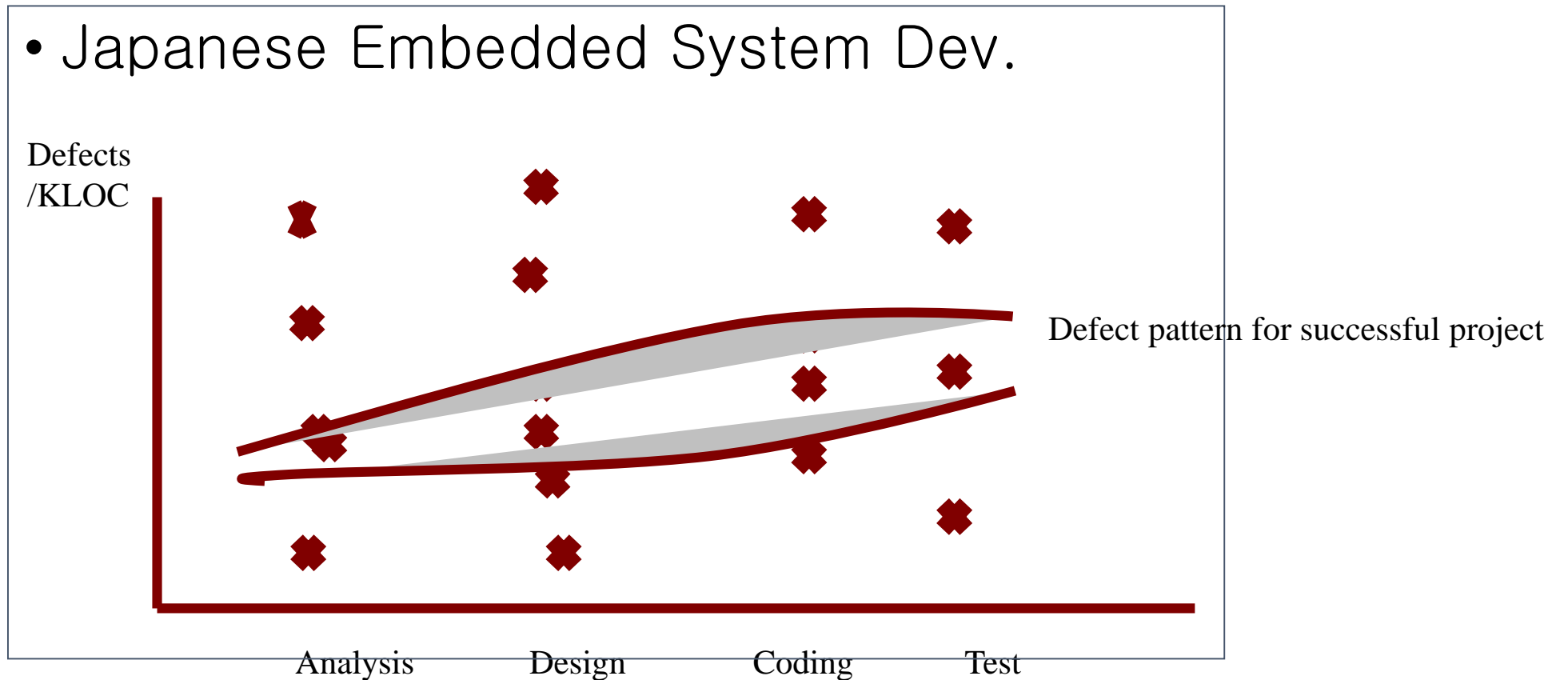
SW Quality Standards

- ISO 9126 : product
- ISO 14598 : process
- ISO25000: ISO9126 + ISO14598

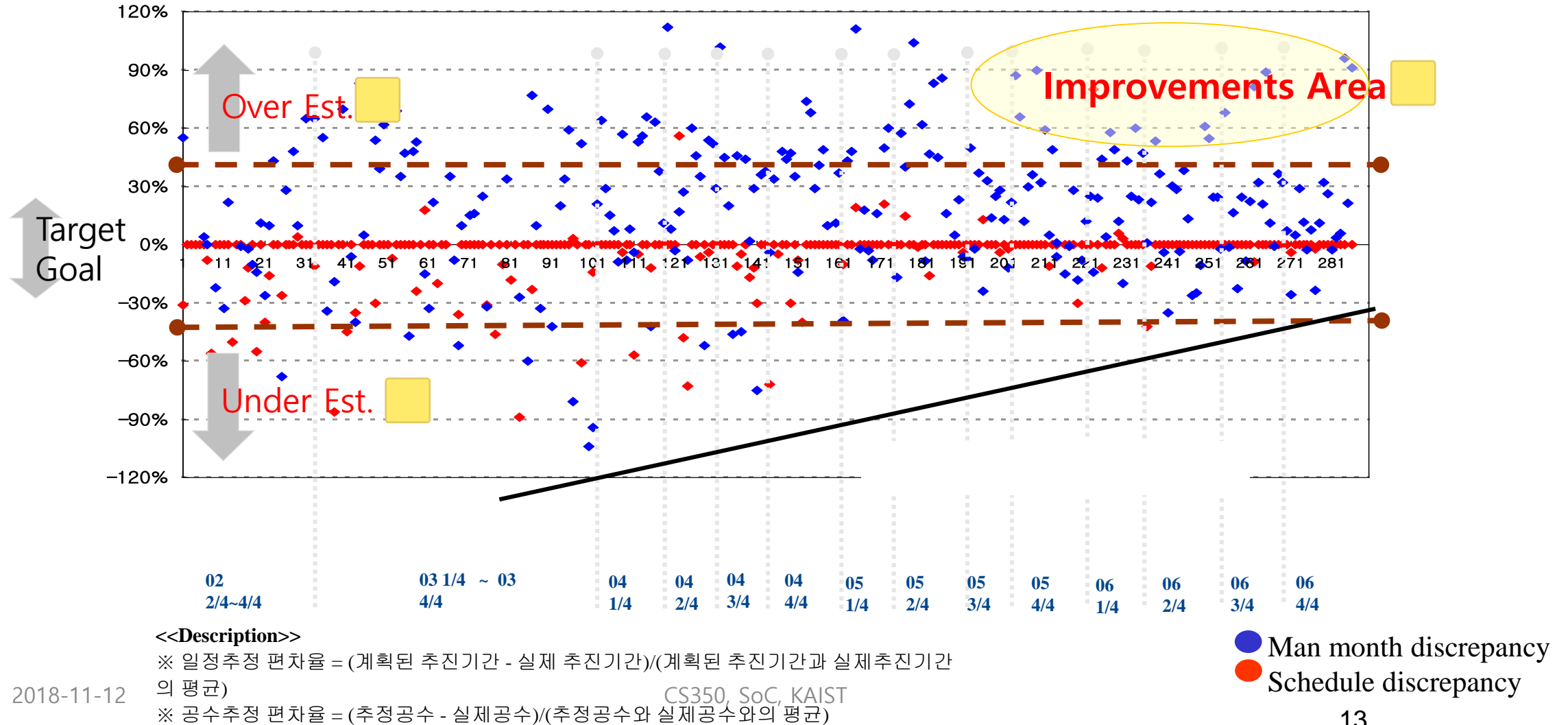
ISO25000:SQuaRE




SW Quality in Practice



Quality/Process Improvement: Success Story



Representative Qualities

- Correctness, Reliability, Robustness, Safety
- Performance 
- User Friendliness
- Verifiability
- Maintainability
- Reusability
- Portability
- Understandability
- Interoperability
- Productivity
- Timeliness
- Visibility



Correctness, Reliability, and Robustness

- Often used interchangeably, meaning that the degree of the application's performing its functions as expected.
 - However, they are different slightly from each other.
-
- In addition, "safety" becomes important.

Correctness

- Correct if the program behaves according to the specification of the functions
- Assumptions
 - A specification of the system is available
 - It is possible to determine unambiguously if a program meets the specification.

