

Klaus Moser

Mass Customization Strategies

**Development of a competence-based framework
for identifying different mass customization
strategies**



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Klaus Moser

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Contents

Acknowledgements	V
List of figures	XI
1 Introduction, research questions and research process	1
1.1 Introduction to mass customization	1
1.2 The conception of mass customization in the academic literature and in practice	4
1.3 Objectives and research questions	8
1.4 Research process overview.....	10
2 Theoretical framework	14
2.1 Classification of organizations	14
2.2 Organization theory	17
2.3 Organizational systematics framework.....	23
2.4 Organizational systematics and the resource-based view (RBV) .	31
2.5 Theoretical framework for the literature reviews	34
2.5.1 General framework	34
2.5.2 Theoretical framework for literature review of mass customization classification.....	36
2.5.3 Theoretical framework for literature review of mass customization competencies	38
3 Literature reviews	42
3.1 Mass customization classifications	42
3.2 Mass customization competencies	52
4 Empirical research design	63
4.1 Case study research	65
4.1.1 Introduction to case study research.....	66
4.1.2 Case study research in management research.....	66
4.1.3 Forms of case study research.....	68
4.1.4 Stages of case study research	69
4.1.5 The industry research group: A new form of case study research	72
4.1.5.1 Evaluation of existing industry research groups	72
4.1.5.2 Action research	76
4.1.5.3 Framework for doing research with an industry research group	77

4.2	The international mass customization casebook project: Research stages	84
4.2.1	Getting started	84
4.2.2	Selecting cases	85
4.2.3	Crafting instruments.....	86
4.2.4	Entering the field.....	88
4.2.5	Documenting data	88
4.2.6	Analyzing data.....	89
4.2.7	Enfolding literature	92
4.2.8	Reaching closure.....	92
4.3	The industry research group project: Research stages	93
4.3.1	Defining the research objective and scope.....	94
4.3.2	Recruiting the industry research group.....	97
4.3.3	Crafting instruments.....	100
4.3.4	Holding the industry research group meetings.....	101
4.3.5	Documenting data	105
4.3.6	Analyzing data.....	106
4.3.6.1	Content analysis technique	106
4.3.6.2	Theoretical framework for identifying the dominant competencies for mass customization.....	107
4.3.6.3	Coding of empirical data.....	108
4.3.6.4	Scheme for evaluating the empirical data	109
4.3.6.5	Empirical data for the identification of the dominant competencies.....	110
4.3.6.6	A preliminary set of mass customization competencies.....	111
4.3.7	Enfolding literature	121
4.3.8	Mass customization case studies from the industry research group project	122
5	Empirical data: Mass customization case studies.....	123
5.1	121TIME.....	124
5.2	Adidas	125
5.3	APC.....	126
5.4	Audi.....	127
5.5	BMW.....	128
5.6	Delance.....	129
5.7	Design&MC Lab.....	130
5.8	Deutsche Telekom.....	131
5.9	F.L.Smith	132
5.10	Left foot	133
5.11	MarelliMotori.....	134
5.12	Selve.....	135
5.13	Steppenwolf.....	136
5.14	Turo Tailor.....	137

6	Data analysis: Dominant competencies for mass customization..	138
6.1	Identification and description of the eight dominant competencies for mass customization	139
6.1.1	Customer integration	141
6.1.2	Application of product configuration systems	145
6.1.3	Employment of product modularity.....	149
6.1.4	Product variant management.....	154
6.1.5	Central production and logistics planning	159
6.1.6	Management of mass and individual production.....	161
6.1.7	Management of flexible organization and processes.....	165
6.1.8	Process documentation and IT support.....	168
6.2	Evaluation of the results.....	172
6.2.1	Model of the eight dominant competencies for mass customization.....	172
6.2.2	Comparison with academic literature	175
6.2.3	Evaluation from the perspective of organizational classification	184
7	Mass customization strategies.....	187
7.1	Study by Spring & Dalrymple: Roles of customization.....	188
7.2	Empirical investigation of mass customization strategies.....	190
7.2.1	Application of Spring & Dalrymple's typology	190
7.2.2	Extension of Spring & Dalrymple's typology	192
7.2.3	Seven mass customization strategies	193
8	Discussion: A mass customization typology.....	196
8.1	Seven mass customization strategies and eight dominant competencies for mass customization: Model of a mass customization typology	196
8.2	Comparison with academic literature.....	205
9	Conclusions and limitations	209
9.1	Results	209
9.1.1	Results regarding the study of the research questions in this work	209
9.1.2	Results regarding the research design and collection of mass customization case studies	212
9.2	Limitations of this research and indications for further research	213
9.3	Management implications.....	217
9.3.1	Mass customization as a business strategy for every organization.....	217
9.3.2	Beyond the eight dominant competencies: Change management	219
9.3.3	Analysis scheme for classifying mass customization organizations.....	220

Appendix.....	222
Appendix 1: Internet search on the understanding of mass customization ..	222
Appendix 2: Applied search terms for the literature reviews	224
Appendix 3: Companies investigated in the casebook project	225
Appendix 4: Case outline for the casebook project.....	226
Appendix 5: Members of the industry research group (overview)	227
Appendix 6: Members of the industry research group (details)	228
Appendix 7: Workshop participants of the industry research group.....	229
Appendix 8: Meeting rhythm of the industry research group	230
Appendix 9: Empirical data of the industry research group	231
Appendix 10: Model of a mass customization typology.....	244
References.....	245
Index	277

