Software Product Maturity in Source Selection

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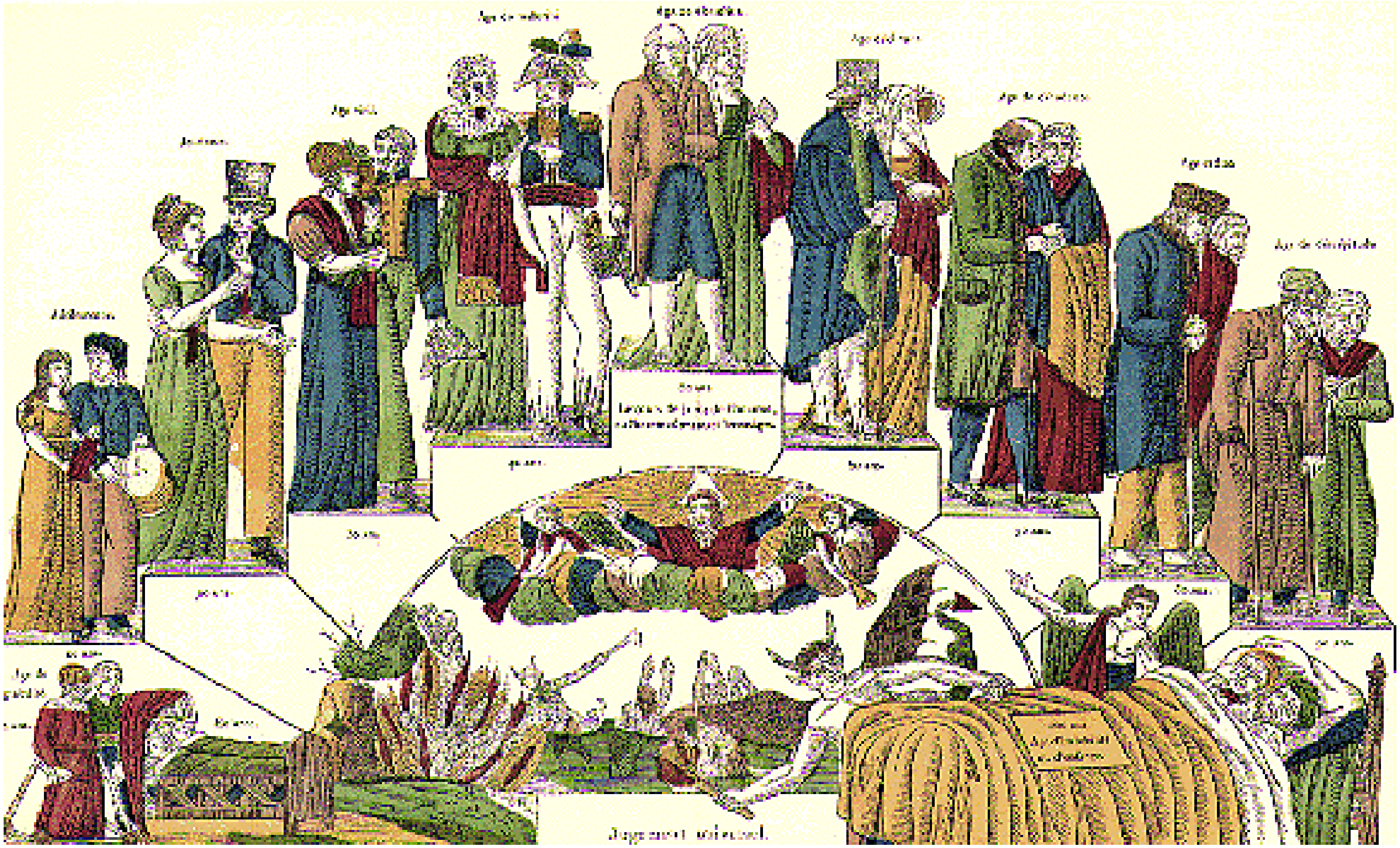
SOFTWARE
CONSORTIUM