Reliability

- The ability of a system to perform its requested functions under stated conditions whenever required
- Can define in terms of statistical behavior: MTTF, MTBF

Robustness

- The degree to which a system continues to function in the presence of invalid inputs or stressful environmental conditions.
- Robust if it behaves reasonably, even in circumstances that were not anticipated in the requirements specification.
- “graceful degradation”

Safety

- A sub-category of robustness specifically concerned with avoiding certain bad behaviors.
 - Undesired outcomes are called "hazards."
- Safety Engineering is concerned with identifying and preventing hazards.
 - Ex: A nuclear reactor meltdown

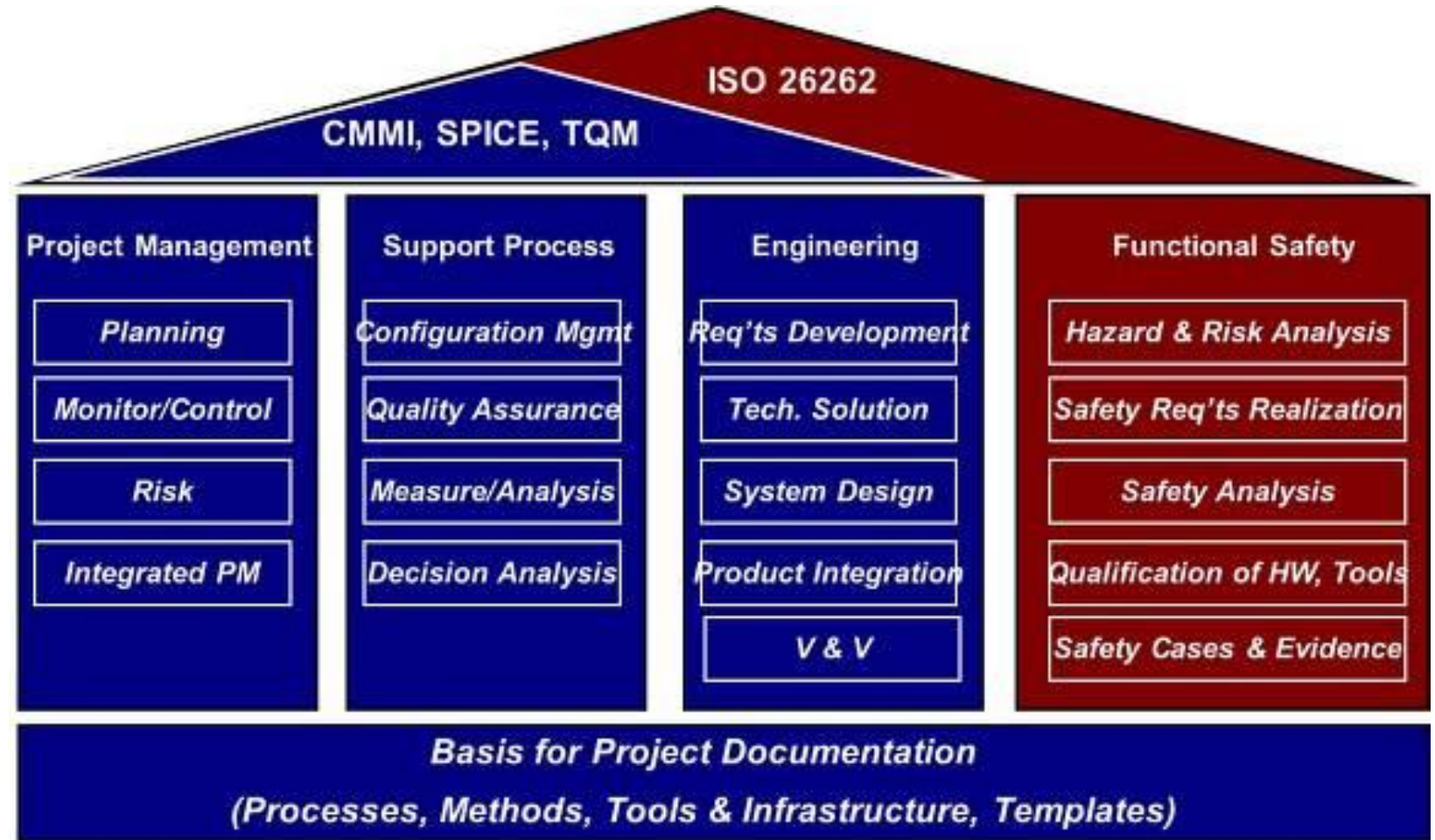
Dependability Properties

- **Correctness:** Consistency of implementation with specification