List of figures

Figure 1.	Management consulting practices covering the field of mass customization	3
Figure 2.	Research interest in mass customization.....	4
Figure 3.	Definition of the term mass customization.....	6
Figure 4.	Research process and structure of this work.....	13
Figure 5.	Work presenting taxonomies and typologies.....	17
Figure 6.	Overview of classical management theories	18
Figure 7.	Overview of human relations theories	19
Figure 8.	Overview of the contingency theory	20
Figure 9.	Overview of population ecology/organizational evolution..	21
Figure 10.	Overview of new institutional economics	22
Figure 11.	Basic theories of organizational classification	24
Figure 12.	Basic theories, concepts and terms of McKelvey's framework	29
Figure 13.	Existing research applying organizational systematics	31
Figure 14.	Definition of the term competence	33
Figure 15.	Definition of the term strategy.....	34
Figure 16.	Framework for the literature reviews of this work.....	35
Figure 17.	Analysis scheme for the literature review of existing classification studies	38
Figure 18.	Porter's generic value chain and areas of competencies	39
Figure 19.	Mass customization value chain and seven areas of competencies	40
Figure 20.	Analysis scheme for the literature review of competencies..	41
Figure 21.	Results from the literature review (classifications).....	47
Figure 22.	Results from the literature review (competencies).....	54
Figure 23.	Results from an extended literature review (competencies)..	61
Figure 24.	Research agenda of this work.....	65
Figure 25.	Studies utilizing case study research in the mass customization field	68
Figure 26.	Forms of case study research.....	69
Figure 27.	Empirical research design of this work	69
Figure 28.	Process of conducting case study research	70
Figure 29.	Process of conducting case study research in the context of the casebook project.....	71
Figure 30.	Definition of industry research group	72
Figure 31.	Identified industry research groups in management research	75
Figure 32.	Management research using the group interview technique	80
Figure 33.	Process of conducting research with an industry research group	83
Figure 34.	Companies examined in the casebook project.....	86

Figure 35.	Researchers involved in the casebook project.....	87
Figure 36.	Overview of the applied case outline.....	89
Figure 37.	Method for shaping hypotheses on the types of mass customization	91
Figure 38.	Defined research objective and project plan.....	96
Figure 39.	Communicated benefits expected from the joint research project	97
Figure 40.	Process of recruiting the industry research group.....	98
Figure 41.	Breakdown of the number of participants per meeting	102
Figure 42.	Example of a typical meeting agenda.....	103
Figure 43.	Model of the meetings' structure.....	104
Figure 44.	Online portal for collecting and distributing project material	106
Figure 45.	Basic scheme for identifying dominant competencies.....	108
Figure 46.	Evaluation scheme for the identification of the dominant competencies	110
Figure 47.	A preliminary set of mass customization competencies.....	112
Figure 48.	Fourteen mass customization case studies applied in this work	123
Figure 49.	The eight dominant competencies for mass customization..	140
Figure 50.	Explanation of customer integration	141
Figure 51.	The Turo Tailor case study and customer integration.....	144
Figure 52.	The Adidas case study and customer integration.....	145
Figure 53.	Definition of product configuration (systems).....	146
Figure 54.	The F.L.Smidth case study and application of product configuration systems.....	148
Figure 55.	The APC case study and application of product configuration systems	149
Figure 56.	Definition of modularity.....	150
Figure 57.	Definitions of build-to-order and postponement	151
Figure 58.	The Left foot case study and employment of product modularity	153
Figure 59.	The BMW case study and employment of product modularity	154
Figure 60.	Basic understanding of product variant management and product variety	155
Figure 61.	The Left foot case study and product variant management	158
Figure 62.	The Audi case study and product variant management	159
Figure 63.	The Adidas case study and central production and logistics planning	161
Figure 64.	The Turo Tailor case study and management of mass and individual production	163
Figure 65.	The BMW case study and management of mass and individual production	164

Figure 66.	The Steppenwolf case study and management of flexible organization and processes	167
Figure 67.	The Left foot case study and process documentation and IT support	170
Figure 68.	The 121TIME case study and process documentation and IT support	171
Figure 69.	The eight dominant competencies in relation to the information cycle of mass customization: The model of the eight dominant competencies for mass customization.....	174
Figure 70.	Comparison of the empirical results with the study by Haddock et al. 2005	179
Figure 71.	Comparison of the empirical results with the study by Kotha 1996a	180
Figure 72.	Comparison of the empirical results with the study by Peters/Saidin 2000	181
Figure 73.	Comparison of the empirical results with the study by Blecker et al. 2005	183
Figure 74.	The Spring/Dalrymple typology	189
Figure 75.	Fourteen case studies classified according to the Spring/Dalrymple typology	191
Figure 76.	The Spring/Dalrymple typology extended and applied to 14 case studies	193
Figure 77.	The seven mass customization strategies.....	194
Figure 78.	Fourteen case studies classified applying the two primary strategies	195
Figure 79.	Underlying logic for the development of a mass customization typology	196
Figure 80.	Model of a mass customization typology.....	198
Figure 81.	Classification of mass customization business examples.....	205
Figure 82.	Management implications	217
Figure 83.	Analysis scheme for classifying organizations as mass customization businesses and for determining the degree of mass customization (schematic).....	221
Figure 84.	First Internet search on the understanding of mass customization	222
Figure 85.	Second Internet search on the understanding of mass customization	223
Figure 86.	Applied search terms for the literature reviews (classification)	224
Figure 87.	Applied search terms for the literature review (competencies)	224
Figure 88.	Companies investigated in the casebook project	225
Figure 89.	Case outline for the casebook project	226
Figure 90.	Members of the industry research group (overview).....	227
Figure 91.	Members of the industry research group (details)	228
Figure 92.	Workshop participants of the industry research group.....	229
Figure 93.	Meeting rhythm of the industry research group	230

Figure 94.	Citations by workshop participants (data of competencies 1-3)	231
Figure 95.	Citations by workshop participants (data of competencies 4-6)	232
Figure 96.	Citations by workshop participants (data of competence 7)	233
Figure 97.	Citations by workshop participants (data of competencies 8-9)	234
Figure 98.	Citations by workshop participants (data of competencies 10-12)	235
Figure 99.	Citations by workshop participants (data of competence 13)	236
Figure 100.	Citations by workshop participants (data of competence 14)	237
Figure 101.	Citations by workshop participants (data of competence 15)	238
Figure 102.	Citations by workshop participants (data of competencies 16-17)	239
Figure 103.	Citations by workshop participants (data of competencies 18-19 and other citations)	240
Figure 104.	Competencies for mass customization (results from a first step evaluation of the empirical data of competencies 1-12)	241
Figure 105.	Competencies for mass customization (results from a first step evaluation of the empirical data of competencies 13-19)	242
Figure 106.	Dominant competencies for mass customization (results from a two-step evaluation of all empirical data of competencies 1-19)	243
Figure 107.	Model of a mass customization typology	244

1 Introduction, research questions and research process

1.1 Introduction to mass customization

In order to meet their individual needs, today's consumers are increasingly demanding customized goods and services when shopping for products. In addition, customers are gradually gaining influence on corporate decisions and requesting customer orientation. The main causes of this trend lie in the increasing saturation of markets and the pressure of globalization on local economies. Companies are responding to this development by offering mass customized products, as the needs of modern customers are often not met by mass produced goods. This business strategy allows the fulfillment of individual customer wishes while upholding the efficiency of mass production (Meffert/Bruhn 1995, p. 178; Hildebrand 1997, p. 12-14; Nitsche 1998, p. 15; Amaro et al. 1999, p. 350; Pine II 1999, p. 131; Shapiro/Varian 1999, p. 78; Prahalad/Ramaswamy 2000; Thome/Schinzer 2000, p. 9-10; Tapscott et al. 2001, p. 151; Tian et al. 2001; Kotler et al. 2003, p. 449; Picot et al. 2003, p. 3f; Piller 2003, p. 190; Tseng/Piller 2003a, p. 4f; Zuboff/Maxmin 2003, p. 143; Gräßler 2004, p. 25; Gershenfeld 2005a, p. 21; von Hippel 2005a, p. 33-43).