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Defining SW Product Maturity

- US/UK/AUS Software-intensive Systems Acquisition Working Group work strand
- No standard definitions/scales
- Not Software Technology Readiness Levels (TRL)
  - Maturity addresses a specific product
  - TRL addresses underlying technology
- Highly dependent on environment and application context
- Many dimensions of maturity

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The Approach

- Gathered a group of experts to:
  - Review existing approaches
  - Develop characteristics and information sources
  - Develop guidance for source selection
  - Develop RFQ/RFP language

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Focused on Source Selection

- General maturity problem is extremely difficult
  - Limited time and resources
  - Need for significant effort to work on development-based maturity
  - Some promising work (MDA, AF) but untried
- Source selection has been a Congressional emphasis
- Source selection bounds the problem to measuring existing, working software (e.g. COTS, GOTS, legacy)

Software in Source Selection

- Many different kinds of source selections
  - Greenfield vs. Upgrade
  - Traditional business-process IT system implementation vs. Command and Control or embedded software
- Different kinds of software in programs
  - Only software that exists has determinable maturity
  - Aggregations of existent and non-existent software are common

- Software doesn't exist (Not measurable)
  - Developmental software

- Software exists (Measurable)
  - COTS
  - GOTS
  - Prototype
  - NDI/Legacy
  - Experimental

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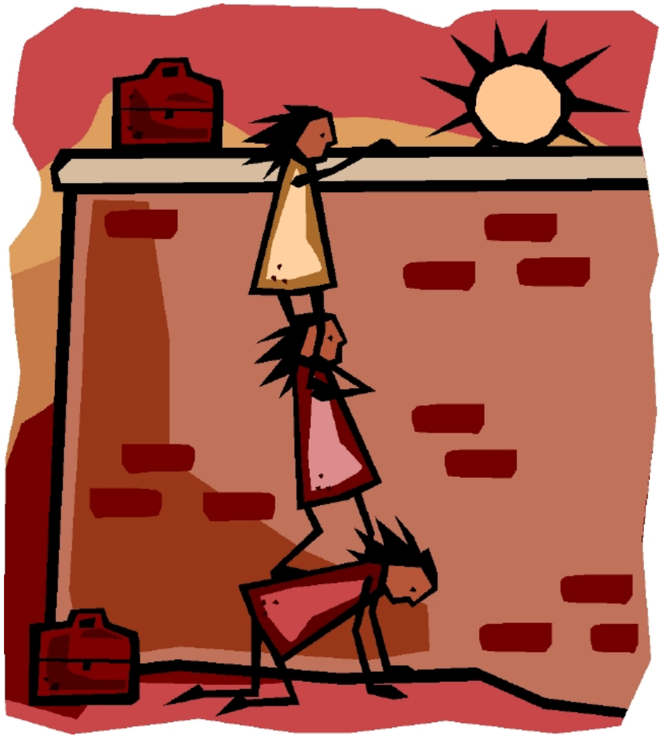
Observations



- Software product maturity is value-neutral
  - Mature software not better than immature software in some instances; must be interpreted in light of risk
    - *Web-pages*
    - *Proofs of concept*
- Software can become senile
  - Number of changes overwhelm the architecture
  - Environment changes
  - Utility degrades
- Level of understanding of context directly impacts risk and interpretation of maturity
  - Poorly understood application environment or target makes risk assessment difficult

