

## MASTER'S THESIS

### Ontological model for information systems development methodology

Yeung, Chung Kei

*Date of Award:*  
2006

[Link to publication](#)

#### General rights

Copyright and intellectual property rights for the publications made accessible in HKBU Scholars are retained by the authors and/or other copyright owners. In addition to the restrictions prescribed by the Copyright Ordinance of Hong Kong, all users and readers must also observe the following terms of use:

- Users may download and print one copy of any publication from HKBU Scholars for the purpose of private study or research
- Users cannot further distribute the material or use it for any profit-making activity or commercial gain
- To share publications in HKBU Scholars with others, users are welcome to freely distribute the permanent URL assigned to the publication

# **Ontological Model for Information Systems Development Methodology**

YEUNG Chung Kei

A thesis submitted in partial fulfillment of the requirements

for the degree of

Master of Philosophy

Principle Supervisor: Dr. Chan, Stephen Lai Chung

Hong Kong Baptist University

Feb 2006

## **Abstract**

The Information Systems Development Methodologies (ISDM) is applied for providing methods and skills of developing an information system. Although there are many methodologies, there is a need of new methodologies for meeting different problem situations and requirements. In this thesis, we propose a new approach and explanation on ISDM that is developed from a strong philosophical foundation of ontology. In order that the philosophical views can be translated into practice, we also proposed steps to follow for system implementation. More specifically, we propose a step which we call Systems Establishment, to be followed with our Function, Operation, and Procedure nexus. It can be utilized by less experienced system developers as the details in each step require more mechanical implementation than creativity.

Our proposed ontological model for ISDM provides a new approach to explain the ISDM. The ontology views the information system as the reality which can be described and explained for its existence, specification, and structure. The perceived situations of the people are also taken into consideration, which assist to define the nature and get acceptance of the system. The reconciliation of the perceptions is also suggested for improving the coherence and performance of the resulting system. The extraction of information from the people's perceptions is also emphasized. The information identified can be fully utilized for providing details of the system. Less effort on creativity is required, which reduce the difficulties and increase the efficiency when developing the system. As a conclusion, we have provided a new approach and added some additional elements and characteristics into the model for describing an ISDM.

This thesis is divided into three parts. The first part is to study the fundamental knowledge on the ISDM, systems concepts and systems thinking, and ontology. The study of these topics provides the basic knowledge on the areas that we research. The second part is to propose our Ontological Model on the ISDM. The details of our approach are described and explained. Several theories are applied, such as perceived situation, reconciliation, and information extraction. The third part is then the illustration of our proposed model to show how it works.

# Table of Contents

	Page
Declaration.....	i
Abstract.....	ii
Acknowledgements.....	iii
Table of Contents.....	iv
List of Tables.....	viii
List of Figures.....	x
Overview.....	1
Chapter 1 Introduction to Information Systems Development Methodology (ISDM) .	4
1.1 Introduction.....	4
1.2 Information System and Its Development Methodology.....	5
1.3 The Evolution of ISDM.....	6
1.4 The Foundation of ISDM.....	7
1.4.1 The Definitions of ISDM.....	7
1.4.2 The Concepts in ISDM.....	10
1.4.3 The Realization of Information System by Using ISDM.....	12
1.5 The Essential Factors for ISDM.....	14
1.6 The Benefits of Using ISDM.....	16
1.7 Conclusion.....	18
Chapter 2 Systems Concepts and Systems Thinking.....	19
2.1 Introduction.....	19
2.2 Systems Concepts.....	19
2.2.1 Emergence and Hierarchy.....	20
2.2.2 Communication and Control.....	22
2.3 Systems Thinking.....	22
2.3.1 What is Systems Thinking?.....	23
2.3.2 Introduction to Hard Systems Thinking.....	24
2.3.3 Introduction to Soft Systems Thinking.....	25
2.3.4 Characteristics of Hard and Soft Systems Thinking.....	26
2.3.5 A Contingency Approach.....	29
2.3.6 Examples of Different Types of Systems Thinking.....	31
2.4 Conclusion.....	34