Mass customization is acknowledged as providing a substantial source of differentiation. Kotha (1995) valued it as "the emerging paradigm for competitive advantage" (Kotha 1995, p. 22). Since then, the hypothesis by Kotha has been empirically proven; companies can gain a competitive edge and attain higher profitability when applying the concept of mass customization (Piller/Schoder 1999; Sanders 2000; Grasmugg/Schoder 2002; Grasmugg/Schoder 2003).

The concept of mass customization

Recognizing the market trend towards individualization and an increased demand of customized products and services, some visionary researchers foresaw mass customization or laid out its fundamental concept decades ago already (Toffler 1970; Skinner 1974, p. 118; Shapiro 1979, p. 140f; Davis 1987; Kotler 1989; Winger/Edelman 1989; Pine II 1993). Yet mass customization only came to be of practical relevance at a later date; the development of today's information and communication technologies enabled customer integration and the necessary information transfer at low costs (Zerdick et al. 1999, p. 163, 194f; Tseng/Jiao 2001, p. 705; Piller 2003, p. 267-270; Reichwald et al. 2003b, p. 105). From this point on, the concept was further developed and made more widely known (Pine II et al. 1993; Kotha 1995; Piller 2003; Tseng/Piller 2003b).

Mass customization business examples

Motivated by the promising potential of gaining a competitive advantage, numerous companies launched mass customization businesses during the last decade (Tseng/Piller 2003c, p. 519). Among them are some well-known mass producers like Adidas, Nike and Puma. Mass customization had already made a particularly strong impact on the industrial markets before the term was even coined, but the number of implementations in the consumer goods market only just started gaining significance during the last decade (Spring/Dalrymple 2000, p. 441).

The analysis of current business examples testifies to the relevance of mass customization in the industry. The collection of business examples documented for this work during an 18-month period (in 2004 and 2005) is comprised of a list of more than 200 examples spanning companies from Adidas (athletic shoes, Germany) to Youngor (apparel, China), various sectors including the automotive industry (Audi and BMW, Germany) and publishing business (Personal Novel, Germany), international locations from Mexico (Awards Inc., award plates) to Switzerland (121TIME, wristwatches), and including such pioneers as Levi's (jeans, 1994) and Steppenwolf (bikes, 1995). A presentation of mass customization case studies in Chapter 5 will provide case data for most of these examples and expand upon this list (for more information on the companies Levi's, Personal Novel, Awards Inc. and Youngor, see Piller 2002, p. 935; Goetze 2005; Gonzalez-Velarde et al. 2005; Hongjun 2005; more business examples can be found in the lists and company descriptions in Cox/Alm 1998; Piller 2003, p. 392-409; Piller/Stotko 2003, p. 275-287; Hallett 2005).

Management consulting practices

Not only has the number of business implementations increased over the past few years, but management consulting firms are also expressing a greater interest in the matter and responding to the trend towards individualization by accumulating knowledge and expertise in the field of mass customization in order to support the industry in its implementation of the concept. Some companies have even established separate consulting practices and started offering these services to their clients.

A study of the top four management consulting firms in the U.S. provides an overview of current consulting practices. All four firms have recently intensified their interest in the topic. The Boston Consulting Group (BCG) has offered the "Segment-of-One®" approach to mass customization since the late eighties already (Winger/Edelman 1989; Edelman/Malak 1997; Winger/Edelman 2000), and Booz Allen Hamilton (BAH) introduced the mass customization practice of "Smart Customization" in 2003. The consulting expertise of BAH builds on a broad empirical examination of case studies (Booz Allen Hamilton 2003; Booz Allen Hamilton 2004; Oliver et al. 2004; Haddock et al. 2005). Bain & Company has also just recently published a study on the importance of mass customization as being one of the 25 most

popular management tools (Rigby 2005a). However, just like McKinsey & Company, Bain does not offer its clients a specific consulting service covering the field of mass customization. See the Figure 1 for further details on the study conducted on the consulting practice of the top four management consulting firms.

Management consulting company ¹	Consulting practice (brand name under which the consulting service is offered)	Short description
The Boston Consulting Group (BCG)	Segment-of-One® (Winger/Edelman 1989; Edelman/Malak 1997; Evans/Wurster 2000, p. 149; Winger/Edelman 2000).	Segment-of-One® is based on a service and marketing-oriented customization approach, and also describes a framework for product customization. BCG's consulting practice is the earliest known concept in the consulting industry.
	Customonomics (Barber et al. 2000; Strack/Villis 2001; Strack/Villis 2002).	Customonomics presents the central idea that accounting and controlling mechanisms must be based on customer value generation instead of capital return.
Booz Allen Hamilton (BAH)	Smart Customization (Booz Allen Hamilton 2003; Booz Allen Hamilton 2004; Oliver et al. 2004; Haddock et al. 2005).	Compared to the other consulting practices in this figure, Smart Customization can be regarded as the most comprehensive. It builds on a framework of certain capabilities that are required in order to implement customization strategies.
Bain & Company	Bain does not offer a consulting service specifically covering the field of mass customization, but it has introduced mass customization as being one of the 25 most popular management tools in its ninth edition of studies on management tools (Rigby 2005a).	Based on the findings from the study on management tools, Bain presents a mass customization framework including the necessary steps for implementing mass customization (Rigby 2005b).
McKinsey & Company	McKinsey does not offer a specific consulting service covering the field of mass customization, but the company has published intensively on the subject (see the journal <i>The McKinsey Quarterly</i>).	The most prominent article, <i>The False Promise of Mass Customization</i> , concludes that the concept is not a feasible and sustainable business strategy for the automotive industry ² (Agrawal et al. 2001).

