MOBMAS

- A Methodology For Ontology-Based Multi-Agent Systems Development

by

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CERTIFICATE OF ORIGINALITY

I hereby declare that this submission is my own work and to the best of my knowledge it contains no material previously published or written by another person, nor material which to a substantial extent has been accepted for the award of any other degree or diploma at The University of New South Wales or any other educational institution, except where due acknowledgement is made in the thesis. Any contribution made to the resarch by others, with whom I have worked at The University of New South Wales or elsewhere, is explicitly acknowledged in the thesis.

I also declare that the intellectual content of this thesis is the product of my own work, except to the extent that assistance from others in the project's design and conception or in style, presentation and linguistic expression is acknowledged.

Quynh Nhu Tran

ABSTRACT

"Agent-based systems are one of the most vibrant and important areas of research and development to have emerged in information technology in the 1990s" (Luck et al. 2003). The use of agents as a metaphor for designing and constructing software systems represents an innovative movement in the field of software engineering: "*Agent-Oriented Software Engineering* (AOSE)" (Lind 2000; Luck et al. 2003).

This research contributes to the evolution of AOSE by proposing a *comprehensive ontology-based methodology for the analysis and design of Multi-Agent Systems* (MAS). The methodology is named **MOBMAS**, which stands for **"*M*ethodology for *O*ntology-*B*ased *MAS*s"**. A major improvement of MOBMAS over the existing agent-oriented MAS development methodologies is its explicit and extensive **support for *ontology-based* MAS development**. Ontologies have been widely acknowledged for their significant benefits to interoperability, reusability, MAS development activities (such as system analysis and agent knowledge modelling) and MAS operation (such as agent communication and reasoning). Recognising these desirable ontology's benefits, MOBMAS endeavours to identify and implement the various ways in which ontologies can be used in the *MAS development process* and integrated into the *MAS model definitions*. In so doing, MOBMAS has exploited ontologies to enhance its *MAS development process* and *MAS development product* with various strengths. These strengths include those ontology's benefits listed above, and those additional benefits uncovered by MOBMAS, e.g. support for verification and validation, extendibility, maintainability and reliability. Compared to the numerous existing agent-oriented methodologies, MOBMAS is the first that explicitly and extensively investigates the diverse potential advantages of ontologies in MAS development, and which is able to implement these potential advantages via an ontology-based MAS development process and a set of ontology-based MAS model definitions.

Another major contribution of MOBMAS to the field of AOSE is its ability to address all key concerns of MAS development in one methodological framework. The methodology provides support for a comprehensive list of methodological requirements,

which are important to agent-oriented analysis and design, but which may not be well-supported by the current methodologies. These methodological requirements were identified and validated by this research from three sources: the existing agent-oriented methodologies, the existing evaluation frameworks for agent-oriented methodologies and conventional system development methodologies, and a survey of practitioners and researchers in the field of AOSE. MOBMAS supports the identified methodological requirements by combining the strengths of the existing agent-oriented methodologies (i.e. by reusing and enhancing the various strong techniques and model definitions of the existing methodologies where appropriate), and by proposing new techniques and model definitions where necessary.

The process of developing MOBMAS consisted of three sequential research activities. The first activity *identified and validated a list of methodological requirements for an Agent Oriented Software Engineering methodology* as mentioned above. The second research activity *developed MOBMAS* by specifying a development process, a set of techniques and a set of model definitions for supporting the identified methodological requirements. The final research activity *evaluated and refined MOBMAS* by collecting expert reviews on the methodology, using the methodology on an application and conducting a feature analysis of the methodology.

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LIST OF ABBREVIATIONS

ACL	Agent Communication Language
AOSE	Agent-Oriented Software Engineering
BDI	Belief-Desire-Intention agent architecture
BDIM	Methodology for BDI agents
HLIM	Methodology with High-Level and Intermediate levels
MAS	Multi-Agent System
MEI	Methodology for Enterprise Integration
OCL	Object Constraint Language
OO	Object Oriented
P2P	Peer to peer
PC	Program Committee
SDLC	System Development Lifecycle
UML	Unified Modelling Language
UCM	Use Case Map