

Survey of Business and Technical Considerations for Product Line Development

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Introduction

- Business and technical considerations offer incentives for product line development
- Business and technical considerations also pose challenges to product line development
- Perspectives and priorities of “stakeholders” concerning product line development should depend on the type of stakeholder
 - Buyer (makes the decision to acquire the software)
 - Developer (builds something with the software)
- Stakeholder perspectives and priorities on reusable (product line) software are worthy of assessment
 - To better understand incentives and barriers to software reuse
 - To identify possible domain areas for product line development and application

Introduction (continued)

- For a product line to be successful, the following issues must be taken into consideration
 - Business case for justifying the product line
 - Definition of the domain
 - Technical challenges
 - Organizational issues
 - Stakeholder perspectives, conflicts and constraints
 - Strategy for implementing the product line

Survey Objectives and Approach

- Assess product line development considerations from both the buyer and developer perspectives
- 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

Background and Progress to Date

- Completed two-year Aerospace participation in Control Channel Toolkit (CCT) product line development effort
- Identified initial set of business, technical and organizational considerations relating to product line development
- Identified issue categories (“talking points) for a user survey
- Developed survey items based on “talking points” with Richard S. Marken of The Aerospace Corporation
- Developed survey for presentation at GSAW99
- Briefed and distributed survey at GSAW99: “Assessing Business and Technical Considerations for Product Line Development”
- Since GSAW99, disseminated survey to a larger population of respondents
- Collected and analyzed survey results

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 (e.g., “responsiveness”)
- 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
 - History of successful use of software components in similar projects
 - Developer's preference to "build from scratch"
 - Degree to which development conforms to a reference architecture
 - Development phase in which the software components are used (e.g., definition, design/development, production, O&M)
 - How thoroughly components have been tested

Sample Survey Items & Questions (con't)

- Respondents were asked to rate the following variables in terms of their importance to product line development
 - Satellite ground control domain (planning, scheduling, commanding) covered by the reusable components
 - Maturity of contractor's software development process
 - Project complexity
 - Compliance with DoD and commercial standards
 - Component maturity
 - Interface management strategy
 - Stability of the requirements
 - Quality of component documentation
 - Level of customer support (e.g., training, help)

Profile of Survey Respondents

- By perspective (Buyer versus Developer)
 - 77.5% of respondents answered from both perspectives
 - 20% of respondents answered from Buyer perspective only
- By title or position
 - Engineering Management 32.5%
 - Engineering 60%
 - Other 7.5%
- By degree of previous experience with software development for satellite ground control systems
 - Mean = 9.7 years Median = 10 years Range = 0 to 25 years
- By degree of previous experience with reusable software
 - Mean = 9.0 years Median = 8 years Range = 0 to 34 years

Survey Results from “Buyer” Perspective

Variables of Highest Importance from Buyer perspective (Rank & Score)

- (1) Demonstrated cost savings from using software components in previous, similar applications (4.27)
- (2) Satellite ground control domain(s) covered by reusable components (4.19)
- (3) History of successful use of software components in similar projects (4.13)
- (4) How thoroughly components tested (4.08)
- (5) Project complexity (3.97)
- (6) Demonstrated development time savings from using software components in previous, similar applications (3.94)

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

Variables of Highest Importance from Buyer perspective (Rank & Score)

(7) Stability of the requirements	(3.86)
(7) Satellite support domain area(s) into which reusable software components are to be incorporated	(3.86)
(7) Contractor’s COTS and legacy software policies	(3.86)
(8) Level of customer support (training, help)	(3.85)
(9) Number of mission specific requirements	(3.83)
(10) Compliance with commercial standards	(3.72)
(11) Component maturity	(3.69)
(12) Maturity of software development process	(3.54)
(12) Interface management strategy	(3.54)

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

Variables of Lowest Importance from Buyer perspective (Score)

Degree to which contractor’s architecture development is structured
by classes and objects rather than by frameworks and components
(2.34)

Contractor’s preference for a particular approach (e.g., top down, bottom
up approach to software reuse) (2.86)

Object-oriented language (2.86)

Provision of reference architecture by component developer
(3.21)

Compliance with DoD standards (3.22)

Contractor’s preference to “build from scratch” (3.23)

Survey Results from “Developer” Perspective

Variables of Highest Importance from Developer perspective (Rank & Score)