Figure 1. Management consulting practices covering the field of mass customization

¹ Representative selection of the top four firms based on a ranking of the top 50 most prestigious consulting firms in the U.S. published by the career services company Vault (Vault 2005).

² However, the article neither considers nor states that the European, or in particular, the German automotive industry has already implemented sustainable and profitable mass customization strategies.

1.2 The conception of mass customization in the academic literature and in practice

Overview of the academic literature

The increased number of academic articles on the topic of mass customization is one example of the growing importance of the mass customization concept. An overview of the number of published academic articles shows that research interest in the subject has been continually high over the last six years (source: EBSCO Business Source Premier database). From 2000 to 2005, a total of 321 articles addressing the topic of mass customization were published.³ Figure 2 provides additional details on the literature overview.

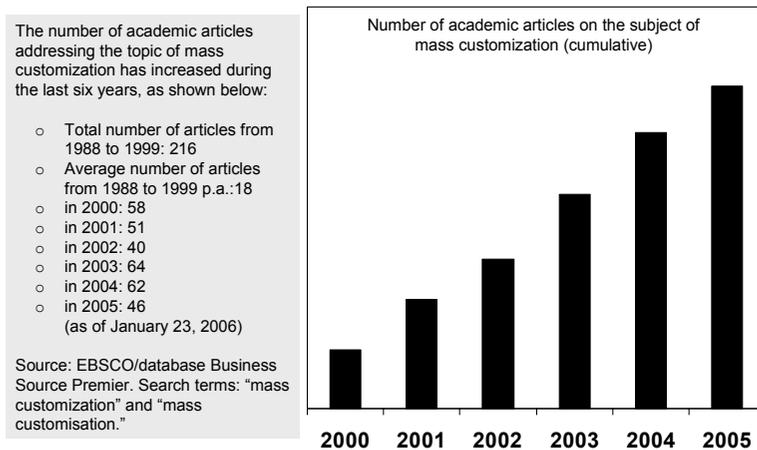


Figure 2. Research interest in mass customization

Definitions of the term mass customization

Although much has been published about mass customization in the academic literature, commonly accepted definitions and frameworks have not yet been established. Many academic definitions exist, all of which differ in one or more aspects (Davis 1987; Pine II 1993; Piller 2003). Consequently, there is currently no consistent understanding of mass customization. Furthermore, because the concept is multidisciplinary, reaching a general consensus in the

³ This number is only a rough estimation. Articles that discuss the topic of mass customization but use another term were not covered. Moreover, because the analysis was conducted on January 23, 2006, it is likely that the full year of 2005 was not included.

consistency of the term is difficult (Blecker et al. 2005, p. 49). When searching Google (www.google.com, search term: “define mass customization”) for different definitions, the results point to a wide range of conceptual understandings in academics and practice.

The results of such an analysis carried out in September 2004 show that the term was found to be defined 13 times (accessible via Google). Most often, mass customization is viewed as a business strategy or production technology, but the concept is also understood as a marketing instrument and economic trend (Google 2004). The repetition of this Internet search in December 2005 yielded similar results. Ten different definitions were identified this time, fewer than in 2004 and more homogenous in their understanding with a focus on business strategy and production technology (Google 2005). While only two of the definitions are identical with those from 2004, one of the ten definitions originates from the same source as a definition from 2004, although the latter was modified that same year. For more details, see the search results for mass customization definitions presented in Appendix 1.

Definition of mass customization for this work

Research questions pertaining to mass customization classification and competencies require a common definition of the concept (see Section 1.3). While defining the term for this work, the main objective was to create a common understanding of mass customization as the underlying concept for the two projects presented here (see Chapter 4 for details on the projects *international mass customization casebook* and *industry research group on mass customization*). A common definition of the concept was particularly needed in order to facilitate the project work of the industry research group on mass customization. This is also why emphasis is placed on a working definition that is rather short and easily understandable, particularly for the involved managers (see Chapter 4). Moreover, a broad definition is desirable, as an overly narrow definition of the term would limit the explorative nature of this research process and, more specifically, create biases and restrict the possible range of results when empirically identifying the different types of mass customization.

As discussed in the section above, many definitions of mass customization exist (for another detailed discussion, see Piller 2003, p. 188-191; Piller 2005c, p. 314f). Most definitions of the concept aim at explaining the oxymoron of the term mass customization—the combination of the two contradictory terms and concepts of “mass production” and “customization” (Piller 2003, p. 184). The definition for this work (and projects presented herein) should also provide an explanation of the concepts of *mass* and *customization* in mass customization. After having reviewed the existing definitions of mass customization and evaluating them in regard to the discussed selection criteria

(explanatory value, length and clarity), the following working definition was found to be most appropriate for this work.

Mass customization corresponds to “producing goods and services to meet individual customer’s needs with near mass production efficiency” (Tseng/Jiao 2001, p. 685).⁴

In this working definition, the term *mass* relates to “mass production efficiency” and the term *customization* corresponds to the needs of “individual customers.” This work will refer to companies applying the mass customization concept as *mass customizers* or *mass customization companies/firms*.

Figure 3. Definition of the term mass customization

A more comprehensive understanding of the concept is represented by the following academic definition of mass customization, which also applied to this work, but was deemed too broad to facilitate a common understanding in the work of the industry research group on mass customization: “Mass customization refers to a *customer co-design process* of products and services, which meet the *needs of each individual customer* with regard to *certain product features*. All operations are performed within a *fixed solution space*, characterized by stable but still flexible and responsive processes. As a result, the *costs associated with customization* allow for a price level that does *not imply a switch in an upper market segment*” (Piller 2005c, p. 315; emphasis in original).

The discussion of the concept of mass customization is concluded at this point, since this work will provide additional insights into the concept, particularly through its empirical findings on mass customization classification and competencies, and the empirical data from the two projects presented here. Moreover, literature on mass customization is cited throughout the remainder of this work.

