

A Monitoring Data Set for Evaluating QoS-Aware Service-Based Systems

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Abstract—Research in service-oriented computing traditionally struggles with the absence of public cases and data sets for evaluating and comparing research results. This is particularly evident for QoS-aware service-based computing, where public and widely accepted QoS traces would help to strengthen the fair comparison of QoS-aware automated composition and QoS prediction approaches. In this paper, we present one public data set produced for the evaluation of a contribution to the IEEE Transactions on Services Computing journal. We briefly introduce the background story of the use case and describe our monitored data set. We hope that this data set can serve as a basis for evaluation of future research papers from other authors.

Keywords—service-based computing; case study; data set; QoS

I. INTRODUCTION

One of the foundations of academic research is the potential for evaluation, comparison, discussion, and, ultimately, falsification of published results. However, since many years, this is only partially true for many papers published in the area of services computing, as often the described systems are not publicly available, and the results reported as part of paper evaluations are not easily reproducible. We argue that the field of Quality-of-Service (QoS) research particularly suffers from this problem, as it leads to a plethora of competing algorithms for QoS estimation, QoS-aware service composition and QoS-aware adaptation being published, without any means for fair numerical comparison. Ultimately, practitioners are unable to find the results most suitable to their needs, hampering the adoption of research results in industrial practice.

In this paper, we aim at providing a publicly available data set for evaluating and comparing QoS-related research, e.g., work related to QoS-aware service composition, QoS prediction, prediction of SLA violations or self-adaptive service-based systems. The data set has originally been used in the evaluation of a contribution to the highly visible IEEE Transactions on Services Computing (TSC) journal [1]. Even though the data set does not contain real production data, it still stems from a physically deployed test application (as compared to simply generating random QoS measures). We argue that the provided data set adds value as compared to existing ones [2], [3], as existing data sets often focus on the performance of single services, and less on non-functional attributes of business processes as a whole.

II. CASE STUDY DESCRIPTION

In this section, we briefly introduce the background story of the used case study. The following description is based on the case originally discussed in [1].

The case considers a reseller of built-on-demand heavy-duty industry robots (ACMEBOT). Customers request a quote for a specific robot in a specific configuration. ACMEBOT plans the steps necessary for the requested configuration, checks if necessary parts are not in the internal warehouse (these parts need to be ordered from external suppliers), and generates an offer. The customer can then either cancel or place the order. If the order is placed, ACMEBOT starts by getting all missing parts from external suppliers. As soon as all parts are available, the product is scheduled for assembling. After assembling is finished, the product is subject to a quality control step, and, if successful, shipped to the customer. In parallel to the shipping of the product, the customer is billed and an invoice is sent. ACMEBOT's core business process is depicted in Figure 1 (roughly following BPMN notation).

III. DATA SET DESCRIPTION

We have implemented parts of this case study based on the VRESCo SOA runtime environment [4], using .NET Windows Communication Foundation (WCF) technology. The implementation has been deployed on a server running Windows 2007 SP2 (64 bit). The server machine was equipped with 2 2.99GHz Xeon X5450 processors and 32 GByte RAM. We used a MySQL 5 database as a data backend, and deployed all necessary components on the same server machine to reduce the impact of external aspects such as network latency on our results. We implemented the case using Windows Workflow Foundation. The current Sourceforge version of VRESCo¹ already contains this example project, and can be studied by the interested reader. We provide some details on how to setup the case study online². This web page also contains more details on the technical realization of the case. From this implementation, we monitored a data set of almost 10000 composition instances using the VRESCo event engine. This data is also available online³. The composition instances in this

¹<http://sourceforge.net/projects/vresco/>

²<http://www.infosys.tuwien.ac.at/prototypes/VRESCo/experimentation>

³<http://www.infosys.tuwien.ac.at/staff/leitner/dataset.arff>

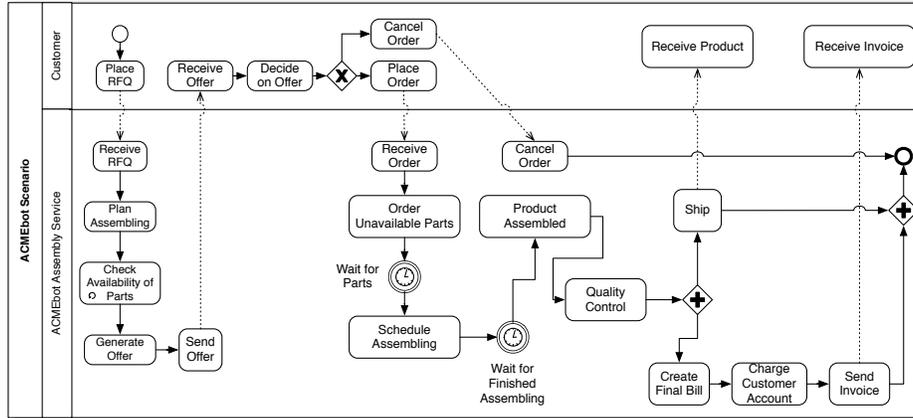


Figure 1. High-Level Scenario Illustration (Originally Published in [1])

data set were created by repeatedly triggering the service composition with varying parameterizations and levels of parallelization over the course of approximately three hours. In the data set, some instances have been executed exactly as defined, while one or more adaptations (e.g., invoking one of the base services with higher priority) have been applied to others. Adaptations have been selected at random, i.e., no concrete predicted performance problem has led to these adaptations. Please find some base information about that data set in Table I.

Table I
DATA SET BASE STATISTICS

# of Instances (Total)	9848
# of Instances (Not Adapted)	3660
# of Instances (Adapted)	6188
# of Attributes	89
# of Activities of Monitored Composition	45
# of Service Invocation Activities	23
Mean Process Duration	36208 ms
Process Duration Standard Deviation	6227 ms

The data set is formatted in WEKA ARFF format⁴, so that the data can be loaded easily using the WEKA machine learning toolkit. Every line in the data set is a single composition instance. Lines are whitespace-separated list of attribute values. Some values contain whitespace themselves, these are enclosed with ' '. The special character ? identifies a missing attribute value. The first value in each row is an UUID identifying the instance. The following values are various metrics, which can be monitored from the running instance, such as response times of services, the ordered product, the duration of subbranches, and similar. From these values, the most interesting is the first attribute (DELIVERY_TIME), which represents the duration of the process instance as a whole. The boolean attributes at the end of each line are indicators of whether a given adaptation

action has been applied to this instance. 1 indicates that this action has been applied, 0 that it has been skipped. The concrete semantics of each adaptation are implementation-specific, and cannot be described here for reasons of brevity. More information on each attribute is provided inline.

IV. ONGOING WORK

We are currently collaborating with experts within the S-Cube Network of Excellence [5] to align our case study implementation (and, in turn, the data set) more with industrial practice. We plan to also make all future versions of the data set publicly available via our web page, just like the current incarnation.

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⁴<http://www.cs.waikato.ac.nz/ml/weka/arff.html>