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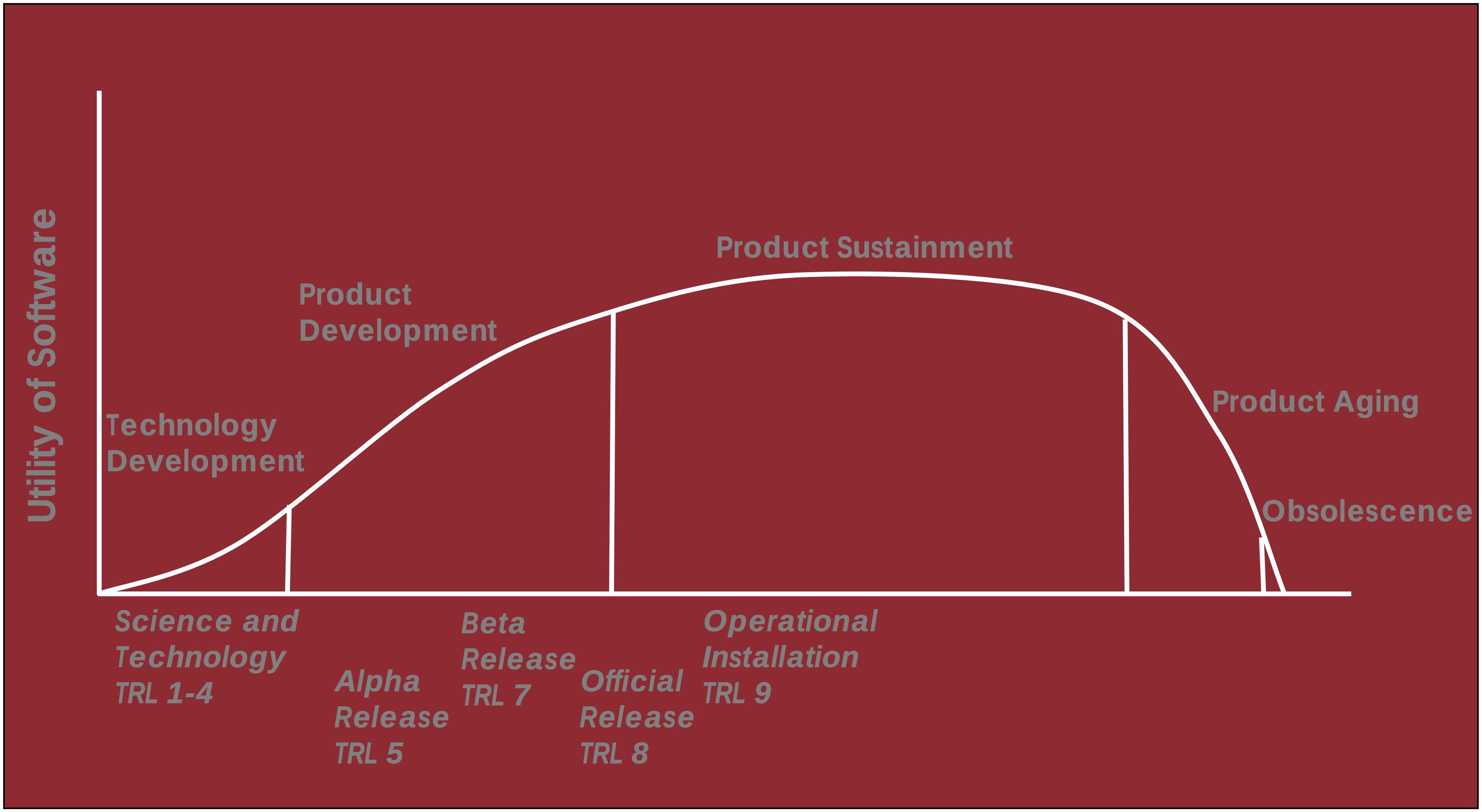
Notional SW Maturity Lifecycle



Maturity Evaluation Characteristics

- Represent areas/ dimensions affecting product maturity
- Must be considered both separately and as a group
- Weight of each characteristic may differ in any particular situation
- Must be evaluated against intended purpose

Candidate Characteristics

1. Understanding of the potential for latent defects within the product
2. Understanding of the domain of product applicability
3. Predictability of product behavior (within well-defined parameters)
4. Product stability
5. Product supportability
6. Product pedigree

