Towards Business Value Driven Management of Business Processes and Service-Oriented Architectures

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Motivating Example

Presentation Topic

- Q: When a management system has several options, which one to choose?
  - A: The one that maximizes business value!
- Q: So, how to implement this?
  - A: This presentation provides some insights

Presentation Overview

- About NICTA and our team’s project
- Need for business value driven management and some challenges in modeling business values and business strategies
- Our solutions for a specification language, run-time management middleware, and integration with software design activities
- Questions and discussion

About NICTA (www.nicta.com.au)

- Centre of Excellence, use-inspired research
- Established 2002, now 5 labs in 4 cities
- Over 400 research staff and 300 postgraduate research students
- NICTA members:
  - NICTA partners:
Overview of NICTA Research

**Research Themes**
- ICT challenges in...
- Embedded Systems
- Networked Systems
- Making Sense of Data
- Managing Complexity

**Business Areas**
- ICT used for...
- Biomedical and Life Sciences
- Intelligent Transport Systems
- Safety and Security
- Environmental Management
- Mobile Systems and Services
- Software Infrastructure

- Many projects, all with some *industry collaboration*

Our Team’s Project: Business Adaptation and Interoperation

- Advanced software technologies for *fluid and adaptive business-to-business inter-operation*
  - Fluid and flexible inter-operation extending resource-oriented architecture principles
  - Vocabulary management with ontologies
  - Determining scope, size, and cost of developing service-oriented systems
  - Performance analysis of service-oriented systems
  - Run-time monitoring and adaptation frameworks
  - Adaptation that maximizes business value

Project’s Application Areas

- Business processes implemented with service-oriented and resource-oriented architectures
  - History of successful collaboration with Australian government departments and industry consortia
  - Patent applications (submitted or in preparation)
- Hybrid cloud computing systems
  - We study and use Microsoft Azure, Google App Engine, and Amazon cloud offerings
  - We seek additional industry & research partners

Business Value Driven Management

*Why is it needed?*
Challenges in modeling business value metrics and business strategies

On Optimization of Technical Metrics

- Traditional IT system management determines and optimizes *technical metrics*
  - e.g., response time, availability, ...
- Autonomic systems minimize human involvement, but for the same metrics
- Many works on QoS management (some with adaptation) of Web service systems
  - e.g., WSLA, Smartware, Dynamo, JOpera, ...

Business Value Metrics

- What is *important for customers/users*?
  - Technical metrics? Not really…
  - Impact on their business? Yes!
- *Business value metric* = any measure of business worth
  - financial: income, cost, profit, ROI, …
  - non-financial: number of customers, customer satisfaction, market share, …
  - Related terms: KPI (Key Performance Indicator), …
Alternatives for B:

- E

Motivating Example – Revisited

Alternatives for B:

- A
- B
- C
- D
- E

From Technical to Business Metrics

- Problem: complex mappings between technical metrics and business value metrics
  - e.g., better availability vs. better profit

- Business value metrics are diverse!

- Which business value metrics to maximize depends on business strategy
  - e.g., "exceptional customer satisfaction" vs. "cost leadership"

Some Related Work

- Financial metrics (e.g., prices, penalties) in some Web service management systems

- Balanced scorecard (BSC)
  - financial worth is only one dimension

- Business-driven IT management (BDIM)
  - determining business-technical mappings
  - using them for IT system management decisions
  - impact analysis of changes in business/technology

Some Challenges: I. Modeling of Business Value Metrics

1.1 Explicit description of various characteristics of business value metrics (financial vs. non-financial, contractual vs. predictions, …)

1.2 Monetization of non-financial metrics?
  - e.g., 80% customer satisfaction => $100 per day

1.3 Modeling of probabilistic values
  - e.g., related to uncertain events, risks, trust

1.4 Specifying time value of money
  - e.g., $10 now vs. $1 per month over 10 months

Some Challenges: II. Modeling of Business Strategies

II.1 Explicit description of various characteristics of business strategies
  - e.g., whether non-financial metrics are used

II.2 Limiting temporal scope of relevant events

II.3 Calculating overall business value of an option
  - e.g., monetization, currency conversion, net present value of future payments, filtering/weights of different business value metric types, etc.

II.4 Comparing overall values of various options
  - e.g., constraints (e.g., cost limits), priorities of business value metric types, tiebreaking, etc.

