

TABLE OF CONTENTS

INDEX OF FIGURES.....	<i>xxi</i>
INDEX OF TABLES	<i>xxv</i>
PART I INTRODUCTION.....	27
CHAPTER 1 INTRODUCTION	29
1.1. MOTIVATION.....	30
1.2. OBJECTIVES OF THE THESIS	32
1.3. RESEARCH METHODOLOGY OF THE THESIS.....	33
1.4. STRUCTURE OF THE THESIS	34
PART II STATE OF THE ART	37
CHAPTER 2 SOFTWARE ARCHITECTURES.....	39
2.1. SOFTWARE ARCHITECTURES IN THE SOFTWARE LIFE CYCLE.....	40
2.2. PROPERTIES OF SOFTWARE ARCHITECTURES	41
2.3. DEFINITION OF SOFTWARE ARCHITECTURE.....	44
2.4. MAIN CONCEPTS OF SOFTWARE ARCHITECTURES	47
2.4.1. Component	47
2.4.2. Connector	49
2.4.3. Port	52
2.4.4. Connection.....	52
2.4.5. System	53
2.4.6. Composition Relationship	53
2.4.7. Architectural Style.....	53
2.4.8. View	55
2.4.9. Property and Constraint.....	56
2.5. CONCLUSIONS.....	56
CHAPTER 3 ASPECT-ORIENTED SOFTWARE DEVELOPMENT.....	59
3.1. AOP: ASPECT-ORIENTED PROGRAMMING.....	61
3.1.1. Base Code.....	64
3.1.2. Join Point.....	64
3.1.3. Pointcut.....	65
3.1.4. Advice	65
xiv	
3.1.5. Aspect.....	66
3.1.6. Properties.....	66
3.1.6.1. Weaving Time	66
3.1.6.2. Instantiation of aspects	67
3.1.6.3. Data Type Systems	67
3.1.6.4. Aspect Management	68
3.1.6.5. Semantics.....	68
3.2. ASPECT-ORIENTED MODELS	69
3.2.1. Symmetric vs. Asymmetric Models	69
3.2.2. Multi-Dimensional Separation of Concerns (MDSOC)	70
3.2.3. Composition Filters (CF).....	72
3.3. ASPECT-ORIENTED DEVELOPMENT IN THE SOFTWARE LIFE CYCLE.....	74
3.3.1. Requirements.....	75
3.3.2. Analysis and Design.....	78
3.3.3. Implementation.....	80
3.4. CONCLUSIONS.....	82
CHAPTER 4 ASPECT-ORIENTED SOFTWARE ARCHITECTURES...85	
4.1. ASPECT-ORIENTED APPROACHES AT THE ARCHITECTURAL LEVEL.....	86

4.1.1. PCS: The Perspectival Concern-Space Framework.....	87
4.1.2. CAM/DAOP: Component-Aspect Model/Dynamic Aspect-Oriented Platform.....	88
4.1.3. Superimposition.....	90
4.1.4. TRANSAT.....	91
4.1.5. ASAAM: Aspectual Software Architecture Analysis Method	92
4.1.6. AVA: Architectural Views of Aspects	93
4.1.7. AspectLEDA.....	94
4.1.8. AOCE: Aspect-Oriented Component Engineering.....	95
4.1.9. Component Views	96
4.1.10. Aspectual Components	97
4.1.11. Caesar	97
4.1.12. JASCO.....	98
4.1.13. FUSEJ	99
4.1.14. JAC.....	100
4.1.15. JIAZZI	100
4.2. COMPARISON OF ASPECT-ORIENTED SOFTWARE ARCHITECTURES.....	101
4.3. CONCLUSIONS.....	107
PART III PRELIMINARIES	109
xv	
CHAPTER 5 PRELIMINARIES	111
5.1. TELEOPERATION SYSTEMS: THE TEACHMOVER ROBOT	111
5.1.1. The Tele-operation Domain.....	112
5.1.2. The TeachMover Robot.....	113
5.1.2.1. The morphology of the TeachMover Robot	113
5.1.2.2. The Software Architecture of the TeachMover Robot.....	115
5.2. FORMALISMS.....	117
5.2.1. Modal Logic of Actions.....	117
5.2.2. π - Calculus	118
5.2.2.1. Main Concepts of π -calculus	119
5.2.2.2. PRISMA dialect of π -calculus.....	120
5.3. CONCLUSIONS.....	124
PART IV PRISMA.....	127
CHAPTER 6 THE PRISMA MODEL	129
6.1. INTRODUCTION TO THE PRISMA MODEL	129
6.2. PRISMA FORMALIZATION	134
6.2.1. Interface.....	134
6.2.2. Service.....	135
6.2.3. Played_Role.....	137
6.2.4. Aspect.....	138
6.2.5. Port	142
6.2.6. Weaving	143
6.2.7. Architectural Element.....	152
6.2.8. Connector	152
6.2.9. Component	154
6.2.10. Attachment	154
6.2.11. Binding.....	159
6.2.12. System.....	164
6.3. CONCLUSIONS.....	167
CHAPTER 7 THE PRISMA METAMODEL.....	171
7.1. THE PRISMA METAMODEL.....	172
7.2. THE PACKAGE “TYPES”	173
7.2.1. The Package “Interfaces”	173
7.2.2. The package “Aspects”.....	175
7.2.2.1. The package “Attributes”.....	178
7.2.2.2. The package “Services”.....	180

