Value-Based Software Engineering

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Outline

• Value-Based Software Engineering (VBSE) Overview
  – Motivation
  – 7 key steps and practices
• Value of Dependability Example
  – Example project: Sierra Mountainbikes
  – Business case summary
  – Value of Dependability model and analysis
• Conclusions
Motivation for Value-Based SE

• Current SE methods are basically value-neutral
  - Every requirement, use case, object, and defect is equally important
  - Object oriented development is a logic exercise
  - “Earned Value” Systems don’t track business value
  - Separation of concerns: SE’s job is to turn requirements into verified code
    – Practitioners escape from blame
    – Academics escape from reality

• Value – neutral SE methods are increasingly risky
  – Software decisions increasingly drive system value
  – Corporate adaptability to change achieved via software decisions
  – System value-domain problems are the chief sources of software project failures
The “Separation of Concerns” Legacy

• “The notion of ‘user’ cannot be precisely defined, and therefore has no place in CS or SE.”
  - Edsger Dijkstra, ICSE 4, 1979

• “Analysis and allocation of the system requirements is not the responsibility of the SE group but is a prerequisite for their work”
  - Mark Paulk at al., SEI Software CMM* v.1.1, 1993

* Capability Maturity Model
Why Software Projects Fail

352 companies - 8,000 software projects. Source: The Standish Group, 1995
7 Key Elements of VBSE

1. Benefits Realization Analysis
2. Stakeholders’ Value Proposition Elicitation and Reconciliation
3. Business Case Analysis
4. Continuous Risk and Opportunity Management
5. Concurrent System and Software Engineering
6. Value-Based Monitoring and Control
7. Change as Opportunity
DMR/BRA* Results Chain

**ASSUMPTION**
Order to delivery time is an important buying criterion

**INITIATIVE**
Implement a new order entry system

**OUTCOME**
Reduce time to process order
Reduced order processing cycle (intermediate outcome)
Reduce time to deliver product

**OUTCOME**
Contribution
Reduced order processing cycle
Increased sales

*DMR Consulting Group’s Benefits Realization Approach
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The Model-Clash Spider Web: Master Net

Users
- Many features
- Changeable requirements
- Applications compatibility
- High levels of service
- Voice in acquisition
- Flexible contract
- Early availability

Maintainers
- Ease of transition
- Ease of maintenance
- Applications compatibility
- Voice in acquisition

Acquirers
- Mission cost/effectiveness
- Limited development budget, schedule
- Government standards compliance
- Political correctness
- Development visibility and control
- Rigorous contact

Developers
- Flexible contract
- Ease of meeting budget and schedule
- Stable requirements
- Freedom of choice: process
- Freedom of choice: team
- Freedom of choice: COTS/reuse

PC: Process
PD: Product
PP: Property
S: Success
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Example Project: Sierra Mountainbikes

- Based on what would have worked on a similar project
  - Quality leader in specialty area
  - Competitively priced
  - Major problems with order processing
    - Delivery delays and mistakes
    - Poor synchronization of order entry, confirmation, fulfillment
    - Disorganized responses to problem situations
    - Excess costs; low distributor satisfaction
Order Processing Project GQM

**Goals:** Improve profits, market share, customer satisfaction via improved order processing

**Questions:** Current state? Root causes of problems? Keys to improvement?

**Metrics:** Balanced Scorecard of benefits realized, proxies
- Customer satisfaction ratings; key elements (ITV: in-transit visibility)
- Overhead cost reduction
- Actual vs. expected benefit and cost flows, ROI
Expanded Order Processing System Results Chain

- New Order Entry System
  - Less time, errors in order processing
  - Less time, errors per order-entry step

- New Order Fulfillment System
  - Less time, errors per order-fulfillment step

- New Order Fulfillment Processes, Outreach, Training
  - Fewer order-fulfillment steps, errors

- Increased customer satisfaction, Decreased operations costs
  - Faster, better order fulfillment inputs

- Increased Profits, Growth
  - Increased Sales, Profitability, Customer Satisfaction

Assumptions
- Increasing market size
- Continuing consumer satisfaction with product
- Relatively stable e-commerce infrastructure
- Continued high staff performance
Baseline Business Case Analysis
– LiGuo will provide details

• COCOMO II cost estimate, nominal RELY rating: $3.14M
• Total hardware-software-support estimate: $7.5M
• Estimated added profits = $29.8M; ROI = 2.97
• Estimated total sales = $531M
• Nominal RELY Mean Time Between failures = 300 hours
• For 3-hour Mean Time to Repair, Availability = 300 / ( 300 + 3 ) = 0.99
• Assuming 1% downtime = 1% lost sales and profits,
• Lost Profits = ($531M ) (.01) = $5.31M
Dependability ROI Analysis: iDAVE Model

–Information Dependability Attribute Value Enhancement Model

COCOMO II Cost Estimation Relationships (CER’s)

Capability Investments

COQUALMO Dependability Estimation Relationships (DER’s)

Dependability Investments

Stakeholder Value Estimation Relationships (VER’s)

Dependability ROI
ROI for Higher Availability

- Analysis tools: 13 seats @ $20K = $260K
- Peer Reviews: $65K training + $145K reviewing = $210K
- Added testing: (0.10)x($3.14M development) = $314K
- Total investment = $784K
- Rework savings = $450K  (COCOMO II TOOL, PMAT)
- Resulting MTBF = 10,000 hr
- Resulting Availability = 10,000/ (10,000+3) = 0.9997
  - Lost Profits = ($531M)(.0003) = $0.16M
  - ROI = ($5.31M - .16M + .45M) / .784M = 6.1
Reasoning About the Value of Dependability

• Further Availability investments not worthwhile
  – Very High COCOMO II RELY: (0.16)($3140K) = $502K
  – Lost Profits savings at most = $160K

• Further Dependability investments not worthwhile?
  – Quite possible that security worth an investment
  – Maslow need hierarchy: satisfied needs are not motivators

• Implies that dependability requirements are emergent rather than pre-specifiable
  – Iterative analysis is better than single-pass analyses
  – Adaptive dependability mechanisms increasingly important
References