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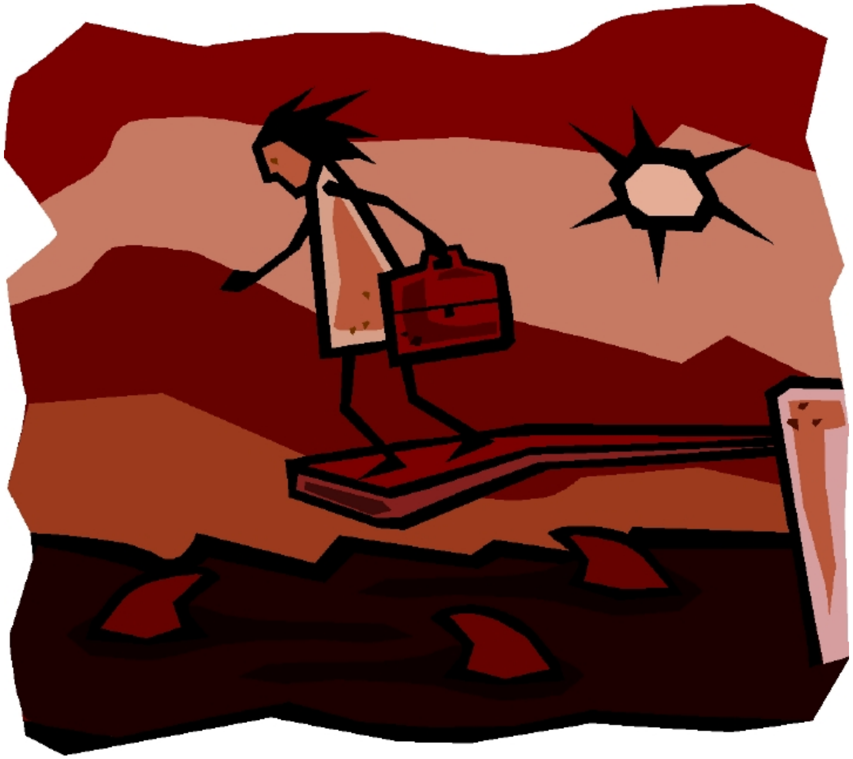
Potential for latent defects

- Addresses the risk of undetected bugs
- Possible measures or information sources
  - History and trends of types/frequency of faults
  - Certifications and test packages
  - Test regimen
  - Test coverage



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Domain of product applicability

- Addresses risk of suitability of the product to the intended task
- Possible measures or information sources
  - Compatibility measures
  - Robustness (adaptability, scalability, portability, security, safety, integrity, etc.)
  - Availability and quality of design and maintenance documents
  - Certifications and test packages
  - Specific operational environment(s)
  - Limitations on product use

Predictability of product behavior

- Addresses the risks associated with suitability of operational and functional quality
- Possible measures or information sources
  - Test regimen
  - Test coverage
  - History and trends of types/frequency of faults
  - MTBF
  - Availability
  - Recovery from faults
  - Compatibility measures
  - Accuracy
  - Completeness of features/functions definition

Product stability

- Addresses the risks associated with historic volatility that could re-emerge
- Possible measures or information sources
  - Release history and frequency
  - History and trends of types/frequency of faults
  - Obsolescence potential
  - Software aging characteristics

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Product supportability

- Addresses the risks associated with continuing suitability of the product
- Possible measures or information sources
  - Availability of training
  - Availability of vendor/developer/consultant support
  - Recovery from faults
  - Mean time between failure
  - Availability and quality of design/maintenance documents
  - Dependency on events out of product control
  - Life expectancy
    - *First shipment date*
    - *End-of-life plans*
    - *Market share*
    - *Market trend*
    - *Rights granted on discontinuation of product*

Product pedigree

- Addresses the risks associated with the developers/sources for the product
- Possible measures or information sources
  - Installed base
  - Market share
  - Market trend
  - Maturity of underlying technology
  - Customer references
  - Confidence in adherence to standards
  - History of upward compatibility

