

Contents

Foreword	V
Acknowledgements	VII
Abstract	IX
List of Figures	XV
List of Tables	XIX
1 Introduction	1
1.1 Motivation	1
1.2 Solution Approach	3
1.3 Scientific Contribution	4
1.4 Overview	5
I Foundations	7
2 Software Architecture	9
2.1 Software Architecture Basics	9
2.2 Detailed Design	14
2.3 Architectural Styles	15
2.4 Architecture Metrics	19
2.5 Architectural Erosion	21
3 Software Evolution and Modernisation	23
3.1 Reengineering	25
3.2 Migration	26
3.3 Reverse Engineering	27
3.4 Architecture Reconstruction	30
3.5 Restructuring	37

4	Graph Clustering	45
4.1	Graphs	45
4.2	Graph Clusterings	45
4.3	Clustering Algorithms	47
4.4	Applications of Graph Clustering	51
5	Model-Driven Software Development	55
5.1	Modelling Concepts	56
5.2	Model Transformations	59
5.3	Architecture in Model-Driven Software Development	60
5.4	Interoperability Metamodels for Reengineering	62
5.5	Model-Driven Reengineering Approaches	67
II	Clustering-Based Support for Software Architecture Re- structuring	71
6	MARE Approach	73
6.1	Problem Description	73
6.2	Application Scenarios	74
6.3	Goals of MARE	77
6.4	Research Questions	79
6.5	Definitions	81
7	MARE Method	83
7.1	Embedding in the Reengineering Process	84
7.2	MARE Clustering Activities	101
7.3	MARE Metamodels	108
7.4	Summary	116
8	MARE Clustering	119
8.1	Goals and Criteria of the Clustering	119
8.2	Target-Architecture-Driven Clustering	121
8.3	Impact of Dependencies on the Clustering	131
8.4	Arbitrary Decisions	133
8.5	Result Validation	136
8.6	Summary	142

III Evaluation	145
9 Evaluation Methods	147
9.1 Goals of the Evaluation	147
9.2 GQM Plan	149
10 Case Studies	157
10.1 Preliminary Case Study	157
10.2 Open Source Case Study	164
10.3 Industrial Case Study	186
10.4 Summary	194
11 Related Work	197
11.1 Architecture Restructuring	197
11.2 Architecture Reconstruction	200
11.3 Alternatives to Hierarchical Clustering	206
11.4 Summary	208
IV Conclusion	211
12 Results	213
12.1 MARE Method	213
12.2 MARE Clustering Algorithm	215
12.3 Evaluation	216
13 Future Work	219
13.1 Automated Restructuring of the Implementation	219
13.2 Definition of Cohesion for Coarse-Grained Modules	220
13.3 Further Evaluation of MARE	220
14 Concluding Remarks	223
Bibliography	225