Chapter 3	Introduction to Ontology .....	35
3.1	Introduction.....	35
3.2	Literature Survey on the Definitions of Ontology .....	36
3.3	The Characteristics and Comparison of Three Perspectives of Ontology .....	38
3.4	The Integration of Three Perspectives of Ontology in ISDM .....	42
3.4.1	The Integration of Three Perspectives of Ontology.....	43
3.4.2	Application of Three Perspectives of Ontology in ISDM .....	44
3.5	Conclusion .....	46
Chapter 4	Understanding the ISDMs by Using Ontological Model.....	48
4.1	Introduction.....	48
4.2	Overview of Ontological Model .....	49
4.2.1	Systems Establishment .....	50
4.2.2	Systems Definition and Specification.....	53
4.2.3	Systems Construction .....	55
4.3	Applications of Ontological Model in ISDMs.....	56
4.4	Special Characteristics of Ontological Model .....	59
4.4.1	Characteristics of Systems Establishment .....	59
4.4.2	Characteristics of Systems Definition and Specification.....	62
4.5	Implications of the Ontological Model .....	64
4.6	Conclusion .....	65
Chapter 5	Systems Establishment .....	67
5.1	Introduction.....	67
5.2	Situations to define Perceptions – Rationale and Overview.....	68
5.2.1	Five W’s and One H .....	69
5.2.2	Improvement on the Root Definition and Conceptual Model of SSM .....	70
5.2.3	Literature Survey on Definition of Situation .....	72
5.3	Contents of Situation Definition .....	74
5.3.1	Factors for Abstracting Situation .....	75
5.3.2	Elements for Specifying the Factors .....	78
5.3.3	Initial System Hierarchy Formation .....	82
5.4	Summary of Situation Definition.....	83
5.5	Sufficiency of Situation Definition for Systems Definition and Specification ..	85
5.5.1	Mapping of Situation Definition to Olle’s Framework .....	86
5.5.2	Mapping of Situation Definition to SSM.....	88
5.6	Implementation of Systems Establishment.....	93
5.6.1	Identifying the Situation Definitions Perceived by Related Parties.....	93
5.6.1.1	Introduction of Waterfall Model and Spiral Model .....	94
5.6.1.2	Guidance for Defining Situation Definitions.....	96
5.6.1.3	The Advantages of Using the Models in Defining the Situations .....	103
5.6.2	Guidance for Defining the Elements in Situation Definition .....	104
5.6.2.1	Formats of the Elements .....	104
5.6.2.2	The Numbering of the Elements in Situation Definitions .....	105

5.6.3	Reconciling the Perceptions.....	106
5.6.3.1	The Need for Reconciling the Perceptions .....	108
5.6.3.2	The Classifications and Definitions of Contradiction and Contradiction-Free.....	109
5.6.3.3	The Resolution of Contradicted and Contradiction-Free Perceptions ..	111
5.6.3.4	Resolution of Contradicted Perceptions .....	113
5.6.3.5	Resolution of Common and Similar Perceptions.....	115
5.6.3.6	The Resulting Perceptions .....	119
5.6.3.7	The Significance of Our Work on Reconciliation of Perceptions .....	119
5.7	Conclusion .....	120
Chapter 6 Systems Definition and Specification.....		123
6.1	Introduction.....	123
6.2	Elements in Systems Definition and Specification.....	124
6.2.1	Review the Definition of Information System.....	124
6.2.2	Information System Development Architecture .....	126
6.2.3	Standard Elements for Describing the Process and Data.....	127
6.2.4	Methods for Modeling the System in Systems Definition and Specification .....	131
6.3	Transforming from Systems Establishment to Systems Definition and Specification .....	132
6.3.1	Functions, Operations, and Procedures Approach.....	132
6.3.2	Suitability of Functions, Operations, and Procedures Approach for Systems Establishment Transformation .....	133
6.3.3	Mapping of Situation Definition to Functions, Operations, and Procedures .....	135
6.4	Steps for Systems Definition .....	136
6.4.1	Extracting Keywords for Retrieving the Requirements.....	136
6.4.1.1	Benefits of Using Keywords.....	137
6.4.1.2	Methods for Keywords Extraction.....	137
6.4.1.3	Extracting Verb Phrases, Nouns, and Noun Phrases for Retrieving the Main Idea from the Situation Definitions .....	138
6.4.2	Extracting the Requirements from Situation Definitions .....	139
6.4.3	Deliverable after the Extraction .....	142
6.5	Steps for Systems Specification.....	142
6.5.1	Steps for Logical Design.....	143
6.5.2	Steps for Technical Design .....	147
6.6	Significance of Systems Definition and Specification .....	148
6.7	Conclusion .....	149

Chapter 7	Systems Construction .....	151
7.1	Introduction.....	151
7.2	Realization of Database .....	151
7.3	Realization of Menu.....	152
7.4	Realization of Triggers .....	154
7.5	Realization of System Programs.....	156
7.6	Conclusion .....	157
Chapter 8	An Illustration of Using Ontological Model for ISDM .....	158
8.1	Case Description .....	158
8.2	Systems Establishment .....	159
8.2.1	Identifying the Situation Definitions Perceived by Related Parties.....	159
8.2.2	Reconciling the Perceptions.....	165
8.3	Systems Definition and Specification.....	171
8.3.1	Extracting the Processes and Rules from the Finalized Situation Definitions and Ordering the Processes by Sequence .....	171
8.3.2	Extracting the Data from the Situation Definitions and Identifying the Useless and Redundancies Information .....	171
8.3.3	Identifying the Entities, Attributes, and Values.....	178
8.3.4	Identifying the Mandatory Data.....	180
8.3.5	Identifying the Relationship and Cardinalities between Entities.....	180
8.3.6	Specifying the Data Format .....	183
8.3.7	Identifying the Manipulation for the Procedures .....	183
8.4	Systems Construction .....	188
Chapter 9	Conclusion and Future Work.....	189
	List of References .....	193
	Curriculum Vitae .....	209