- **Reliability:** Likelihood of correct functioning
- **Robustness:** Acceptable behavior in unusual circumstances
- **Safety:** Absence of unacceptable behaviors

SW Safety in Manufacturing Products

- ISO26262
 - Road vehicles – **Functional Safety**
 - International standard for functional safety of electrical and/or electronic systems in automobiles
- Functional Safety explained
 - The detection of smoke by sensors and the ensuing intelligent activation of a fire suppression system
 - The activation of a level switch in a tank containing a flammable liquid, when a potentially dangerous level has been reached, which causes a valve to be closed to prevent further liquid entering the tank and thereby preventing the liquid in the tank from overflowing.

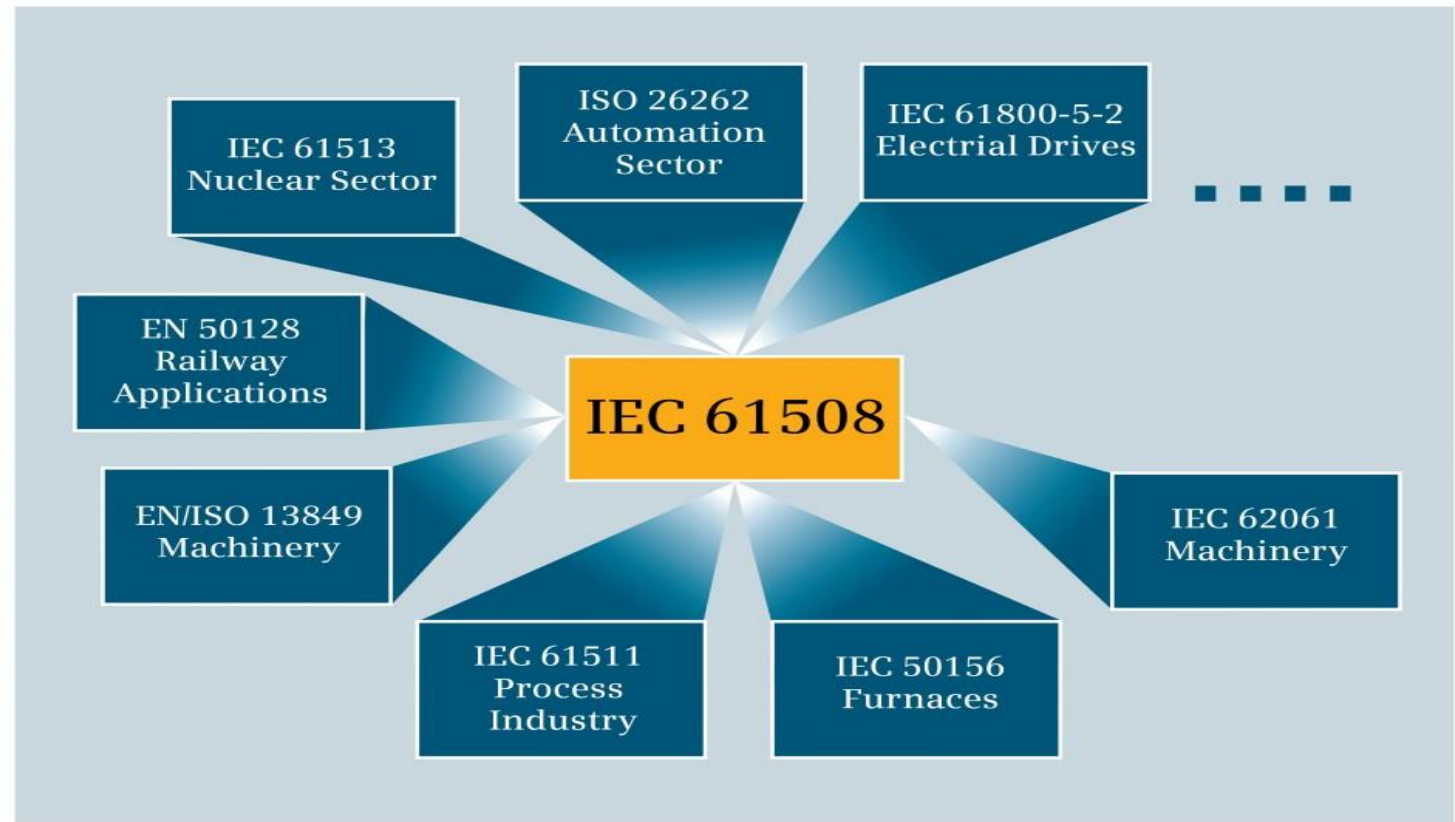
Relationship between CMMI.. and ISO26262