Use of the term mass customization in practice

The lack of a common understanding of the term mass customization is probably also the reason why the term is not widely applied in practice or in non-academic publications. A non-representative list of incidentally selected newspaper articles covering the subject of mass customization and specifically reporting on the companies Fujitsu Siemens (computers), Levi’s (jeans), Loewe (TV sets), Schmitz Cargobull (trucks) and Trek (bicycles) was analyzed,

⁴ This definition builds on an earlier definition by the authors, which adds more clarity to the concept: “Mass customization aims to provide customer satisfaction with increasing variety and customization without a corresponding increase in cost and lead time. It emphasizes the economies of scope, rather than the old paradigm of mass production to mass produce standardized products through economies of scale.” (Tseng/Jiao 1996, p. 153)

and in only one of these six articles was the term mass customization used (Hüttmann 2004; Barrett 2005; Großer 2005; Hegmann 2005; Müller 2005; World of Garment-Textile-Fashion 2005).

As argued in Section 1.1, mass customization examples are growing in number, yet the term itself is rarely applied. This raises the question as to why there is confusion about the concept.

Statements on the current state of mass customization

The limitations caused by the lack of a common definition of mass customization are also mentioned by researchers who have examined the concept.

“Today, mass customization is a buzzword.” (Piller 2005c, p. 314)

“The term today is used for all kind of strategies connected with high variety, personalization, and flexible production.” (Piller 2005c, p. 314)

“There is not one mass customization concept, but many forms and structures.” (Piller 2005b; cp. Kumar 2005, p. 308f)

Duray et al. (2000) state that “extant literature has not established good conceptual boundaries for mass customization, nor has that literature presented a means to distinguish among the vast array of mass customization practices in a way that lends clarity.” (Duray et al. 2000, p. 606)

As stated above, the limitations of mass customization not only lie in a missing common definition, but also in the absence of a commonly accepted framework of mass customization. Such a framework is necessary if we are to understand the various types of mass customization that exist in practice. Furthermore, the existence of precisely defined mass customization types would facilitate research on this concept, e.g., different researchers would be able to focus their studies on the same types of organizations.

The case study research presented in Chapter 5 empirically examines mass customization case studies in more detail, proving that there are differences in today’s implemented concepts of mass customization. The concepts differ by their degree of offered product customization, the scope of internally performed activities, applied technologies and other dimensions.

The literature analysis presented in Chapter 3 argues that research on mass customization has developed different typologies, but these do not work as good models for understanding the differences between the various types (examples of typologies include Lampel/Mintzberg 1996; Duray 2002; Potter et al. 2004; see Chapter 3 for a detailed overview and discussion of existing mass customization typologies). Research in the field of organizational classification, which enables academics and professionals to group existing

mass customization examples into different organizational types, is more interesting than mere definitions of the concept. Further work on these classifications would help promote a general understanding of the concept, because firms could then be associated with mass customization and its different forms (Crowson 1970, p. 1; Carper/Snizek 1980, p. 65; McKelvey 1982, p. 3).

1.3 Objectives and research questions

While intensively examining case studies from the early beginning of his research in the field of mass customization, the author began looking for a common denominator for all of the different case studies that were titled “mass customization” by academics and experts. The open question of a widely accepted definition or a framework represents the open research field the author has studied for most of his research career and which is documented with this work. Motivated by this shortage of academic literature and lack of a common understanding of mass customization, this work aims to establish conceptual clarity by developing a framework for understanding the different types of the concept. Moreover, this work seeks to develop a model of the competencies needed to implement a profitable and sustainable mass customization business (unresolved research questions of mass customization classification and competencies are explicitly stated by Tseng/Piller 2003c, p. 529).

To answer these questions, this work focuses on the level of business strategy. This focus also helps answer the question as to why companies pursue mass customization in the first place, and whether or not mass customization is a unique organizational form.

Research questions 1 and 2

As later argued in Chapters 2 and 7, the question of the strategic reasons as to why companies pursue mass customization (*research question 1*) is closely connected with the understanding of the different types of this concept. The second research question of this work aims at examining whether or not mass customization is a unique organizational form (*research question 2*). Both of these research questions span the area of organizational classification and represent this work’s central field of research.

Research question 3

To develop an understanding of the different types of mass customization, this work first seeks to construct a framework on how to derive a taxonomy, before formulating hypotheses of the different existing types (*research question 3*). In particular, the objective of this work is to identify the differences within a defined set of 14 mass customization companies. Due to this limited

empirical field, the expectation of this work is not to derive a generally applicable taxonomy, but rather, to formulate hypotheses on the different types.

Research question 4

As later argued in Chapter 2, the chosen theoretical framework for studying the classification of organizations is the organizational systematics framework by McKelvey (1982). This competence-based framework requires the study of the dominant competencies of organizations (*research question 4*) before different organizational forms can be identified. In addition, this work examines the question as to why there is no comprehensive framework that presents the applied competencies of mass customization companies from an empirical perspective (see Section 3.2 for details). In doing so, the focus of this research lies in identifying the competencies currently utilized by companies that already implement a mass customization business strategy. General conditions enabling companies to employ mass customization and external factors are not considered here.⁵

The question of studying the competencies for mass customization is also relevant within the context of analyzing the possible reasons for the drawbacks, limits and failures of mass customization business ventures. In October 2003 for example, the pioneer Levi Strauss was forced to end its “Original Spin” program (Piller 2004a; cp. description of the Levi Strauss case in Piller 2002, p. 935 and discussion of mass customization in Reibstein 2002). Procter&Gamble also announced the closure of its mass customized cosmetic line “Reflect.com” on June 13, 2005 (Piller et al. 2004a, p. 441; Piller 2005d; Reflect 2005). The possible reasons for this and other business closures are still under debate (Huffmann/Kahn 1998; Agrawal et al. 2001; Zipkin 2001; Piller/Ihl 2002a; Reibstein 2002; Piller et al. 2004b), but upon closer examination of such failures, a lack of the necessary competencies to implement mass customization can often be identified. This comes as no surprise, as sufficient competencies in the area of knowledge, experience and management practices first need to be gained before a new business concept like mass customization can be put into effect. Moreover, managers are confronted with a complex business concept that holds challenging managerial tasks (Ramirez 1999, p. 57f). As a result, analyzing the dominant competencies for mass customization will also help us gain insights into the business failures of the past while contributing to the understanding of why companies actually pursue this concept.

⁵ In contrast to this work, Blecker et al. (2005) discuss conditions enabling product customization and distinguish between conditions before and after mass customization implementation, as well as internal and external factors (Blecker et al. 2005, p. 23-29). One can criticize Blecker et al. (2005) since they do not clearly distinguish basic conditions, e.g., “customizability of products” from competencies, e.g., “process flexibility” (Blecker et al. 2005, p. 31).