7.2.2.3. The package “Constraints”	181
7.2.2.4. The package “Preconditions”.....	182
7.2.2.5. The package “Valuations”	183
7.2.2.6. The package “PlayedRoles”.....	184
xvi	
7.2.2.7. The package “Protocols”	185
7.2.3. The package “ArchitecturalElements”	186
7.2.4. The package “Weaver”.....	189
7.2.5. The package “Components”	190
7.2.6. The package “Connectors”	191
7.2.7. The package “Attachments”	192
7.2.8. The package “Systems”.....	194
7.2.9. The package “Bindings”.....	195
7.2.10. The package “Ports”	197
7.3. THE PACKAGE “ARCHITECTURE SPECIFICATION”.....	198
7.4. THE PACKAGE “COMMON”	200
7.5. CONCLUSIONS.....	203
CHAPTER 8 THE PRISMA ASPECT-ORIENTED ARCHITECTURE DESCRIPTION LANGUAGE.....	205
8.1. THE TYPE DEFINITION LEVEL	206
8.1.1. Interface.....	206
8.1.2. Aspects	207
8.1.2.1. Attributes	209
8.1.2.2. Services.....	211
8.1.2.3. Valuations.....	214
8.1.2.4. Preconditions	217
8.1.2.5. Constraints	218
8.1.2.6. Transactions.....	219
8.1.2.7. Played_Roles	222
8.1.2.8. Protocols	223
8.1.3. Simple Architectural Elements: Components and Connectors	227
8.1.4. Attachments.....	230
8.1.5. Systems.....	231
8.2. THE CONFIGURATION LEVEL	237
8.3. CONCLUSIONS.....	239
PART V THE PRISMA FRAMEWORK	243
CHAPTER 9 THE PRISMA CASE	245
9.1. GRAPHICAL MODELLING TOOL.....	247
9.1.1. PRISMA UML Profile	247
9.1.2. Domain-Specific Language Tools (DSL Tools).....	249
9.1.3. PRISMA as a Domain-Specific Language	252
9.1.4. The PRISMA Modelling Tool.....	256
9.1.4.1. The Graphical AOADL of PRISMA	256
9.1.4.2. Verification of PRISMA Models.....	263
9.2. MODEL COMPILER.....	264
xvii	
9.2.1. Components.....	266
9.2.2. Aspects	267
9.3. CONFIGURATION MODEL	271
9.4. PRISMANET	275
9.4.1. PRISMANET Architecture.....	275
9.4.2. PRISMA model implementation	279
9.4.2.1. Asynchronous executions	280
9.4.2.2. Aspects	281
9.4.2.3. Simple Architectural Elements: Components and Connectors	284
9.4.2.4. Communication: Attachments and Bindings	290
9.4.2.5. Complex Architectural Elements: Systems.....	294
9.4.3. Memory Persistence	295
9.4.4. Transaction Manager	296

9.4.5. Log	299
9.5. CONCLUSIONS.....	300
CHAPTER 10 THE PRISMA METHODOLOGY.....	303
10.1. STAGES OF THE PRISMA METHODOLOGY.....	304
10.1.1. First Stage: Detection of Architectural Elements and Aspects	304
10.1.1.1. Identification of Architectural Elements.....	304
10.1.1.2. Identification of Crosscutting Concerns	305
10.1.2. Second Stage: Software Architecture Modelling.....	305
10.1.2.1. Interfaces	307
10.1.2.2. Aspects	307
10.1.2.3. Simple Architectural Elements	308
10.1.2.4. Systems.....	308
10.1.2.5. Configuration of Software Architectures.....	309
10.1.3. Third Stage: Code Generation and Execution.....	310
10.2. INTEGRATION OF COTS IN PRISMA.....	310
10.3. CONCLUSIONS.....	311
PART VI CONCLUSIONS AND FURTHER RESEARCH.....	315
CHAPTER 11 CONCLUSIONS AND FURTHER RESEARCH.....	317
11.1. CONCLUSIONS.....	317
11.2. FURTHER RESEARCH	327
BIBLIOGRAPHY.....	331
APPENDIX A.....	359
A. PRISMA AOADL SYNTAX.....	359
A.1. ARCHITECTURAL MODEL.....	360
xviii	
A.2. INTERFACES	360
A.3. ASPECTS.....	360
A.3.1. Attributes	361
A.3.2. Services.....	362
A.3.3. Preconditions	362
A.3.4. Transactions.....	362
A.3.5. Constraints.....	363
A.3.6. Played_Roles.....	364
A.3.7. Protocol	364
A.4. COMPONENTS	365
A.5. WEAVINGS.....	365
A.6. PORTS.....	366
A.7. CONNECTORS.....	366
A.8. ATTACHMENTS.....	366
A.9. SYSTEMS	367
A.10. CONFIGURATION.....	369
A.11. COMMON ELEMENTS.....	371
A.11.1. DataTypes	371
A.11.2. Parameters	371
A.11.3. Formulae	371
A.11.4. Conditions	372
A.11.5. Arithmetic Expressions.....	372
A.11.6. Functions.....	373
A.11.7. Processes.....	373
APPENDIX B THE PRISMA UML PROFILE	375
B.1. CORRESPONDENCES BETWEEN PRISMA CONCEPTS AND UML CONCEPTS.....	376
B.2. PRISMA UML PROFILE	377
B.2.1. Aspect	377

B.2.2. Component.....	378
B.2.3. Port	379
B.2.4. Protocol	380
B.2.5. Weaving.....	380
B.2.6. Attachment.....	381
B.2.7. Binding	381
APPENDIX C.....	383
C. PRISMA SOFTWARE ARCHITECTURE OF THE TEACHMOVER	
383	
C.1. COMMON.....	383
C.2. INTERFACES	384
C.3. ASPECTS.....	385
C.4. ARCHITECTURAL ELEMENTS	389
C.5. CONFIGURATION	392
ACRONYMS.....	395
INDEX.....	397