Business Value Driven Engineering and Management of Web Services and Their Compositions

Dr. Vladimir Tosic
NICTA, UWO, and UNSW
Outline

• About NICTA
• Problem of business-IT alignment and past results
• Benefits of bridging design-time and run-time
• Run-time specifications of business values and strategies in WS-Policy4MASC
• Business-value driven management in MASC
• Design-time specifications in UML profiles for WS-Policy4MASC
• Conclusions and future work
• Call for book chapters
About NICTA

- Australian center of excellence in use-inspired ICT (info & communications technology) research
- Established 2002, now 5 labs in 4 cities
- NICTA members (governments and universities):
  - NICTA partners:
    - 422 research staff, 296 postgraduate students
    - 4 research themes (e.g., managing complexity) & 6 business areas (e.g., software infrastructure)
Problem of Business-IT Alignment

- Execution of IT systems should be coordinated with business objectives, values, and operations
- However, IT (e.g., performance) improvements need not improve business value (e.g., profit)
  - The gap between managing IT systems and managing businesses that use them
  - One of the causes is complexity of mappings between technical and business metrics
- An old problem – many communities work on it, but in relative isolation
Value-Based Software Engineering

• Software engineering that puts explicit emphasis on business value during the engineering process
  – Determining software requirements that best support organization’s business strategy
  – Model-driven architecture with value annotations
  – Prioritizing test cases based on potential defect impact on organization’s profits (cf. coverage)

• Papers by Barry Boehm, book by S. Biffl et al.
• EDSER and ESC workshops at ICSE conferences
• However: What about run-time manageability?
Business-Driven IT Management

• Management = monitoring + control
• BDIM determines mappings between technical and business performance metrics and uses them to make run-time IT system/service management decisions that maximize business value
  – Impact of decreased availability on profits
• BDIM workshops, papers by HP Labs members
  - Quality of business (QoBiz), management by contract, management by business objectives
• However: What about mapping to requirements?
IT Governance

• Part of corporate governance that tries to ensure that IT supports business objectives/strategies
  – Study of effective use of IT for business growth
  – Business decisions that lead to strategic alignment between business and IT
• Balanced scorecard (BSC) with 4 dimensions
  – Financial, customer, internal business processes, learning & growth
• Various frameworks (e.g., COBIT, ITIL)
• Papers by Weill & Ross, Norton & Kaplan
• However: What about technical decisions?
Benefits of Integration

• Linking all life-cycle stages with bi-directional information transfer, e.g., for impact analysis
• New closed-control loops for adaptation
  1. Engineering IT systems during design-time to maximally support run-time management
  2. Managing IT systems during run-time to align with and leverage business value information captured in augmented design-time models
  3. Feeding back monitored run-time information about business value compliance and various changes to improve/update design-time models
Overview of My Recent Research

• Focuses on Web services and their compositions
  – Distributed components using XML, SOAP, WSDL
• Built on experiences from work on contract-based specification and management (WSOL/WSOI)
• Differentiation on specifying and processing business value and business strategy information
  – Run-time specification: WS-Policy4MASC
  – Run-time management: MASC middleware
  – Design-time: UML profiles for WS-Policy4MASC
  – Run-time selection: UDDI extensions (ongoing)
WS-Policy4MASC

• Policy – high-level operation & management goals and/or rules (e.g., for security, performance, …)

• WS-Policy (standardized by W3C) is a general policy specification framework for Web services
  – Policy is a collection of policy alternatives
  – Policy alternative is a collection (operators: all, exactly one) of policy assertions
  – WS-PolicyAttachment – general mechanism to associate a policy with its scope (e.g., WSDL file)
  – Leaves details for extensions (e.g., WS-Security)

• WS-Policy4MASC adds new policy assertions and details necessary for run-time management
Goal and Action Policy Assertions

• Goal policy assertions guide monitoring in MASC
  – Requirements and guarantees (about functionality or QoS) to be met in desired normal operation
  – E.g., response time of service X $\leq 1$ second (*)
• Action policy assertions guide control in MASC
  – Actions to be taken if certain conditions are met
  – E.g., if (*) not met, replace service X with service Y
  – WS-Policy4MASC and MASC advantage over related work is in built-in support for diverse range of common Web service composition adaptations
• Some advantages over WS-CoL, WSPL, ACPL, …
Utility Policy Assertions

• Diverse business values assigned to conditions
  – E.g., if (*) was met, requester pays provider $2; otherwise provider pays requester $1
  – WS-Policy4MASC advantage is in modeling not only financial business values (prices, penalties), but also many others (e.g., customer satisfaction)

• Business values classified along several dimensions
  – Benefits vs. costs, agreed vs. possible, tangible vs. intangible, absolute vs. relative

• Combinations determine business value types
  – E.g., absolute intangible possible benefits (models the major aspects of customer satisfaction)
Meta-Policy Assertions

• Specify which policy assertions are conflicting and which policy conflict resolution strategy to use
  – Policy conflict: 2 or more policy assertions are triggered, but only 1 can be executed (e.g., skip activity vs. replace activity)

