UNIVERSITEIT VAN PRETORIA
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Towards an ontology-driven software development approach: An unended quest

by

Nehemiah Mavetera

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Declaration

I, Nehemiah **Mavetera,** declare that:

Towards an ontology-driven software development approach: An unended quest which I hereby submit for the degree of Doctor of Philosophy in Information Technology at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at this or any other tertiary institution.

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Signature of candidate

This 10th day of November, 2011.

Preface

"There is no royal road, but there is a road"

Fredrick, P. Brooks, 1987

It is common knowledge that software development projects more often than not, have missed their schedules, are out of budget or result in flawed products. A plethora of software development methods have been proposed and used. These can be classified abstractly as structured methodologies, object-oriented methodologies and, lastly, as a more recent invention, agile methodologies.

To support these methodologies, several methods, techniques and tools have been developed and used. All these were roads that were developed and used in an attempt to get to the end, but they are not royal roads. As is common in a methodological scientific way of solving a problem, the first step leads to the second, and the future step should be preceded by the current step. All these methodologies have brought the software development process to its current state and it is at this stage that we need to evaluate the successes achieved so far and, in certain cases, the failures too. In the end, we need to find a software development approach and methodology that suits the requirements of the future.

'Towards an ontology-driven software development approach: An unended quest' is a research study motivated by the lack of return on investment in current information systems. The root cause of this lack of return on investment is attributed to the way in which software products are developed. Software practitioners have adopted and used industrial engineering principles to fashion software products. Unlike the process of fashioning machines, the fashioning of software products requires an appreciation of the human element that is always present and resident in organizational information systems.

Failure to incorporate the humanistic element in the development process will lead to the resultant products being mechanistic, rule-based and no better than machines. A new road that fosters a transition from the development of mechanistic software products to the development of romantic software products is proposed in this thesis. Briefly, romantic systems are implemented using romantic software products. These are systems that imitate the way human beings behave in organizational information systems. They understand the organizational culture, context, capture tacit and intuitive knowledge among other things. Starting from the classical definition of ontology as a study of existence, the growth and incorporation of such ontology to new uses that focus on "*What is there that we can*

individuate and characterize?", a new software development approach is proposed. This research study presents a new framework that can be used to develop software products that exhibit human behavioural characteristics and that are both adaptable and evolvable.

Abstract

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Nehemiah Mavetera

Over the years the field of software development has undergone a series of mutations, particularly in the types of approaches and methodologies that are applied during the development process. One thing that has not been fully achieved by software development method engineers is to move the development process completely from the mechanistic functionalist paradigm to a neo-humanist romantic paradigm. Although many researchers claim to have introduced new development paradigms in software development, these are merely new methodologies that are grounded in old paradigms. There are three fundamental development approaches that lie in the hard systems approach: the traditional structured, object-oriented and the recently invented agile approaches that have been widely adopted by software practitioners. Few of these practitioners have embraced the soft systems approach and their development methods have not migrated from the syntactic processes of the hard-systems approach.

Another problem that software developers continue to face is a lack of a method or tool that can augment current syntactic programming language technologies and software development methods by the addition of semantic-based tools to facilitate the construction of romantic, adaptive and evolvable software products. In fact, most of the problems encountered in software development can be attributed to deficiencies in the methodologies, that is: the approaches, methods, techniques and tools used during the development of the software product. This research study introduces the concept of ontologies in software development and motivates for an ontology-driven approach to software development that reduces the mechanistic nature of software products but increases their adaptability and usability.

Although current industrial and academic research has focused at the semantic properties of ontologies in software development, researchers have not considered how the methodological process can be designed and used to develop romantic software products. This research study used one variant of GTM and followed an interpretive approach in the investigation of several issues that are known and documented but not addressed by the current software development approaches. The field of software development has been investigated and a framework of requirements that enables the development of romantic

systems is presented. The ontology discipline, focusing on the semantic, pragmatic and contextual characteristics of ontologies, was also consulted. Starting from a set of differentiated ontological frameworks and from the syntactic, semantic and pragmatic nature of ontologies, the research then presents a framework of ontologies that can be co-opted into a software development approach to address the deficiencies in current software development approaches highlighted in the framework of software development requirements.

As part of the research findings, a new definition of ontology, as well as a framework of components that make up the ontology and a theoretical translation model that is needed to develop romantic software products, are presented. The theoretical translation model comprises three parts: an ontology-driven software development framework, an ontological approach to software development and an ontology-based methodology for software development. Of note is the use of domain, method, process, intentional, and status ontologies at different stages of software development to cater for the semantic, pragmatic and contextual gaps that are not currently addressed by existing development approaches. However, in this study, a balance is reached between addressing the needs of current and future developers of software products, that is, one that reacts to an urgent market need, as well as addressing a software development approach need that is heavily grounded in the softer, neo-humanist paradigm.

KEYWORDS

Software development, Framework, Approach, Methodology, Romanticism, Ontology.

To

My Late Parents, Nehemiah (Snr.), Gamuchirai and Wife, Tsungai Mavetera

and

My Lovely Wife, Chipo Gertrude and my children

Samantha, Patience, Kudzai Rejoice, Tinotenda and Kudzanai Nehemiah (Jnr.)

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And, lastly,

Thank You, Almighty God, for With You Nothing is Impossible.

Matthew 19, verse 26

This thesis, *Towards an ontology-driven software development approach: An unended quest,* by Mr. Nehemiah Mavetera, was edited for language, grammar and style by Ciaran Michael Mac Carron MA, Hons. BSc, who has been a member of the South African Translators' Institute for over 25 years and has had over 25 years' experience in the editing and translation of theses, manuals etc.

Signed

C M Mac Carron

20 August 2010

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