

Business and Technical Considerations for Product Line Development: An Update

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Background

- Initial results and implications of a product line survey were briefed by this presenter at GSAW2000
- Since GSAW2000, a web-hosted version of survey was disseminated to a larger population of “Buyer” and “Developer” respondents at <http://www.aero.org/gssr>
- Combined results from the two surveys have been analyzed
- Since September 2000, have participated in development of a product line business case (strategic software reuse) initiative
 - Commonality between survey and business case objectives
 - Survey contributed to business case development and insight
- Results of survey and business case initiative have been examined and summarized
- Relevance and implications of survey and business case results have been summarized

Objectives of Briefing

- Summarize purpose and results of product line survey
- Summarize purpose and results of business case initiative
- Compare product line survey and business case initiative, in terms of
 - Objectives
 - Focus Areas & Issues Addressed
 - Results
 - Interpretation and Implications
- Summarize the value and “lessons learned” from product line survey and business case initiative

Product Line Survey

- Assess product line development considerations from both the buyer and developer perspectives (“mindsets”)
- Gather additional insight into technical, business and organizational considerations for product line development and application
- Investigate incentives and challenges concerning product line development
- Better understand perspectives, conflicts, constraints and possibilities for cooperation between buyers and developers
- Represent and communicate breadth of needs within acquisition community concerning reusable and evolvable SGS architectures

Profile of Survey Respondents

- By perspective (Buyer versus Developer)
 - 81% of respondents answered from both perspectives
 - 15% of respondents answered from Buyer perspective only
- By title or position
 - Engineering Management 30.0%
 - Engineering 61.4%
 - Other 8.6%
- By degree of previous experience with software development for satellite ground control systems
 - Mean = 11.1 years Median = 10 years Range = 0 to 40 years
- By degree of previous experience with reusable software
 - Mean = 10.2 years Median = 10 years Range = 0 to 40 years

Survey Results from “Buyer” Perspective

Variables of Highest Importance from Buyer perspective

- 1 Demonstrated cost savings from using software components in previous, similar applications (4.29)
- 2 Satellite ground control domain(s) covered by reusable components (4.16)
- 3 How thoroughly components tested (4.15)
- 4 History of successful use of software components in similar projects (4.14)
- 5 Level of developer experience with software reuse or product lines (4.12)
- 6 Demonstrated development time savings from using software components in previous, similar applications (4.09)

Survey Results from “Buyer” Perspective (con’t)

Variables of Lowest Importance from Buyer perspective

Degree to which contractor’s architecture development is structured
by classes and objects rather than by frameworks and components

(2.47)

Object-oriented language

(2.81)

Contractor’s preference for a particular approach (e.g., top down, bottom
up approach to software reuse)

(2.87)

Contractor’s preference to “build from scratch”

(3.11)

Survey Results from “Developer” Perspective

Variables of Highest Importance from Developer perspective

- 1 Stability of the requirements (4.44)
- 2 Level of management and support for software reuse (4.23)
- 3 Degree of information sharing across programs/organizations impacted by software reuse initiative (4.22)
- 4 How thoroughly components tested (4.19)
- 5 Type of development architecture (4.14)

Survey Results from “Developer” Perspective (con’t)

Variables of Lowest Importance from Developer perspective

Compliance with DoD standards	(2.84)
Degree to which contractor’s software development is structured by classes and objects rather than by frameworks and components	(3.08)
Contractor’s preference to “build from scratch”	(3.17)
Demonstrated cost savings from using software components in previous, similar applications	(3.25)

Comparison of Buyer and Developer Perspectives

	<u>Buyer</u>	<u>Developer</u>
How thoroughly components tested	3 (4.15)	4 (4.19)
Level of developer experience with software reuse or product lines	5 (4.12)	7 (4.08)
Level of management commitment and support for software reuse	10 (3.89)	2 (4.23)

Comparison of Buyer and Developer Perspectives (con't)

	<u>Buyer</u>	<u>Developer</u>
Demonstrated cost savings from using software components in previous, similar applications	1 (4.29)	26 (3.25)
Degree of information sharing across programs/organizations	22 (3.40)	3 (4.22)

Interpretation of Survey Results

- Not surprising that “demonstrated cost savings” of much greater importance from Buyer than from Developer perspective
- Component testing important from both perspectives
- Developer experience important from both perspectives
- Object oriented language of lesser importance from both perspectives
- Technical aspects of component development of less importance from Buyer perspective than from Developer perspective
 - Implication that the “how” of development less important to Buyers
 - However, project complexity of comparable importance
- Level of management support for reuse more important to Developers
- Degree of information sharing across programs/organizations impacted by software reuse more important to Developers

Implications of Survey Results

- Survey results suggest potential for consensus / cooperation between Buyers and Developers
 - Several software variables of comparable importance from both perspectives (e.g., project complexity, component testing, developer experience)
 - Therefore, potential for consensus and cooperation, based on “incentives”
- Other results clearly reflect differences between the two perspectives
 - Demonstrated cost savings much more important from Buyer perspective
 - Degree of information sharing across programs/organizations impacted by software reuse more important from Developer perspective
 - Level of management commitment and support for software reuse more important from Developer perspective
- Importance of Buyer / Developer interaction is underscored, based on
 - Potential for consensus and cooperation
 - Differences between the two perspectives

Business Case Initiative

- Acquisition Steering Group (ASG) action item was assigned to determine a business case for software reuse within the NRO
- Participants included former CCT program manager, SEI, and Aerospace
- Initiation of strategic software reuse / product line “data call”
 - Original goal to determine information on software component libraries
 - Scope of data call was expanded to extract more detailed information on software acquisition programs
- Information gathered via interviews and a structured questionnaire
- Results will be briefed by former CCT program manager and SEI

