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

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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

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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)

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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

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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. Biffi et al.
- EDSER and ESC workshops at ICSE conferences
- However: What about run-time manageability?

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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?

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IT Governance



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- 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?

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Benefits of Integration



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- 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

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Overview of Our Recent Research



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- 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)

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Overview of Web Services



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- 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

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WS-Policy4MASC



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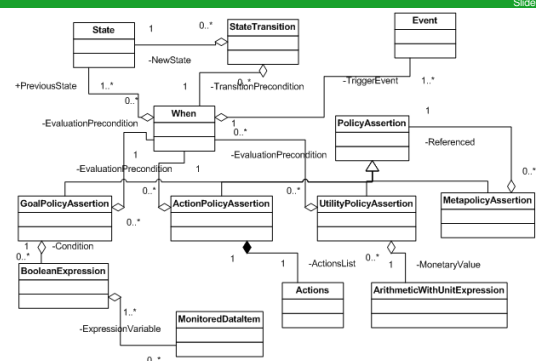
- Policy – high-level operation & management goals and/or rules (e.g., for security, performance, ...)
- WS-Policy (standardized by W3C) is a general policy specification framework for Web services
 - Policy is a collection of policy alternatives
 - Policy alternative is a collection (operators: all, 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

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WS-Policy4MASC Main Concepts



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Goal and Action Policy Assertions



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- 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, ...

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Utility Policy Assertions



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- 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

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Utility Policy Assertions (cont.)



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- 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

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Meta-Policy Assertions



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- 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

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Policy Conflict Resolution



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- 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)

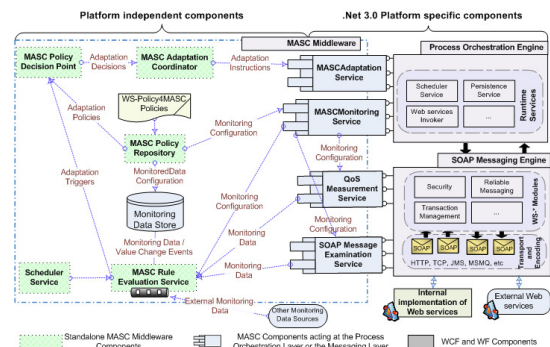
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MASC Middleware Architecture



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Use of WS-Policy4MASC in MASC



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- 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

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UML Profiles for WS-Policy4MASC



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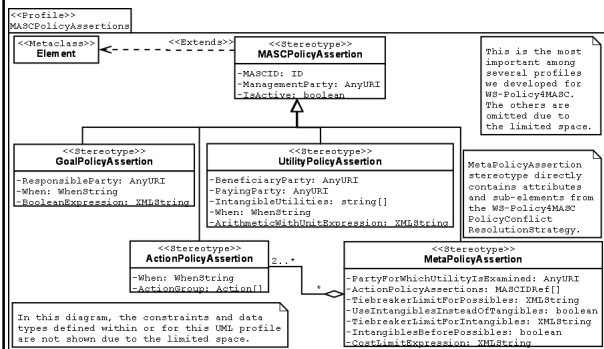
- An approach to VBSE+BDIM integration
1. Engineering: Specification of business value (and other non-functional information) in UML models
 - E.g., using Eclipse plug-ins
 2. Management: Generation of WS-Policy4MASC policies from UML models (semi-automatically)
 - E.g., using XSLT on XML representations 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

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UML Profile for Policy Assertions



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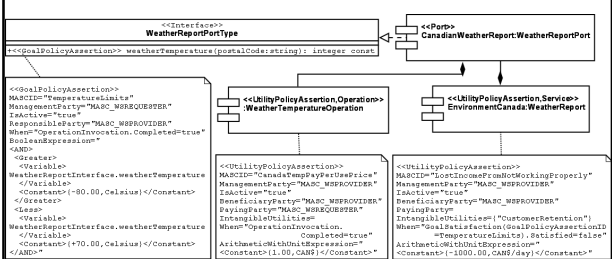


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Example Use of This UML Profile



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

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Conclusions



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- 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

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Ongoing and Future Work



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- 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



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- Questions?
- Criticisms?
- Insights?
- Contact information:
 - *vladat at_server: computer.org* (please write "Your Seminar on VBSE-BDIM" in the Subject line)

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