Extending WS-Policy4MASC Language and MiniZnMASC Middleware with BMM Business Motivation

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ABSTRACT
The WS-Policy4MASC language and MiniZnMASC middleware enabled making IT system self-management decisions that maximize diverse business value metrics (e.g., profit, customer satisfaction). We now introduce their new extensions that use additional information about longer-term business ends (e.g., goals) and means (e.g., strategies), which are the key concepts from the Business Motivation Model (BMM) industrial standard for modeling business intent. Our new solutions enable making adaptation decisions that might not look best in the short-term, but lead to highest longer-term business value. This business view is a major advantage over works by other authors, which focused on maximizing technical metrics (e.g., availability). We evaluated our solutions by prototype implementation and experiments with it.

Categories and Subject Descriptors
K.6.4 [**Management of Computing and Information Systems**]: System Management

General Terms
Management.

Keywords
Business-driven IT management, business motivation model, dynamic adaptation, policy-driven management, self-management.

1. INTRODUCTION AND MOTIVATION
To improve alignment between IT systems and businesses, IT system management should maximize business value and be guided by business goals and strategies. A business value metric is a measure of business worth that is relevant to a business stakeholder. Both financial business value metrics (e.g., profit, return on investment), and non-financial business value metrics (e.g., market share, customer satisfaction) are important for businesses. While business users view technical quality of service (QoS) metrics (e.g., response time, availability) only as a means to achieve maximization of business value, the past IT system management solutions mostly focused on optimization of technical QoS metrics. The goal of business-driven IT management (BDIM) research [1] is to develop algorithms and architectures that make runtime IT system management decisions that maximize business value metrics. A common limitation of the past BDIM work is that it mostly focused on maximizing profit. However, human business managers use many business strategies and maximization of short-term profit is not always appropriate to achieve long-term business goals. Business motivation (aspects such as goals, strategies, competitive positioning) is a major differentiator of companies in a market, so it should be used by self-managing BDIM solutions for deciding how to adapt IT systems to runtime changes. Also, integration of autonomic computing and BDIM was identified in [1] as an area of open research challenges.

WS-Policy4MASC [2], our extension of the WS-Policy industry standard, is a policy language that can describe various adaptations of IT systems (particularly, service-oriented systems and business processes) and all information necessary for decision making. WS-Policy4MASC defined 5 new types of WS-Policy policy assertions: 1) goal policy assertions prescribe conditions to be met (e.g., desired response time); 2) action policy assertions list adaptation actions; 3) utility policy assertions contain financial and non-financial business metrics for particular situations; 4) probability policy assertions specify probabilities of occurrence; and 5) meta-policy assertions describe which business value metrics are important for adaptation decisions when several action policy assertions can be applied but only 1 has to be chosen.

Our MiniZnMASC [3] is middleware for autonomic BDIM. It implemented novel decision making algorithms that at runtime provide adaptation decisions depending on different business strategies and operational circumstances, in a way that achieves maximum overall business value while satisfying all given constraints. MiniZnMASC can also support traditional decision making that maximizes technical metrics, but the BDIM aspect is a major advantage over the past related work, which focused on maximization of technical QoS metrics with only limited support for profit-related business value metrics (if any). Our algorithms use information specified in WS-Policy4MASC policy assertions. They are triggered by data/events collected by external monitoring modules. To find globally optimal decisions when multiple adaptations should be done in parallel (e.g., when a change affects many business processes), MiniZnMASC uses the powerful constraint programming language MiniZinc and its free efficient constraint solver. The main self-management control loop is closed by external modules that execute the chosen adaptations. An additional internal self-management control loop adapts probability policy assertions based on historical values of monitored data.

