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:
- Over 400 researchers, 300 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, improvements in IT (e.g., performance) 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 Our Recent Research**

- Focuses on Web services and their compositions
- 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)

**Overview of Web Services**

- Distributed components (usually software) that can be described, discovered, and communicated with using a set of XML-based standards
  - XML = Extensible Markup Language
  - SOAP, WSDL, UDDI, BPEL, ... (often named WS-*)
  - Communication is over the standard Internet protocols (HTTP, TCP/IP)
- Motivation: the old problem of interoperability between heterogeneous systems
- Support by all major computing companies

**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

**WS-Policy4MASC Main Concepts**
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 <= 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
  - Absolute vs. relative
  - Tangible (financial) vs. intangible (other)
  - Agreed vs. possible
  - Benefits vs. costs

Utility Policy Assertions (cont.)

- Combinations determine business value types
- A particular business value is represented with a monetary amount and a business value type
  - E.g., AUS$10 absolute intangible possible benefits (models major aspects of customer satisfaction)
- One benefit of the classification is representation of various business strategies (e.g., exceptional customer satisfaction) in meta-policy assertions
  - In various circumstances, different business value types are relevant for decision making

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 associated with consequences of choosing 1 of the policies
  - Model diverse business strategies (e.g., exceptional customer satisfaction)
  - MASC implements corresponding 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)

MASC Middleware Architecture

- 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 associated with consequences of choosing 1 of the policies
  - Model diverse business strategies (e.g., exceptional customer satisfaction)
  - MASC implements corresponding algorithms
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

- An approach to VBSE+BDIM integration
  1. Engineering: Specification of business value (and other non-functional information) in UML models
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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

Conclusions

- Addressing business-IT alignment requires integrating approaches from various communities
- WS-Policy4MASC offers specification of diverse business values and business-driven policy conflict resolution 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
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Discussion

• Questions?
• Criticisms?
• Insights?
• Contact information:
  • vladat at server: computer.org (please write “Your Seminar on VBSE-BDIM” in the Subject line)