## **Contents**

1	Introduction			
	1.1	Motivation and problem statement		
	1.2	Objectives and work structure		
	References			
2	Factory systems and life cycle thinking in manufacturing			
	2.1	Life cycle thinking in manufacturing	10	
		2.1.1 Life cycle thinking and life cycle concepts	10	
		2.1.2 Life cycle engineering, life cycle management and life cycle		
		planning	12	
	2.2	Factory systems and the environmental impact of manufacturing	15	
		2.2.1 Systems theory	15	
		2.2.2 Factory systems and factory elements	16	
		2.2.3 Production management and factory planning	21	
		2.2.4 The factory life cycle	23	
		2.2.5 Environmental impact of factory systems	25	
	2.3	Preliminary findings	27	
	Refe	rences	29	
3	State	e of research	36	
	3.1	Delimitation of adjacent fields of research and selection of relevant research		
		approaches	36	
	3.2	Definition of evaluation criteria	39	
	3.3	Review of relevant research approaches	41	
		3.3.1 Cluster "factory life cycle"	41	
		3.3.2 Cluster "factory modeling"	44	
		3.3.3 Cluster "factory planning"	46	
		3.3.4 Cluster "evaluation"	48	
		3.3.5 Cluster "life cycle management"	52	
	3.4	Discussion of the review and derivation of research demand	54	
	References			
4	Concept for life cycle planning of factory systems			
	4.1	Common understanding of the factory life cycle	62	
	4.2	Derivation of users, objectives and requirements	64	



		4.2.1 Action areas and decision s	ituations of a life cycle planning conc	ept		
		for factory systems		64		
		4.2.2 Synthesis of users and their	needs	68		
		4.2.3 Concretization of objective	s and analysis of requirements	70		
	4.3	Concept overview		71		
	4.4	Modeling & simulation		74		
		4.4.1 Factory system decomposit	ion	75		
		4.4.1.1 Factory system pe	erspective	75		
		4.4.1.2 Life cycle perspec	etive	77		
		4.4.2 Generic modeling of the fa	ctory life cycle behavior	80		
		4.4.2.1 Parametric model	ing of the life cycle behavior mechani	ism –		
		degraded		85		
		4.4.2.2 Parametric model	ing of the life cycle behavior mechani	ism –		
		inferior		86		
		4.4.2.3 Parametric model	ing of the life cycle behavior mechani	ism –		
		unsuitable		88		
		4.4.2.4 Parametric model unwanted	ing of the life cycle behavior mechani	ism – 90		
		4.4.2.5 Parametric model	ing of the ideal-typical life cycle			
		environmental perfo	rmance of factory elements	91		
		4.4.3 Life cycle oriented process	chain modeling	94		
	4.5	Visualization & evaluation		95		
		4.5.1 Analysis of life cycle relate	-	96		
		4.5.2 Layer model of life cycle e	nvironmental impacts	97		
		4.5.3 Break-even analysis		101		
	Refe	rences		102		
5	Prof	Prototypical concept implementation 10				
-	5.1	Overview of the prototypical imp	lementation	105		
	5.2	Implementation of visualizations		106		
	5.3	Implementation of the factory life	cycle dashboard	108		
	Refe	rences	•	110		
6	Exe	Exemplary applications 11				
	6.1	Life cycle planning of a battery c	ell factory	112		
	6.2	Life cycle planning of a cranksha		121		
	Refe	rences	•	125		
7	Sum	mary, critical review and outlool	·	127		
,	7.1					
	7.2	Critical review		128		
	7.3	Outlook		130		
	Refe	rences		132		