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2. OUR NOVEL SOLUTIONS

The WS-Policy4MASC version from [2] had weak support for alignment with higher-level business considerations. Therefore, we decided to extend it with the key concepts from the Business Motivation Model (BMM) [4], an Object Management Group's (OMG) standard for specification of high-level business motivation and intent (plans) as input into design, development and execution of IT systems. The key concepts in BMM are the hierarchies of ends and means. Ends define what the organization aspires to achieve, while means specify the actions the organization will undertake to achieve the desired ends. Vision and desired result are types of ends. A vision is "an overall image" of the aspiration (it may not be fully or explicitly defined). Goals and objectives are types of desired results and they are more specific. A goal is a qualitatively defined desired result, while an objective is a discrete step towards achieving a goal and provides quantitative metrics measuring progress. Types of means are mission, course of action, and directive. Mission describes the broad ongoing operational activity of the organization. Courses of action define the actions the organization will undertake in terms of strategies (longer term, broadly scoped actions) and tactics (shorter term, narrowly scoped actions). Types of directives are business policies and business rules. While business policies define what can and cannot be done within means in a general sense and are not directly actionable, business rules provide specific actionable guidance but are defined externally to BMM.

An important characteristic of the mappings between BMM and WS-Policy4MASC constructs is that in several cases the same word is used with different meaning in the 2 languages. Most importantly, the term "policy" has substantially different meaning – WS-Policy4MASC policy assertions actually correspond to BMM business rules, while more abstract BMM business policies have no direct correspondence in WS-Policy4MASC. Another important example is that WS-Policy4MASC goal policy assertions correspond well to BMM objectives but not well to higher-level BMM goals. To resolve such terminological differences, we decided to remain within the terminology of WS-Policy4MASC, but add to policy assertions new attributes describing mapping to BMM constructs and also introduce new types of auxiliary constructs describing AND/OR hierarchies of ends and means. We mapped all BMM end constructs to WS-Policy4MASC goal policy assertions, which now have a new String attribute BMMEndsLevel with allowed values "Vision", "Goal", and "Objective". Similarly, WS-Policy4MASC action policy assertions was extended with a new String attribute BMMMeansLevel with possible values "Mission", "Strategy", and "Tactic". Default values "Objective" and "Tactic" support backward compatibility with the previous versions of WS-Policy4MASC. Impact of lower-level ends or means on higher-level ones is quantified through utility contribution weights, specified in the new construct for AND relationships between ends or means. When ends or means are connected through OR relationships, the corresponding new WS-Policy4MASC construct contains an attribute for probability of occurrence of each branch.

For MiniZnMASC to leverage this additional information about longer-term business ends and means, we developed new versions of the algorithm for business-driven selection among conflicting adaptation alternatives, which is used within the MiniZnMASC Policy Conflict Resolution module. The previous version of the algorithm [2][3] calculates summary business value metrics for each adaptation alternative (represented as an action policy assertion), based on WS-Policy4MASC utility and probability policy assertions. The rules about which types of business metrics are relevant in particular situations are specified in meta-policy assertions. We have now added that contribution to the overall business vision can be added (multiplied with some weight specified in the meta-policy assertion) to the summary business value metric for each adaptation alternative. The algorithm for calculation of the contribution to the overall business vision traverses the AND/OR hierarchy of ends and means, calculates the summary business value for each hierarchy node (using the old algorithm that does not consider long-term contribution), and applies utility contribution weights and occurrence probabilities to calculate the overall contribution to the business vision. This new algorithm enables choosing (when this is appropriate) an adaptation alternative that might not look best in the short-term, but gives highest value when longer-term contribution is taken into account.

The need for such adaptation decision making was discussed and illustrated on examples in [2]. The ICAC'11 poster will show another example illustrating our new solutions. In this new example, the conflicting adaptation options are 2 tactics of different BMM strategies. When BMM information is not used, the first tactic provides higher short-term business value. However, when the new algorithm uses business values of respective BMM strategies, the second tactic is of higher longer-term business value.

The new version of WS-Policy4MASC was coded in XML (Extensible Markup Language) Schema, its syntax correctness was verified using XML tools, and its semantic appropriateness was shown on examples. The new algorithms for decision-making were implemented in both C#/.NET and Java/J2EE to show feasibility and then tested for functional correctness. Using realistic examples and the Java prototype of the new MiniZnMASC version, we evaluated appropriateness of our solutions from the business viewpoint. Additionally, we checked on experiments that the impact of our extensions on performance and scalability of MiniZnMASC is low in scenarios of realistic complexity.

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4. REFERENCES

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