- | | |
|---|--------|
| (1) Stability of the requirements | (4.59) |
| (2) Quality of component documentation | (4.25) |
| (3) How thoroughly components tested | (4.23) |
| (4) Type of development architecture | (4.17) |
| (5) Information sharing across software development organizations | (4.13) |
| (6) Type of reference architecture provided | (4.00) |
| (7) Level of customer support (training, help) | (3.93) |

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

Variables of Highest Importance from Developer perspective (Rank & Score)

- | | |
|--|--------|
| (8) Demonstrated development time savings from using software components in previous, similar applications | (3.90) |
| (8) Interface management strategy | (3.90) |
| (9) Project complexity | (3.83) |
| (9) Component maturity | (3.83) |
| (10) Conformance to a reference architecture | (3.79) |
| (11) Number of mission specific requirements | (3.76) |

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

Variables of Lowest Importance from Developer perspective (Score)

Compliance with DoD standards	(2.60)
Degree to which contractor’s software development is structured by classes and objects rather than by frameworks and components	(2.89)
Object-oriented language	(3.03)
Maturity of software development process	(3.03)
Contractor’s preference to “build from scratch”	(3.11)
Demonstrated cost savings from using software components in previous, similar applications	(3.23)

Comparison of Buyer and Developer Perspectives

Variables of High Importance from both Buyer and Developer perspectives (Rank & Score)

	<u>Buyer</u>	<u>Developer</u>
How thoroughly components tested	(4) 4.08	(3) 4.23
Project complexity	(5) 3.97	(9) 3.83

Comparison of Buyer and Developer Perspectives (con't)

Variables of Low Importance from both Buyer and Developer perspectives (Rank & Score)

	<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	(23) 2.34	(24) 2.89
Object-oriented language	(22) 2.86	(23) 3.03
Contractor's preference to "build from scratch"	(19) 3.23	(22) 3.11

Comparison of Buyer and Developer Perspectives (con't)

Variables Important from Buyer perspective but Less Important from Developer perspective (Rank & Score)

	<u>Buyer</u>	<u>Developer</u>
Demonstrated cost savings from using software components in previous, similar applications	(1) 4.27	(21) 3.23

Variables Important from Developer perspective but Less Important from Buyer perspective (Rank & Score)

	<u>Buyer</u>	<u>Developer</u>
Type of reference architecture provided by reusable software developer	(18) 3.34	(6) 4.00

Comparison of Buyer and Developer Perspectives (con't)

Variables of Comparable Importance from Buyer and Developer perspectives (Rank & Score)

	<u>Buyer</u>	<u>Developer</u>
Number of mission specific requirements	(9) 3.83	(11) 3.76
Component maturity	(11) 3.69	(9) 3.83
Documented tests showing that component architecture conforms to reference architecture	(15) 3.47	(18) 3.47
Development phase in which software components are used	(17) 3.41	(20) 3.30

Interpretation of Survey Results

- Not surprising that “demonstrated cost savings” of much greater importance from Buyer than from Developer perspective
- Thoroughness of component testing important from both perspectives
- Requirements stability fairly 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
 - e.g., type of reference architecture; conformance to reference architecture
 - Implication that the “how” of development less important to Buyers
 - However, component maturity of comparable importance to both
- Compliance with DoD standards did not rank high from either Buyer or Developer perspective
 - Compliance with commercial standards moderately important to “Buyers”

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, number of requirements)
 - 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
 - Type of reference architecture and conformance to reference architecture more important from Developer perspective
 - Other technical variables of less importance from Buyer perspective (e.g., those pertaining to the “how” of component and software development)
- Importance of Buyer / Developer interaction is underscored, based on
 - Potential for consensus and cooperation
 - Differences between the two perspectives

Future Initiatives and Possibilities

- Distribute survey electronically to a larger population of respondents
 - “On line” dissemination using web-based technology
- Establish correlation between number of years experience with software development and survey results
- Establish correlation between number of years experience with reusable software and survey results
- Communicate results of these initiatives
 - Future briefing (e.g., GSAW 2001)

Summary

- Business and technical considerations offer both incentives and challenges for product line development
- Buyer and Developer perspectives and priorities on reusable (product line) software are worthy of assessment
 - To better understand incentives and barriers to software reuse
 - To identify possible domain areas for product line development and application
 - To gather additional insight into technical, business and organizational considerations for product line development
- Survey results have provided additional insight into some of these business and technical considerations
 - Suggest potential for consensus and commonality
 - Emphasize importance of Buyer / Developer interaction, given the differences between these stakeholder perspectives