

1. Introduction	1
1.1 Motivation	3
1.2 Problem Statement	5
1.3 Thesis Goals	6
1.4 Research Methodology	8
1.5 Thesis Context	10
1.6 Thesis Structure	11
2. Background	13
2.1 Business Process Modeling	14
2.2 Software Variability Modeling	19
2.3 Software Patterns	22
2.3.1 Organizational patterns	23
2.3.2 Architectural patterns	24
2.3.3 Idioms	27
2.3.4 Analysis patterns	27
2.3.5 Design patterns	30
2.4 Conclusions	32
3. State of the Art	33
3.1 Business Process Variability Modeling	35
3.1.1 Process perspectives	35
3.1.2 Process lifecycle	36
3.1.3 Process variability approaches	38
3.2 Software Variability Modeling Patterns	40
3.2.1 Single, Multiple, and Option patterns	41
3.2.2 Patterns for evolving event-based systems	42
3.3 Business Process Modeling Patterns	44
3.3.1 Workflow patterns	44
3.3.2 Patterns for business process change	53
3.4 Discussion	58
3.5 Conclusions	61
4. VIVACE: Process Variability Characterization	63
4.1 Research Questions Formulation	65
4.2 The VIVACE Framework	68
4.2.1 Languages for Modeling Business Process Variability	70
4.2.2 Techniques for Modeling Process Variability in a Configurable Process Model	71
4.2.3 Language Constructs for Process Variability	74
4.2.4 Covered Process Perspectives	78
4.2.5 Existing Tools for Managing Process Variability	79
4.2.6 Variability Support Features	80
4.2.7 Empirical Evaluation of Process Variability Approaches	89
4.2.8 Application Domains	90
4.2.9 Aspects Cutting Across VIVACE Aspects	91
4.3 VIVACE in Practice	92
4.3.1 Applying VIVACE to Configurable EPC	92

4.3.2	Applying VIVACE to Provop	95
4.3.3	Applying VIVACE to PESOA	98
4.3.4	Summary of the Evaluation	101
4.4	Discussion	103
4.5	Comparison with Other Characterizations	107
4.6	Conclusions	109
5.	Variability Management in Process Families through Change Patterns	111
5.1	CP1: Insert Configurable Region	113
5.2	CP2: Delete Configurable Region	116
5.3	CP3: Insert Configuration Alternative in a Configurable Region	119
5.4	CP4: Delete Configuration Alternative from a Configurable Region	120
5.5	CP5: Insert Configuration Context Condition of a Configuration Alternative ..	121
5.6	CP6: Delete Configuration Context Condition of a Configuration Alternative .	123
5.7	CP7: Modify Configuration Context Condition of a Configuration Alternative .	124
5.8	CP8: Insert Configuration Constraint Between Configuration Alternatives . . .	125
5.9	CP9: Delete Configuration Constraint Between Configuration Alternatives ..	126
5.10	CP10: Modify Configurable Region Resolution Time . .	127
5.11	Conclusions	1276
6.	Case Study	129
6.1	Context	130
6.2	Research Questions	133
6.3	Case Selection and Data Collection	133
6.4	Results	140
6.5	Discussion	143
6.6	Validity	146
6.7	Conclusions	146
7.	Validation with PAIS engineers.	149
7.1	Research Questions	150
7.2	Subject Selection	151
7.3	Validation Design	151
7.4	Data Collection Procedure	152
7.5	Results	156
7.6	Discussion	159
7.7	Validity	162
7.8	Conclusions	163
8.	Conclusions and Future Work.	165
8.1	Contributions	166
8.2	Publications	167
8.2.1	Main publications	167
8.2.2	Other publications	170
8.3	Research Collaborations	172
8.4	Future work	173
	Bibliography	175
	Appendices	195
	A Check-in Process	197
	B Procedure of the Systematic Study Regarding Process Variability	201

B.1 Research Questions Formulation	202	
B.2 Search String	203	
B.3 Data Source Selection	204	
B.4 Inclusion and Exclusion Criteria	206	
B.5 Quality Assessment	207	
B.6 Study Selection	207	
B.7 Data Extraction Strategy	210	
B.8 Data Analysis	213	
B.9 Statistics of the Primary Studies	213	
B.10 Comparison with other Reviews	216	
C Validation with PAIS engineers		217
C.1 Demographic Survey	217	
C.2 Material Provided for the Tasks	220	
C.2.1 Instructions for the validation	220	
C.2.2 Basic training	221	
C.2.3 Familiarization task 1	223	
C.2.4 Familiarization task 2	225	
C.2.5 Modeling task 1 without CP4PF	227	
C.2.6 Modeling task 2 with CP4PF	230	
D Cheetah Experimental Platform		233
D.1 Design of CEP	233	
D.2 Extension of CEP	234	
D.3 Analysis in CEP	235	