Table of contents

Table of contents IX

Figures XIII

Tables XVII

Abbreviations XIX

1 Introduction 1

1.1 Research problem 1

1.2 Research question and objectives 4

1.3 Research strategy and method 6

1.4 Outline of the thesis 7

2 Innovation, innovation process and the front end of innovation 11

2.1 Definitions, classifications and situations for innovation management 11

2.1.1 Classifications of innovations and R&D projects 12

2.1.2 Situations for innovation management 18

2.2 Dimensions of innovation 22

2.2.1 Strategic dimension of innovation and innovation strategies 22

2.2.2 Technological dimension of innovation 24

2.2.3 Market dimension of innovation 27

2.3 Literature review of process models of the front end of innovation 30

2.3.1 Models of the innovation process and the role of the front end 31

2.3.2 Conceptualizations focussing on the front end of innovation 34

2.3.2.1 Sequential models of the front end of innovation 40

2.3.2.2 Dynamic model of the front end of innovation 43

2.3.2.3 Decision making-model as a simplistic approach for the front end 45

2.4 The front end – idea generation 47

2.4.1 Methods for sensing sources of project ideas 49

2.4.2 Internal sources of project ideas 52

2.4.3 External sources of project ideas 55

2.5 The front end – idea evaluation and selection 59

2.5.1 Evaluation methods 60

2.5.2 Evaluation dimensions 65

2.6 Critical review of the extant literature of the front end of innovation 73

3 Industry convergence as a context for the front end of innovation 75
3.1 Industry convergence 75
3.2 Patterns of industry convergence 78
3.2.1 Technology-driven input-side convergence 81
3.2.2 Market-driven output-side convergence 82
3.3 Industry convergence - a particular context for the front end of innovation 84
3.3.1 Particularities of innovations in converging industry segments 86
3.3.2 Particularities regarding idea generation 90
3.3.3 Particularities regarding idea evaluation and selection 91

4 Conceptual framework and research design to assess the front end in converging industries 93
4.1 Conceptual framework: reasoning and theoretical basis 93
4.1.1 Resource-based view as basis for the conceptual framework 94
4.1.1.1 Core competence approach 98
4.1.1.2 Dynamic capabilities approach and absorptive capacity 100
4.1.2 Toward a contingent RBV to account for the context of convergence 105
4.1.3 Deduction and characterization of the conceptual framework 107
4.1.3.1 Items for typology-building of R&D projects 107
4.1.3.2 Framework to assess front end decisions 113
4.2 Empirical research: methods and data collection 114
4.2.1 Research method: mixed-method approach 114
4.2.2 Data collection and analysis designs for multi-method research 118
4.2.2.1 Sampling logic and unit of analysis 119
4.2.2.2 Collection of qualitative and quantitative data 121
4.2.2.3 Qualitative data analysis 124
4.2.2.4 Quantitative data analysis and combination with qualitative findings 127

5 Empirical analysis of the front end in converging industries 131
5.1 Industry convergence – the case of the emerging NFF-sector 131
5.1.1 Technological context of the NFF-development 139
5.1.2 Market context of the NFF-development 143

5.1.3 Regulatory context of the NFF-sector 147
5.1.3.1 Regulation in the European Union and in Germany 148
5.1.3.2 Regulation in the U.S. 156
5.1.3.3 Regulation in Canada 159
5.1.3.4 Comparison of Regulation in the EU, the U.S. and Canada 164
5.1.4 General innovation strategies in the NFF-sector 166
5.2 The sample – description and identification of different project types 167
5.2.1 Description of the sample collected in the Province of Quebec, Canada 168
5.2.2 Problem areas and barriers to innovation in the NFF-sector 170
5.2.3 Identification of generic R&D types and different innovation strategies 176
5.3 Qualitative data analysis of the front end in converging industries 189
5.3.1 Sources of ideas - results of qualitative analysis 190
5.3.2 Evaluation and selection of ideas - results of qualitative analysis 196
5.3.3 Differences according to project types – findings of qualitative analysis 209
5.4 Quantitative data analysis of the front end in converging industries 217
5.4.1 Descriptive statistics – overview on general project differences 217
5.4.2 Sources of ideas – results quantitative analysis 227
5.4.3 Evaluation and selection of ideas – results of quantitative analysis 236
5.4.3.1 Analysis of general group differences on evaluation dimension level 237
5.4.3.2 Analysis of group differences on the evaluation criteria level 240
5.5 Overview on empirical findings and Hypotheses building 252

6 Discussion of findings and implications for theory and practise 255
6.1 Discussion of R&D project types and implications for the RBV-theory 255
6.2 Discussion of type-specific front end decision making and implications for innovation management research 261
6.3 Managerial implications for the front end in general and for the NFF-sector 273

7 Conclusion 285

Appendices 291

References 313