Summary of the four research questions underlying this work

1. What strategic motivation do companies have to pursue mass customization?
2. Is mass customization a unique organizational form?
3. What different types of mass customization exist? This question is subdivided into a) finding an approach for deriving a taxonomy and b) research on developing hypotheses on the different existing types and attributes for differentiating between mass customization companies.
4. Identification of the dominant competencies for mass customization: Which (internal) competencies, and particularly dominant competencies, do companies that currently employ mass customization possess?

Two pre-studies

As a prelude to the research on mass customization classification and competencies in the existing work, *two pre-studies* are conducted. With a discussion and evaluation of existing classification studies, the *first pre-study* aims at comparing the existing models in regard to their applicability as a taxonomy. The *second pre-study* covers a discussion and evaluation of the current state of literature on mass customization competencies. Congruent to the first pre-study, this step will facilitate research on the dominant competencies for mass customization.

1.4 Research process overview

To provide the reader with an understanding of this work's structure, an outline of the presented research is summarized in following (Huff 1999, p. 77). The research process and structure of this dissertation are defined by the four research questions presented in Section 1.3, the defined theoretical framework (Chapter 2) and the empirical research design (Chapter 4). The explorative nature of the research questions suggests deploying a theory-based and inductive research process, as well as empirical and qualitative research design (Gill/Johnson 1997, p. 23-38, 33-36; Easterby-Smith et al. 2002, p. 3, 46f, 54-57; see Chapters 2 and 4 for details).

This work consists of nine chapters. *Chapter 2* lays out the basic theoretical frameworks with particular emphasis on the *competence-based framework for identifying different types of mass customization*. After a discussion of the different theories of organizational classification, the organizational systematic

framework for deriving a mass customization taxonomy is established and outlined in detail (McKelvey 1982). Work on the RBV theory is added to this framework in order to expand the perspective of research on competencies for mass customization. Finally, Chapter 2 provides frameworks for reviewing the literature.

Both above-mentioned pre-studies are examined in *Chapter 3*. The evaluation and discussion of the current state of the literature on mass customization classifications and competencies paves the ground for the empirical treatment of these topics in subsequent chapters.

The empirical research design of this work is outlined in *Chapter 4*. To empirically study the topics of classification and dominant competencies, the case study research method is applied, and two different forms of which are specifically pursued in order to derive data on business cases. The first form involves classical data collection techniques typical of case study research and performed by an international research consortium, and the second form of case study research is new in the area of management research: the industry research group. Two research projects, the international mass customization casebook project and the industry research group on mass customization, are outlined in detail in Chapter 4. Both of these projects deliver the empirical data for answering the research questions underlying this work. Together with a framework for identifying the dominant competencies for mass customization derived from the two empirical projects, the empirical results covering a preliminary set of mass customization competencies (19 competencies) are also presented in Chapter 4. All other empirical data are presented in Chapters 5 and 6.

Chapter 5 offers descriptions of 14 mass customization case studies, which build on the empirical data of the two research projects in this work. As mentioned above, both research projects conduct different forms of case study research, yet deliver empirical data on case studies. The company descriptions presented here focus on the case data relevant for investigating the questions regarding competencies and classification of mass customization.

The empirical findings of the research on the competencies for mass customization are presented in *Chapter 6*. These findings build on the work of the industry research group on mass customization. The empirical data include a model of the eight dominant competencies for mass customization. The results are critically reviewed and juxtaposed with the respective academic literature (presented in Section 3.2). Chapter 6 closes with the conclusion that mass customization is recognized as a unique organizational form, a finding that builds on the argumentation that the existence of a distinct combination of the eight identified dominant competencies confirms a unique organizational form (according to the framework by McKelvey 1982).

Chapter 7 discusses mass customization strategies. Based on the discussion of existing typologies (Section 3.1), the typology by Spring/Dalrymple (2000) is chosen and applied by classifying 14 mass customization case studies. With

this analysis, the typology by Spring/Dalrymple (2000) is extended and seven mass customization strategies are hypothetically identified as various existing types.

Based on the results of the eight dominant competencies (Chapter 6) and seven mass customization strategies (Chapter 7) a conceptual model of a mass customization typology is derived in *Chapter 8*. At the same time, the eight dominant competencies for mass customization are applied as classification attributes in order to identify the different mass customization strategies.

Chapter 9 summarizes the results of this work and illuminates its limitations, most notably those concerning the applied empirical research design and the validity of the empirical data. The work concludes with management implications, which illustrate a new understanding of mass customization as a business strategy for any organization. Second, these management implications point out a competence vital to mass customization: change management. Finally, based on the findings of this research, an analysis scheme for classifying mass customization organizations is proposed.

Figure 4 summarizes the described research process and provides an overview of the structure of this work. The text in italics indicates the main results of this research.

Chapter	Title	Content (<i>italics: main results from this research</i> ⁶)
2	Theoretical framework	<ul style="list-style-type: none"> • Theories of organizational classification • Competence-based framework <ul style="list-style-type: none"> ◦ Organizational systematics framework for deriving a mass customization taxonomy (McKelvey 1982) ◦ RBV theory • Framework for literature reviews
3	Literature reviews	<ul style="list-style-type: none"> • Two pre-studies: Evaluation and discussion of the current state of the literature on: <ul style="list-style-type: none"> ◦ mass customization classifications ◦ mass customization competencies
4	Empirical research design	<ul style="list-style-type: none"> • Case study research: Forms and stages of the research • <i>Industry research group as a new form of case study research</i> • The international mass customization casebook project • Case study research with the industry research group on mass customization • <i>Preliminary set of mass customization competencies</i>
5	Empirical data: Mass customization case studies	<ul style="list-style-type: none"> • <i>Fourteen mass customization case studies</i>
6	Data analysis: Dominant competencies for mass customization	<ul style="list-style-type: none"> • Identification and description of the eight dominant competencies for mass customization • <i>Model of the eight dominant competencies for mass customization</i>
7	Mass customization strategies	<ul style="list-style-type: none"> • <i>Seven mass customization strategies</i>
8	Discussion: A mass customization typology	<ul style="list-style-type: none"> • <i>Model of a mass customization typology</i>
9	Conclusions and limitations	<ul style="list-style-type: none"> • Conclusions of this work • Limitations of this work • Framework for deriving a mass customization taxonomy—a research agenda • <i>Management implications (with particular emphasis on an analysis scheme for classifying mass customization organizations)</i>

Figure 4. Research process and structure of this work

⁶ The main results are also in italics in the respective chapters. Italics are generally used for central terms, frameworks and results throughout this work.

