Software Product Maturity in SIS Source Selection

Richard Turner, OUSD(AT&L)/DS/SIS (George Washington University)
Acquisition of SIS Conference, January 28, 2004
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The Requirement

• Section 804 of the ‘3 Defense Authorization Act requires that OSD

  “assist MILDEP's by ensuring criteria applicable to selection of sources provides added emphasis on
  • Past performance of potential sources
  • Maturity of software products offered by potential sources”
Defining SW Product Maturity

- 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
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
Focus 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 was the 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
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**
  - Collective impact 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
Notional SW Maturity Lifecycle

Utility of Software

- Technology Development (TRL 1-4)
- Product Development
- Product Sustainment
- Product Aging
- Obsolescence

- Science and Technology Release (TRL 5)
- Alpha Release (TRL 7)
- Beta Release (TRL 8)
- Official Release (TRL 9)
- Operational Installation (TRL 9)
Candidate 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

- Understanding of the potential for latent defects within the product
- Understanding of the domain of product applicability
- Predictability of product behavior (within well-defined parameters)
- Product stability
- Product supportability
- Product pedigree
Potential for Latent Defects

• **Addresses the risk of undetected bugs**

• **Possible measures or information sources**
  - Test regimen
  - Test coverage
  - History and trends of types/frequency of faults
  - Certifications and test packages
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
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 software technology(ies)
  - Customer references
  - Confidence in adherence to standards
  - History of upward compatibility
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

<table>
<thead>
<tr>
<th>LOW</th>
<th>Risk/Degree of Needed Assurance</th>
<th>HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td>NDI/COTS Single Solution</td>
<td></td>
<td></td>
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<tr>
<td>Single</td>
<td>Many users</td>
<td></td>
</tr>
<tr>
<td>Local</td>
<td>Enterprise-wide</td>
<td></td>
</tr>
<tr>
<td>Precedented missions</td>
<td>Unprecedented missions</td>
<td></td>
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<tr>
<td>NDI/COTS Aggregate</td>
<td></td>
<td></td>
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<tr>
<td>Peripheral to Mission</td>
<td>Central Element of mission</td>
<td></td>
</tr>
<tr>
<td>Precedented missions</td>
<td>Unprecedented Missions</td>
<td></td>
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<tr>
<td>Short System Operational Life</td>
<td>Long System Operational Life</td>
<td></td>
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</tbody>
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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**
- **Next steps**
  - Complete draft language for OSD Guidebook
  - Refine characteristics and measures
  - Continue to evaluate development maturity concepts
Questions?

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