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Additional factors

- Control over configuration/evolution
  - Does the acquisition need to determine when or how the product will change and the type of features that may be added or dropped?
- Predictability of evolution and obsolescence
  - Does the acquisition have a clear understanding of the direction and speed of product evolution and the time remaining in the product's likely supported life?
- Schedule
  - Does the acquisition understand when the product will be available or updated (such as availability of NDI or required product functionality)?
- Costs
  - Does the acquisition understand the full costs associated with the product, such as licensing, refresh, maintenance

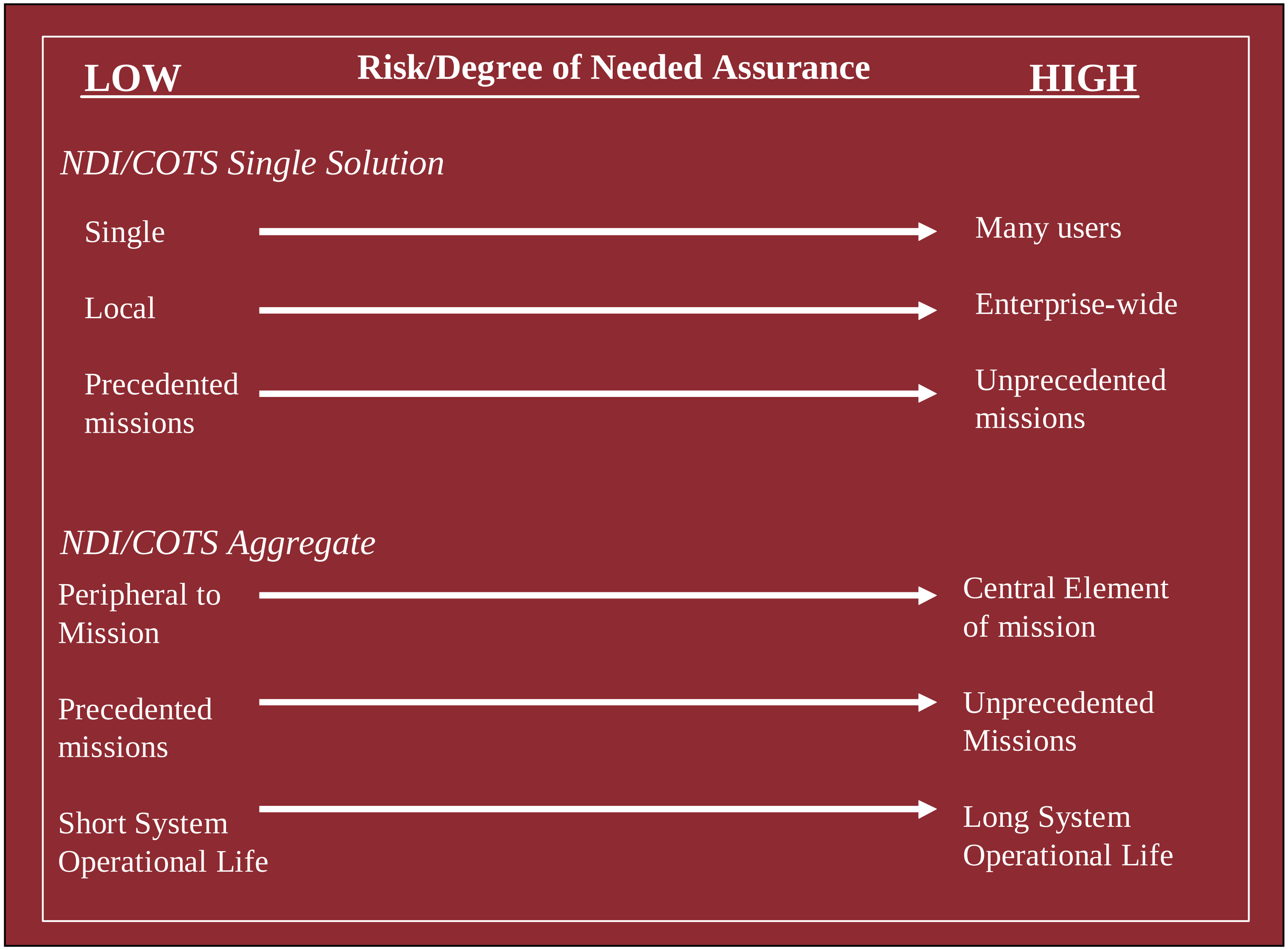
Additional factors - 2

- Architecture
  - Will the product require significant changes to an existing software architecture?
- Operational Context
  - Will the product fit the current or envisioned modes of operation, operational environment (e.g. platform) and process context?
- Fitness for use
  - Do the product characteristics meet the needs of the envisioned use (such as security, availability, and scalability)?
- Modification of product
  - Will there need to be modifications to the product that will prevent normal developer/vendor refresh?

Additional factors - 3

- Release synchronization
  - Will the vendor release schedule impact operations?
- Pedigree of product developer
  - Does the acquisition have confidence in the developer/vendor (including disclosure of subcontractors)?

Context impacts risk



LOW **Risk/Degree of Needed Assurance** **HIGH**

NDI/COTS Single Solution

Single → Many users

Local → Enterprise-wide

Precedented missions → Unprecedented missions

NDI/COTS Aggregate

