

TABLE OF CONTENT

Preface	I
Abstract.....	III
Table of Content	V
List of Abbreviations and Symbols	VII
1 Introduction and Motivation.....	1
1.1 Task of Process Industries	2
1.2 Trends affecting Process Industries	2
1.3 Challenges and the Role of Simulation for Process Industries	5
1.4 Research Questions.....	7
1.5 Thesis Structure.....	8
1.6 Publications	10
2 Definitions and Background.....	11
2.1 Definitions	11
2.2 Purpose of Simulation.....	13
2.3 Types of Simulation	14
2.4 Levels of Abstraction for Simulation Models	17
2.5 Process Plant Life-Cycle.....	20
2.6 Simulation within the Plant Life-Cycle	24
3 Methodology	33
4 Status Quo: Role of Simulation within the Plant Life-Cycle	37
4.1 Methodology	37
4.2 Online Survey Results.....	38
4.2.1 Survey Background	38
4.2.2 Statistical Basis	40
4.2.3 Survey Results	41
4.3 The Status Quo – Summary	48
5 Vision: Integrated use of Simulation within the Plant Life-Cycle.....	51
5.1 Online Survey Results.....	51

5.2	The Vision – Summary.....	56
6	Roadmap: Enable the integrated use of Simulation.....	59
6.1	Methodology.....	59
6.2	Requirements from Simulation Use Cases	60
6.3	Requirements from Fields of Actions	61
6.4	Requirements Overview	64
6.5	The Roadmap.....	67
7	Prototype: Towards the integrated use of Simulation	71
7.1	Methodology.....	71
7.2	New Workflow with integrated Simulation	71
7.3	Foundations for Prototypical Implementation	74
7.3.1	Example used.....	74
7.3.2	Tools used.....	74
7.3.3	Requirements selected.....	77
7.4	Details of the technical Implementation	81
7.4.1	Software-in-the-Loop	81
7.4.2	Hardware-in-the-Loop	82
7.4.3	Device Models	82
7.4.4	Automatic Model Generation	83
7.4.5	Model reuse and Co-Simulation	87
7.4.6	Operator Training.....	88
7.4.7	3D-Operator Training	89
7.5	New User Experience	90
7.6	The Prototype – Summary.....	91
8	Discussion of Results	93
9	Summary and Outlook	99
	Bibliography.....	101