NEW COMPLEXITY WEIGHTS FOR FUNCTION POINT ANALYSIS USING ARTIFICIAL NEURAL NETWORKS

By

MOHAMMED ABDULLAH HASAN AL-HAGRI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

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Dedicated to my Parents; Abdullah and Neammh,

to my wife and

my kids; Ammar and Afnan,

to my family.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirements for the Degree of Doctor of Philosophy

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Chairman: Associate Professor Abdul Azim Abdul Ghani, Ph.D.

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Function points are intended to measure the amount of functionality in a system as described by a specification. Function points are first proposed in 1979 and currently they are known as the International Function Points User Group (IFPUG) version 4.1. Function points are computed through three steps. The first step is counting the number of the five components in a system which are external inputs, external outputs, external inquiries, external files, and internal files. The second step is assigning a complexity weight to each of the components using weighting factors that are established according to the ordinal scale: simple, average, or complex. The last step is determining 14 technical complexity factors. Although, function points are widely used, they still have limitations.

Function points suffer from problem with subjective weighting in the second step since the weights used may not be appropriate. The weights are derived from IBM experience. Besides that, the calculation of function points combines measures from an ordinal scale with counts that are on a ratio scale, thus the linear combinations of the calculation are

inconsistent with the measurement theory. As a result, the function points measure used in estimation will produce inaccurate estimates.

This thesis proposes new complexity weights for the function points measure by modifying the original complexity weights using artificial neural network algorithm. Particularly the Back Propagation algorithm is employed to derive the proposed complexity weights. The complexity weights derived are established according to an absolute scale which is much more flexible and suitable.

The real industrial data sets assembled by the International Software Benchmarking Standard Group are used for comparison between the function point measure obtained using the original complexity weights and proposed complexity weights. The results obtained by proposed complexity weights show improvement in software effort estimation accuracy. The results also show reduction of the error margins in effort estimation where the ratio of average error in using the original complexity weights and the proposed complexity weights is 65% to 35% respectively.

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

PEMBERAT KOMPLEKSITI BAHARU UNTUK ANALISIS MATA FUNGSI DENGAN MENGGUNAKAN RANGKAIAN NEURAL BUATAN

Oleh

MOHAMMED ABDULLAH HASAN AL-HAGRI

October 2004

Pengerusi: **Profesor Madya Abdul Azim Abdul Ghani, Ph.D.**

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Function Points bertujuan untuk mengukur amaun kefungsian dalam suatu sistem yang dihuraikan oleh spesifikasi. *Titik Fungsi* mula dicadangkan pada tahun 1979 dan sekarang ini dikenali sebagai *International Function Points User Group (IFPUG)* versi 4.1. *Function Points* dikira melalui tiga langkah. Langkah pertama adalah pengiraan bilangan lima komponen sistem iaitu input luaran, output luaran, pertanyaan luaran, fail luaran, dan fail dalaman. Langkah kedua adalah mengumpukkan pemberat kompleksiti ke setiap komponen dengan menggunakan faktor pemberat yang ditetapkan mengikut skala ordinal *simple, average,* atau *complex*. Langkah terakhir penentuan 14 faktor kompleksiti teknikal. Walaupun *Function Points* digunakan secara meluas, ianya masih mempunyai batasan.

Function Points mengalami masalah dengan pemberatan subjektif dalam langkah kedua oleh kerana pemberat yang digunakan mungkin tidak sesuai. Pemberat diperoleh daripada pengalaman IBM. Selain daripada itu, pengiraan *Function Points* menggabungkan ukuran daripada skala ordinal dengan bilangan yang berskala nisbah, dengan yang demikian kombinasi linear pengiraan tidak konsisten dengan teori

pengukuran. kesannya, ukuran *Function Points* yang digunakan dalam penganggaran akan mengeluarkan anggaran yang tidak tepat.

Tesis ini mencadangkan pemberat kompleksiti baharu untuk ukuran *Function Points* menerusi pengubahsuaian pemberat kompleksiti asal dengan menggunakan algoritma rangkaian neural buatan. Secara khususnya, algoritma *Back Propagation* digunakan untuk menerbitkan pemberat kompleksiti cadangan. Pemberat kompleksiti yang diterbitkan ini ditetapkan menuruti skala mutlak yang lebih fleksibel dan sesuai.

Set data sebenar industri yang dihimpun oleh *International Software Benchmarking Standard Group* digunakan untuk perbandingan antara ukuran *Function Points* yang dihasilkan menerusi penggunaan pemberat kompleksiti asal dan cadangan. Keputusan yang dihasilkan oleh pemberat kompleksiti cadangan menunjukkan pembaikan dalam ketepatan penganggaran keupayaan perisian. Keputusan juga menunjukkan pengurangan margin ralat dalam penganggaran keupayaan dengan nisbah purata ralat dalam penggunaan pemberat kompleksiti asal dan cadangan adalah masing-masing 65% ke 35%.

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MOHAMMED ABDULLAH HASAN AL-HAGRI
October 2004

I certify that an Examination Committee met on 26/10/2004 to conduct the final examination of Mohammed Abdullah Hasan Al-Hagri on his Doctor of Philosophy thesis entitled "New complexity weights for Function Point Analysis using Artificial Neural Networks" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

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MOHAMMED ABDULLAH HASAN AL-HAGRI

Date :26/10/2004

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