Peripheral to Mission → Central Element of mission

Precedented missions → Unprecedented Missions

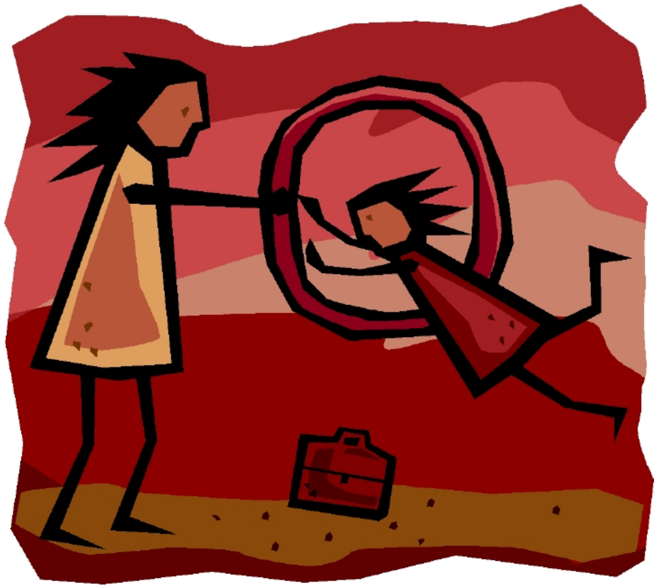
Short System Operational Life → Long System Operational Life

Additional references

- ISO/IEC 14598-4 *Software engineering – Product Evaluation Part 4: Process for acquirers*
  - extensive guidance on evaluating software products.
- ISO/IEC 9126-1 *Information technology – Software quality characteristics and metrics – Part 1: Quality characteristics and subcharacteristics*
  - defines software quality characteristics
- SEI Technical Reports
  - CMU/SEI-2004-TR-013 *An Alternative to Technology Readiness Levels for Non-Developmental Software*
  - CMU/SEI-2003-TR-023 *Identifying Commercial Off-the-Shelf (COTS) Product Risks: The COTS Usage Risk Evaluation*.

Maturity and Agile Development Approaches

- Agile can be effective determining many of the characteristic measures
  - Probability of defects
    - *Test-driven design*
    - *Short iterations yielding operational functionality*
  - Domain applicability
    - *More involved customer*
    - *Acceptance tests for each iteration*
  - Product stability
    - *Automated test environments*
    - *Continuous integration*
  - Product pedigree
    - *Nearly all agile techniques*



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Summary

- Maturity can only be measured on existing software
  - For source selection this means COTS, GOTS, NDI, prototype, experimental
- Initial set of software product maturity characteristics defined
- Maturity evaluation complex - dependent on context and related factors
- Agile approaches may make it easier to determine software product maturity

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Questions?

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