2 Theoretical framework

The objective of Chapter 2 is to formulate the theoretical framework for the research process of this work. In particular, a *competence-based framework* is developed, which forms the basis for studying the central question of *identifying the different types of mass customization*. In the context of this research question, the theoretical framework supports the study of appropriate characteristics for classifying mass customization organizations.

Apart from discussing the basic terms, this chapter focuses on the different approaches of organizational classification found in the literature on organization theory. These are examined and evaluated. One approach is chosen as a framework for this work and also explained in greater detail by elaborating on its link to other disciplines and discussing extant research on organizational classification that applies our chosen framework.

2.1 Classification of organizations

Organizational classification (or the classification of organizations) is “the actual construction of a classification scheme and the identification and assignment of organizational forms to formally designated classes” (McKelvey 1982, p. 462).

The classification of organizations helps structure the research on complex organizations and facilitates the analysis of other research problems such as effectiveness or organizational change. Quantitative research specifically benefits from existing classifications, since these support the definition of the samples to be studied (Haas et al. 1966, p. 157-160; Rich 1992, p. 758; Doty/Glick 1994, p. 230; McCarthy et al. 2000, p. 77-78). Some researchers say that classification systems, if they are comprehensive, are perhaps the most important step in any form of research (Crowson 1970, p. 1; Carper/Snizek 1980, p. 65; McKelvey 1982, p. 3).

Researchers from the field of organizational science request *general classifications*, since many simple, commonsense classifications already exist (McKelvey/Aldrich 1983; Ulrich/McKelvey 1990). *General classification* work aims at utilizing as many classification attributes as possible. The results often lead to the formulation of better theories (McKelvey 1982, p. 20). As opposed to the application of a large number of attributes for deriving a classification, *special classifications* are “groupings of forms based on only one or a few attributes” (McKelvey 1982, p. 461).

The research field of mass customization would benefit from a general classification. Future studies would be able to precisely investigate only those

case studies, which have been associated with the identified types. Results of such studies would not be falsified by the inclusion of mass production or craft manufacturing companies in the study samples.

Evaluation of the importance of classification research within management research

Typologies and taxonomies are of theoretical importance and contribute to theory development if a number of prerequisites are fulfilled. The basic prerequisites concern the existence of an underlying theory of classification and a sufficient number of actual dimensions and classification criteria taken into consideration. With regard to the expected results, objectivity is also important (McKelvey/Aldrich 1983; Rich 1992, p. 759, 767; Fiedler et al. 1996, p. 12).

Because they fail to meet the basics of classification theory and are too simple, the results of classification work do not contribute to theory. Most of the existing classification work does not fulfill the basic prerequisites, as an underlying theoretical framework is either often missing, or is inappropriate (Ulrich/McKelvey 1990, p. 100; Rich 1992, p. 758, 759; Doty/Glick 1994, p. 230, 243).

Classification of organizations: Taxonomy vs. typology

There is a common misunderstanding of the use of appropriate terms in the field of organizational classification. “The terms *classification scheme*, *taxonomy*, and *typology* have been used interchangeably in much of the relevant literature.” (Doty/Glick 1994, p. 232; emphasis in original.) However, there is a distinct difference between two basic approaches of classification theory: *taxonomy* and *typology*.

The first approach (*taxonomy*) is empirical and aims to develop “classification systems that categorize phenomena into mutually exclusive and exhaustive sets with a series of discrete decision rules” (Doty/Glick 1994, p. 232). Apart from the term *taxonomy*, the expression *classification scheme* also refers to this approach. *Taxonomies* aim at identifying the similarities of actual organizations, before grouping these organizations. In comparison to the cited authors, McKelvey (1982) more precisely distinguishes the terms taxonomy and classification: the former is a theory of classification, and the latter is the development of a classification scheme (McKelvey 1982, p. 13). In this work, the term taxonomy is used as described for an approach of the classification theory (which McKelvey also refers to as empiricism (McKelvey 1982, p. 455; see Section 2.3)), whereas the term classification (or organizational classification) is used in this work according to McKelvey’s own definition (see the introduction to this section of Chapter 2).

The second approach is conceptual and does not offer any decision rules for deriving a classification. This approach is called *typology*. The results of typologies are ideal types, which are conceptually derived and often

hypothesized. An ideal type developed through typological work never represents an existing organization, but does approximately characterize actual cases in its limited selection of criteria (Rich 1992, p. 761; Doty/Glick 1994, p. 232, 233; McCarthy 1995; Bozarth/McDermott 1998, p. 429-431).

Existing research on the classification of organizations

In order to deepen our understanding of the different approaches of organizational classification and differentiate between research that generates *taxonomies* and research resulting in *typologies*, various studies are reviewed in following. The analysis of these studies facilitates the development of a framework for this work. See Figure 5 for four classification studies (for a long list of studies about work on typologies, see also Carper/Snizek 1980; McKelvey 1982, p. 137f; Bozarth/McDermott 1998; for the method of literature review applied here and throughout this work, see Section 2.5.1).

The comparison of the four studies illustrates the difference between research presenting *taxonomies*, and research presenting *typologies*. *Taxonomies* are based on empirical work and these studies implement quantitative research methods, whereas research resulting in *typologies* is often conceptual or based on the investigation of a few case studies. The discussion of prerequisites and terms of organizational classification will be continued when presenting the theoretical framework of this research in Section 2.3. The objective of this first section is to point out the importance of these issues.

Taxonomy/ typology framework	Author	Result (summary)	Comments/critique
Typology	Mintzberg 1979; Mintzberg 1983; Mintzberg 1995	All organizations can be classified into five “structural configurations”: “simple structure,” “machine bureaucracy,” “professional bureaucracy,” “divisionalized form” and “adhocracy” (Mintzberg 1979, p. 301f).	The organizational classification by Mintzberg is hypothesized and not empirically derived. Mintzberg does not provide a founded argumentation as to why precisely these five ideal types of organizations are given. The application of this typology to actual case examples is insufficient.
Typology	Gilmore/Pine II 1997	Mass customization companies can be classified by distinguishing four approaches to this business strategy: “ <i>collaborative, adaptive, cosmetic, and transparent</i> ” (Gilmore/Pine II 1997, p. 92; emphasis in original).	Gilmore and Pine develop their typology based on empirical observations of mass customization cases. The authors do not present an empirical validation of the model.

