



UNIVERSITI PUTRA MALAYSIA

**SIZE AND COMPLEXITY METRICS AS INDICATORS OF
MAINTAINABILITY OF BUSINESS PROCESS EXECUTION
LANGUAGE PROCESS MODELS**

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MAINTAINABILITY OF BUSINESS PROCESS EXECUTION
LANGUAGE PROCESS MODELS



By

GEOFFREY MUCHIRI MUKETHA

Thesis Submitted to the School of Graduate Studies, Universiti Putra
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DEDICATION

Dedicated to my dear wife Joan Nkatha, my lovely kids Brian Kobia and Faith Kinya, and to my ever caring parents Julie and Simon Muketha.



Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Doctor of Philosophy

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One of the most popular process modeling languages is the Business Process Execution Language (BPEL). Despite the popularity, BPEL process models have an inherent complexity. This complexity keeps on increasing with age as a result of maintenance routines. Structural properties of BPEL process models such as size and complexity are claimed to influence maintainability factor of the process models.

In the past, researchers have applied measurement to quantify the size and complexity of process models and thereafter utilized the measurement results to modify or to enhance the quality of the models. The problem with BPEL process measurement is that very few valid metrics exist that can be

used for BPEL process models. Although several validation studies have been carried out, these were based on other language environments other than BPEL. To generalize the results of these studies to BPEL process models might be inaccurate, especially that BPEL has richer semantics than most other business process modeling languages. In addition, many of the existing validation studies did not focus on the external quality characteristic of maintainability, which makes it difficult to assess the value of the validated metrics as maintainability indicators for BPEL process models.

To address this problem, this thesis proposes a suite of size and complexity metrics for measuring the structural properties of BPEL process models and then investigates whether these metrics can be useful indicators of the maintainability of BPEL process models. Theoretical validation studies based on Briand's framework and Weyuker's properties were conducted to find out whether the metrics were theoretically sound as required. Empirical studies by means of experimentations were also conducted to find out whether the metrics had any correlation with maintainability sub-characteristics of understandability and modifiability.

Theoretical validation results indicate that the metrics satisfy the two theoretical frameworks at acceptable levels in their respective categories. Experimental results were also significant for all proposed metrics, which means that these metrics are highly correlated to maintainability sub-

characteristics of understandability and modifiability. This shows that the proposed size and complexity metrics can be useful as indicators of the maintainability of BPEL process models.



Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

METRIK SAIZ DAN KOMPLEKSITI SEBAGAI INDIKATOR
KEBOLEHSENGGARAAN MODEL PROSES BAHASA PELAKSANAAN
PROSES URUSAN

Oleh

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Salah satu daripada bahasa pemodelan proses yang popular ialah Business Process Execution Language (BPEL). Walaupun bahasanya popular, model proses BPEL mempunyai kompleksiti terwujud. Kompleksiti model proses BPEL sentiasa bertambah dengan meningkatnya usia sebagai hasil rutin penyenggaraan. Sifat struktur model proses BPEL dipercayai mempengaruhi faktor kebolehsenggaraan model proses.

Pada masa lalu, penyelidik telah mengaplikasi pengukuran untuk mengkuantitikan saiz dan kompleksiti model proses dan selepas itu menggunakan keputusan pengukuran untuk mengubahsuai atau menambah kualiti sesuatu model. Masalah dengan pengukuran proses BPEL ialah

kewujudan hanya sedikit metrik yang sah yang boleh diguna untuk model proses BPEL. Walaupun terdapat beberapa kajian pengesahan dijalankan, ianya berdasarkan ke atas persekitaran bahasa selain daripada BPEL. Membuat generalisasi keputusan kajian tersebut ke atas model proses BPEL mungkin tidak tepat, terutamanya BPEL adalah kaya dengan semantik berbanding dengan kebanyakan bahasa pemodelan proses urusan yang lain. Tambahan pula, banyak kajian pengesahan yang sedia ada tidak memfokus kepada ciri kualiti luaran penyenggaraan, yang menyukarkan untuk menaksir nilai metrik yang disahkan sebagai indikator penyenggaraan model proses BPEL.

Untuk mengatasi masalah ini, tesis ini mencadangkan satu suit metrik saiz dan kompleksiti untuk mengukur sifat struktur model proses BPEL dan kemudiannya menyiasat sama ada metrik tersebut berguna sebagai indikator penyenggaraan model proses BPEL. Kajian pengesahan bersifat teori berdasarkan rangka Briand dan sifat Weyuker dilaksanakan untuk mengetahui sama ada metrik tersebut dari segi teorinya baik seperti yang dikehendaki. Kajian empirik dengan menggunakan eksperimen juga dilaksanakan untuk mengetahui sama ada metrik tersebut mempunyai sebarang korelasi dengan sub-ciri penyenggaraan iaitu kebolehfahaman dan kebolehubahsuaian.

Keputusan pengesahan bersifat teori menunjukkan metrik tersebut memenuhi kedua-dua rangka bersifat teori pada aras yang boleh diterima dalam kategori masing-masing. Keputusan eksperimen juga signifikan untuk semua metrik yang dicadangkan, bermakna metrik tersebut sangat berkorelasi dengan sub-ciri penyenggaraan iaitu kebolehfahaman dan kebolehubahsuaian. Ini menunjukkan bahawa metrik saiz dan kompleksiti yang dicadangkan berguna sebagai indikator penyenggaraan model proses BPEL.

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Finally, I wish to thank all my friends for the many fruitful discussions that we shared together.



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APPROVAL

I certify that a Thesis Examination Committee has met on 25 August 2011 to conduct the final examination of Geoffrey Muchiri Muketha on his thesis entitled “Size and Complexity Metrics as Indicators of Maintainability of Business Process Execution Language Process Models” in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The committee recommends that the student be awarded the degree of Doctor of Philosophy.

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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.



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Date: 25 August 2011

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