Business Case Initiative (con't)

- Determine directorates and organizations that are involved with product line development and strategic software reuse
 - Collect data about their software acquisition experience and history of software reuse
 - Determine existence of software asset inventories or libraries
- Identify organizations, programs and projects that could benefit from strategic reuse
 - Characterize “how business is being done today”
 - Characterize types of software being developed
 - Determine changes required for adopting / implementing strategic reuse
- Gain additional insight into incentives and disincentives concerning strategic reuse and product line development
 - Organizational, cultural and institutional factors

Results / Implications of Business Case Initiative

- “Independent program management” culture poses barriers and impediments to strategic software reuse (“stovepipes”)
- Cost savings associated with software reuse could be limited, due to the limited number of “new development starts”
- Costs of maintaining an asset base are a major consideration
- Technology compatibility is a major factor to consider when deciding whether to reuse existing software
 - Structured versus OO development; changing hardware platforms, etc.
- Ad-hoc reuse appears more prevalent than systematic reuse
 - “Case by case” basis
- Configuration control often lacking in software reuse
 - Lack of libraries or inventories for software assets and components

Results / Implications of Business Case Initiative (con't)

- Contractor disincentives against strategic software reuse / maintaining software reuse libraries
 - Quote that “Government pays us [contractor] to reinvent the wheel”
 - Quote that “if we [contractor] said we had the required software, we would make less money - thus no reuse”
- There appear to be good candidates for software reuse among ground systems
- However, for some projects no significant reuse appears possible
 - Infrastructure required to maximize reuse would outweigh benefits
- Reuse is dependent on doing similar tasks
 - If the applications vary too much, wrapper code could become more complex than writing the code from scratch

Summary

- Business and technical considerations offer both incentives and challenges for product line development and software reuse
- Organizational and stakeholder perspectives/experiences concerning reusable (product line) software deserve assessment
 - To better understand incentives and barriers to software reuse
 - To identify possible domain areas for product line development and strategic software reuse
 - To gather additional insight into technical, business and organizational considerations for product line development
- Survey and business case results have provided additional insight into some of these business and technical considerations
 - Suggest potential for consensus and commonality, but also
 - Emphasize importance of interaction and information sharing among organizations, given perspective differences and cultural factors

Backup Slides

Survey and Business Case Initiative

- Survey addressed the business and technical considerations for product line development and software reuse
 - Commonality and differences with respect to buyer and developer perspectives
 - Incentives and challenges regarding product line development and software reuse
- Business Case addressed the strategic reuse of software, of which product lines are one contributor
- Both viewed as “data calls” to gather information on, and evaluate
 - Interest in product line development and software reuse
 - Incentives and challenges regarding product line development and software reuse
- Survey contributed to the development and understanding of business case objectives and results

Survey Assumptions and Challenges

- Bounding the scope of survey effort to a “reasonable” level of effort
 - Determining most important survey objectives
 - Determining most important and useful survey items (questions)
- Identification of potential survey respondents
- Number of actual survey respondents (i.e., “responsiveness”)
- Interpretation of survey items by survey respondents
 - Some questions as to meaning and interpretation
- Meaningful interpretation of survey results
 - Extracting meaningful and useful conclusions
- Communication and application of survey results

Sample Survey Items & Questions

- Respondents were asked to rate the following variables in terms of their importance to product line development
 - Demonstrated cost savings from using software components in previous, similar applications
 - Demonstrated development time savings from using software components in previous, similar applications
 - Level of management commitment and support for software reuse
 - History of successful use of software components in similar projects
 - Legacy system upon which software development is based
 - Sharing of assets across product lines and families
 - Development phase in which the software components are used (e.g., definition, design/development, production, O&M)

Sample Survey Items & Questions (con't)

- Respondents were asked to rate the following variables in terms of their importance to product line development
 - Degree of cooperation across organizational boundaries by those impacted by a software reuse initiative
 - Communication of software reuse goals and objectives
 - Level of developer experience with software reuse & product lines
 - Compliance with DoD and commercial standards
 - Component maturity
 - Interface management strategy
 - Stability of the requirements
 - Component testing

Comparison of Buyer and Developer Perspectives (con't)

	<u>Buyer</u>	<u>Developer</u>
Degree to which contractor's architecture development is structured by classes and objects rather than by frameworks and components	30 (2.47)	28 (3.08)
Object-oriented language	29 (2.81)	25 (3.29)
Contractor's preference to "build from scratch"	27 (3.11)	27 (3.17)
Compliance with DoD standards	26 (3.30)	29 (2.84)

Comparison of Buyer and Developer Perspectives (con't)

	<u>Buyer</u>	<u>Developer</u>
Project complexity	9 (3.94)	10 (4.04)
Compliance with commercial standards	15 (3.75)	19 (3.64)
Communication of reuse goals and objectives	17 (3.58)	20 (3.62)
Legacy system upon which software development is based	20 (3.50)	18 (3.65)

Business Case Assumptions and Challenges

- Risks and liability concerns associated with software reuse
 - Can Government hold contractor at fault if components do not work?
- Contractor disincentives concerning strategic software reuse
 - View that it is more profitable to build from scratch
 - Contractor has more control over what gets built and delivered when not constrained to reusing existing software elements
- Strong cultural pressures and disincentives against reusing software
 - Reluctance to share knowledge or relinquish control (ownership issues)
- Relatively little systematic exploitation of commonality
- Command and Control area is well understood, and should be a good candidate for development and exploitation of reusable elements
 - There are software reuse “success stories” (CCT program)