Motivating Example – Once Again

Alternatives for B:

- A
- B
- C
- D
- E

98%/day; penalty: $50; price: $20/invocation

95%/day; penalty: $5; price: $3/invocation

99.99%/day; penalty: $80; price: $1/invocation

99.99%/day; penalty: $5/invocation

99%/day; penalty: $10; price: $3/invocation

98%/day; penalty: $5; price: $3/invocation

98%/day; penalty: $5; price: $3/invocation
Overview of Our Recent Research

- Focuses on business processes implemented with Web service compositions
- Built on experiences from WSOL/WSOI
- Differentiation on specifying and processing business value metrics & business strategies
  - Run-time specification: WS-Policy4MASC
  - Run-time management: (Mini)MASC middleware
  - Design-time: UML profiles for WS-Policy4MASC

Our Solutions

WS-Policy Language
MASC and MiniMASC Middleware
UML Profiles for WS-Policy4MASC

Background: WS-Policy

- Policy – high-level operation & management goals/rules (for security, performance, …)
- WS-Policy (standardized by W3C) is a general policy specification framework
  - 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)

UtilityPolicyAssertion (1/2)

- Specification of diverse business value metrics
  - Non-financial are monetized (cf. 1.2);
  - Net present value assumed (cf. 1.4)
  - Support for probabilities (cf. 1.3)
- A utility policy assertion specifies:
  - Situations to which it applies (When construct)
  - Management party and beneficiary party
  - 1 or more business value metrics
- A business value metric has a monetary amount and a business value metric category

Goals, Actions, Probabilities

- GoalPolicyAssertion: conditions to be met in desired normal operation (guide monitoring)
  - E.g., response time of activity \( X \leq 1 \) second (*)
- ActionPolicyAssertion: actions to take if certain situation happens (guide control)
  - E.g., if (*) not met, replace X with activity Y
- ProbabilityPolicyAssertion: probability of a situation (can be used for risk, trust)
  - E.g., probability of (*) occurring is 0.8
UtilityPolicyAssertion (2/2)

- 8 bus. value metric categories: combination of characteristics along 3 dimensions (cf. I.1)
  - Tangible (financial) vs. intangible (non-financial)
  - Agreed vs. possible
  - Benefits vs. costs
- Example: AU$10 intangible possible benefits (models aspects of customer satisfaction)
- Business value metrics can be absolute (as above) or relative (e.g., PriceB=0.7*PriceA)

MetaPolicyAssertion (1/2)

- Policy conflict: several action policy assertions can be applied, but only 1 should
  - E.g., “replace with D” vs. “replace with E”
- Policy conflict resolution with meta-policies
- A meta-policy assertion:
  - Consists of 2 or more conflicting (alternative) action policy assertions and
  - Specification of business strategies maximizing specified business value metric types
- Time limit (cf. II. 2) and cost limit (cf. II. 4)

MetaPolicyAssertion (2/2)

- Strategies classified along dimensions based on business value categories (cf. II.1, II.3)
  - E.g., ‘tangible-only’ vs. ‘intangible-only’ vs. ‘tangible+intangible’
- Tiebreaking in case of close alternatives
  - E.g., ‘tangible+intangible’ instead of ‘tangible-only’
- Example: ‘intangible-only agreed+possible benefits+costs with tiebreaking tangible+intangible’ (models maximization of customer satisfaction)

Policy Conflict Resolution Algorithm

1. Determine relevant utility policy assertions (only for direct actions, within a time limit)
2. Monetize all business value metrics (common currency, optional probabilities)
3. For each conflicting action policy assertion, sum bus. value metrics from same category
4. Eliminate alternatives that do not satisfy constraints (cost limit)
5. Compare alternatives using only business value metric categories given in meta-policy assertion (if needed, apply tiebreaking rules)

MASC Middleware Architecture

Acknowledgment: Abdelkarim Erradi, Piyush Maheshwari

Architecture of MiniMASC+MiniZinc

- Using constraint programming, finds the globally optimal set of adaptations for multiple systems managed at the same time
- MiniZinc – powerful constraint programming language & solver

Acknowledgment: Qinghua Lu, Gareth Edwards, Vern Yao Tee
Integrating Run-Time and Design-Time

1. Engineer during design-time to maximally support run-time management
2. Manage during run-time to leverage business value metric & strategy info in augmented design-time models
3. Feed back monitored run-time information to improve/update design-time models
   - Linking all life-cycle stages with bi-directional information transfer, e.g., for impact analysis
   - New closed-control loops for adaptation

Conclusions and Discussion

Business Value Matters!

Conclusions – Business Value

- System management decisions should be done to maximize business value metrics
- Business value metrics are not only financial
- Business strategy determines relevant business value metrics
- Modeling of business value metrics and strategies is necessary for their run-time use

Conclusions – Our Past Research

- Addresses some (not all) of the challenges
- WS-Policy4MASC supports modeling of diverse business value metrics and strategies
- Our business value metric maximization algorithms prototyped in MASC, MiniMasc and MiniMASC+MiniZinc middleware
- UML profiles for WS-Policy4MASC bridge design-time and run-time adaptation

Questions?