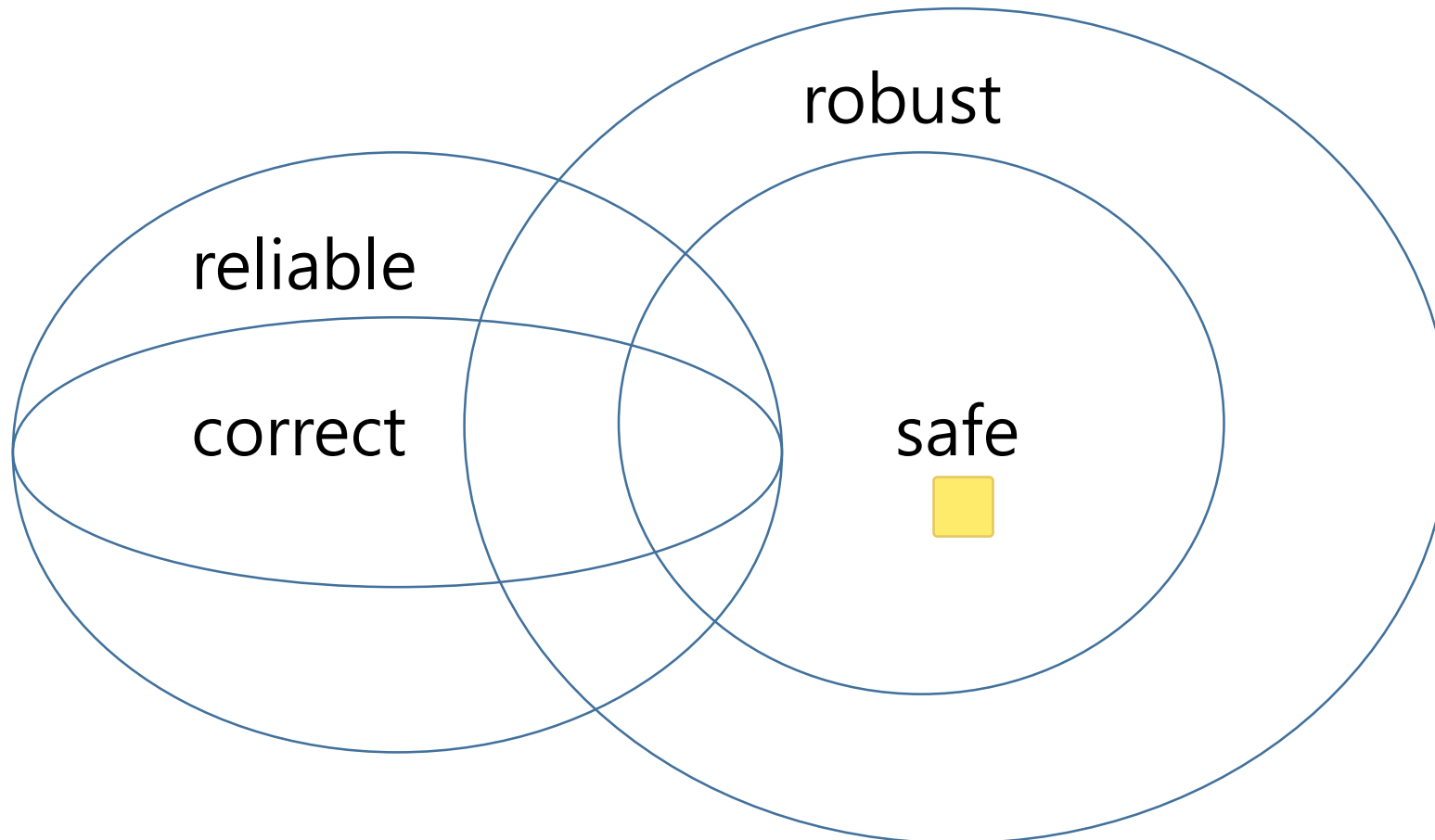
Functional Safety Standards

- IEC61508

A basic functional standard applicable to all kinds of industry.



Dependability Properties



Performance

- Equates performance with efficiency(space, time).
- Affects the usability of the system.
- Evaluation
 - Measurement (monitoring)
 - Analysis
 - Simulation
- Q: When do we need to estimate performance?
- Application of performance to process --> Productivity

User Friendliness

- Ease to use
- Ease with which the system can be configured and adapted to the hardware environment.

Verifiability

- Verifiable if its properties can be verified safely
- Performed either by formal analysis methods or through testing

Maintainability

- Maintenance
 - Corrective
 - Adaptive
 - Perfective
- Software evolution (instead of maintenance)
- Repairability and Evolvability

Reusability

- Use existing components to build a new product.
- Examples: Scientific libraries, X window, Motif, etc
- Reuse levels
 - People
 - Requirements
 - Design
 - Code
- Object-oriented technology: best buy
- Application to process
 - Software methodology
 - Life cycle model

Portability

- Portable if it can run in different environments
 - hardware platforms
 - software platforms

Understandability

- An internal product quality
- Object-oriented paradigm claims ease to understand
- Very important quality characteristics for maintenance and collaborative development

Interoperability

- Ability of a system to coexist and cooperate with other systems
- Open system concept

Productivity