• WS-Policy4MASC advantage is in modeling policy conflict resolution strategies that maximize sums of various business value types
  – Model diverse business strategies (e.g., exceptional customer satisfaction)
  – MASC implements corresponding business-driven management algorithms
Policy Conflict Resolution

- Strategies are also classified along several dimensions, depending on business value classes
  - E.g., ‘tangible-only’ vs. ‘intangible-only’ vs. ‘tangible+intangible’
- When difference between summary business values for conflicting policies is smaller than some threshold, tiebreaking rules can be specified
  - E.g., ‘tangible+intangible’ instead of ‘tangible-only’
- Combinations determine strategies
  - E.g., ‘intangible-only agreed+possible benefits+costs with tiebreaking tangible+intangible’ (models maximization of customer satisfaction)
Use of WS-Policy4MASC in MASC

- Feasibility of WS-Policy4MASC demonstrated by implementing MASC in-memory policy repository, algorithms for policy decision, and other modules
  - Used ‘XML schema to classes’ generator for policy repository classes
- Examined expressiveness, effectiveness, and usefulness of WS-Policy4MASC on 2 case studies (weather report, stock trading)
- To adapt a Web service composition at run-time, only change WS-Policy4MASC policies
UML Profiles for WS-Policy4MASC

• An approach to VBSE+BDIM integration

1. Engineering: Specification of business value (and other non-functional information) in UML models
   – E.g., using Eclipse plug-ins

2. Management: Generation of WS-Policy4MASC policies from UML models (semi-automatically)
   – E.g., using XSLT on XMI representations of UML

3. Feedback: Showing run-time management information (e.g., measurements) in UML models (cf. dashboards) and using it for various analyses
   – E.g., using Eclipse plug-ins
UML Profile for Policy Assertions

<<Profile>>
MASCPolicy Assertions

<<Metaclass>>
Element

<<Extends>>
<<Stereotype>>
MASC Policy Assertion
- MASCID: ID
- ManagementParty: AnyURI
- IsActive: boolean

<<Stereotype>>
Goal Policy Assertion
- ResponsibleParty: AnyURI
- When: WhenString
- BooleanExpression: XMLString

<<Stereotype>>
Utility Policy Assertion
- BeneficiaryParty: AnyURI
- PayingParty: AnyURI
- Intangible Utilities: string[]
- When: WhenString
- Arithmetic With Unit Expression: XMLString

<<Stereotype>>
Action Policy Assertion
- When: WhenString
- Action Group: Action[]

<<Stereotype>>
Meta Policy Assertion
- Party For Which Utility Is Examined: AnyURI
- Action Policy Assertions: MASCID Ref[]
- Tiebreaker Limit For Possibles: XMLString
- Use Intangibles Instead Of Tangibles: boolean
- Tiebreaker Limit For Intangibles: XMLString
- Intangibles Before Possibles: boolean
- Cost Limit Expression: XMLString

This is the most important among several profiles we developed for WS-Policy 4 MASC. The others are omitted due to the limited space.

Meta Policy Assertion stereotype directly contains attributes and sub-elements from the WS-Policy 4 MASC Policy Conflict Resolution Strategy.

In this diagram, the constraints and data types defined within or for this UML profile are not shown due to the limited space.
Example Use of This UML Profile

- Part of a case study used to evaluate our UML profiles
- Ongoing work: Tool support for showing run-time management information and corresponding analyses

October 2007 Seminar by Vladimir Tosic

The imagination driving Australia’s ICT future
Conclusions

- Addressing business-IT alignment requires integrating approaches from various communities.
- WS-Policy4MASC offers specification of diverse business values and business-driven policy conflict resolutions strategies.
- MASC middleware demonstrated feasibility and usefulness of solutions built into WS-Policy4MASC.
- Our UML profiles are a step towards addressing the engineering, management, and feedback challenges, so they improve business-IT alignment.
Ongoing and Future Work

- Extending WS-Policy4MASC models of business values and policy conflict resolution strategies, as well as related MASC management algorithms
  - Standard error of estimates of intangible values
  - Probability distribution of possible future payments
- Using WS-Policy4MASC in Adaptive Middleware Platform (AMP) autonomic computing platform
- Exploring use of AndroMDA (model-driven framework) for processing our UML profiles
- Extending UDDI with WS-Policy4MASC policies
Call for Book Chapters

• “Information Technology Aligned with Business Objectives and Values: Integrating Software Engineering, System Management, and Governance”, edited by Vladimir Tosic
  – Value-based software engineering (VBSE)
  – Business-driven IT management (BDIM)
  – IT governance
  – Integration of results from these 3 areas
• Chapter proposal deadline: March 31, 2008
• Chapter submission deadline: April 30, 2008
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Discussion

• Questions?

• Criticisms?

• Insights?

• Contact information:
  • vladat at_server: computer.org (please, start Subject line with “Your Research” or “IGI Book”)