- A quality of the software production process
- Difficult to measure: simple measure: LOC(Line Of Code)

Timeliness

- Ability to deliver a product on time.
- Requires
 - careful scheduling,
 - accurate work estimation and
 - clearly specified milestones.

Visibility

- Visible if all of its steps and current status are documented
- Allows to weigh the impact of their actions and thus guides them in making decisions.

Additional Quality,...

- There is one important quality missed here.
- What is it?

Quality Requirements in Specific Application Areas

- Information Systems
- Real-time Systems
- Distributed Systems
- Embedded Systems

Information Systems

- Storage and retrieval of data
- Examples: banking systems, library-cataloging systems, etc.
- Qualities
 - Data integrity
 - Security
 - Data availability
 - Transaction performance

Real-Time Systems

- Respond within a predefined and strict time periods
- Examples: factory-monitoring systems, missile guidance systems, mouse-handling software
- Control-oriented
- Scheduling
 - Deadline
 - Priority
- Hard and soft real-times
- Quality
 - Respond time requirements (correctness criterion)

Distributed Systems

- The degree of distribution
 - Data
 - Control
 - Hardware
- Examples: middleware in client/server systems, groupware, etc.
- Qualities
 - System availability

Embedded Systems

- Software is one of many components.
- Has no interface to end-user.
- Examples: Airplanes, robots, microwave ovens, dishwashers, automobiles, etc.

References

- <http://www.sqa.net/iso9126.html>
- <http://iso25000.com/index.php/en/iso-25000-standards>