Taxonomy/typology framework	Author	Result (summary)	Comments/critique
Taxonomy	Haas et al. 1966	99 classification attributes were examined and 75 organizations were studied and classified. The outcomes of the study are ten classes of organizations.	The work by Haas et al. (1966) represents the first development of an empirical taxonomy. This work is of limited practical relevance (Carper/Snizek 1980, p. 67).
Taxonomy	Ulrich/McKelvey 1990	78 classification attributes were examined and 813 organizations from the electronics industry were studied and classified. The outcomes of the study are 13 populations of organizations for the United States and nine populations for Japan.	This research shows one of the most comprehensive studies on empirical classification, applying the organizational systematics framework by McKelvey (1982). For further studies that apply McKelvey's framework, see Section 2.3.

Figure 5. Work presenting taxonomies and typologies

2.2 Organization theory

Organization theory helps explain and understand organizations by providing models and systematic approaches for studying them. An important discipline of organization theory is the classification of organizations (Kieser 1995, p. 1), here the role of theories is to provide frameworks and methods (McKelvey 1982, p. 13).

This section of Chapter 2 offers an overview of the different approaches in organization theory and intends to find a theoretical approach that conceptually supports the development of a classification of mass customization. In following, six different approaches of organization theory are discussed: classical management theories, human relations theories, the contingency theory, population ecology, new institutional economics and the competitive strategy (Kieser 1995; Picot 1999, p. 124-156; Reichwald/Möslein 1999, p. 6-8). These theories are characterized by discussing their basic assumptions and main objectives, and by presenting a general critique of them all. The evaluation primarily focuses on the aspect of whether or not the theories provide a general framework for the classification of organizations. At the end of this discussion and section, a theoretical approach for the classification of organizations in this work is portrayed.

Classical management theories

Classical management theories form the underlying framework for several of today's organization and management theories. The main subject of classical management theory research is the formal organizational structure, which is

understood to follow similar optimization rules as machines (Reichwald/Möslein 1999, p. 7). Research in this field has also considered organizational classification as a means for describing the efficiency of different organizational configurations.

“Perhaps the earliest significant references to organization types can be traced to the writings of Weber. [...] Although Weber did not specifically attempt to develop a taxonomy of organizations, his works have provided the theoretical foundation for many modern-day researchers in the field.” (Carper/Snizek 1980, p. 66)

The classical management theories have laid the ground for many organization and management theories, while also proposing organizational typologies (see Figure 6 for Weber’s ideal types of organizations). However, these theories do not provide a comprehensive framework for the classification of organizations, since the focus lies on conceptual typologies (McKelvey 1982, p. 72, 75).

Theory	Author(s)	Basic theoretical assumptions		
		Main objectives	Critique	Evaluation: General framework for the classification of organizations?
Taylorism/ scientific management, “Admin- istration Industrielle” (Fayol), Bureaucracy	Taylor 1911; Fayol 1916; Weber 1921; Weber 1946; Weber 1947	Similar to machines, the efficiency of organizations can be increased by optimizing technical/formal structures.		
		The main objective of all classical management theory approaches is to optimize the formal organization by considering technical and formal aspects.	Classical management theories consider technical and formal organizational aspects. Efficiency is not measured in relation to external factors or “soft” factors (e.g., human relations in organizations), which also play an important role in determining an organization’s efficiency.	A general framework for classification is not available, although some research work in this field presents a classification of organizations. Weber describes an ideal type of organization (called “bureaucratic”), which is superior to the organizational types “patrimonial” and “feudal.” Weber does not provide a taxonomy, but a conceptually derived typology holding ideal types of organizations.

Figure 6. Overview of classical management theories⁷

⁷ Based on McKelvey 1982, p. 70-72; Kieser 1995, p. 31-89; Morgan 1997, p. 18-22; Reichwald/Möslein 1999, p. 6-7.

Human relations theories

Human relations theories expand the view of the classical management theories by considering human-driven factors as the central subject of research. Similar to the classical management theories, a general classification framework or comprehensive taxonomies are not a primary subject in this field (see Figure 7).

Theory	Author(s)	Basic theoretical assumptions		
		Main objectives	Critique	Evaluation: General framework for the classification of organizations?
Human relations theories (authors below are categorized according to two different groups of approaches within the human relations theories)	Human relation theories expand the mechanistic view of the classical management theories by also considering “soft” factors, e.g., social-psychological dimensions.			
	Human relations and needs are the central subject of studies within these theories of organization. The objective of human relation theories is to deliver explanations of the correlation between human-driven factors and the organizational effectiveness and design.	External factors are not considered; the main focus lies on human-related factors.	Human relation theories do not explicitly provide a general framework for the classification of organizations.	
Human relation/human resources approaches	Mayo 1933; Roethlisberger/Dickson 1939; McGregor 1960; Likert 1961; Argyris 1964; Herzberg 1966			
Human behavioral approaches	Barnard 1938; Simon 1945; March/Simon 1958; Cyert/March 1963			

Figure 7. Overview of human relations theories⁸

Contingency theory

The objective of the contingency theory is to explain differences in organizational structures by analyzing the constraint factors that determine the organizational structure. Generally speaking, this framework builds a basis for organizational classification, because differences in organizational structures are the central subject of study in this theory (see Figure 8). The constraint factors, however, are primarily focused on external factors and the contingency theory does not offer a general framework supporting organizational classification work (Reeves et al. 2003, p. 33).

⁸ Based on Kieser 1995, p. 91-153; Morgan 1997, p. 119-152, 387; Reichwald/Möslein 1999, p. 6-7.

Theory	Author(s)	Basic theoretical assumptions		
		Main objectives	Critique	Evaluation: General framework for the classification of organizations?
Contingency theory	Ackoff 1960; Luhmann 1964; Lawrence/L orsch 1967; Thompson 1967	Efficiency is a function of the organizational structure, which itself is a function of the constraints and contingencies (which lie outside the organization).		
		1. Explain differences in organizational structures. 2. Explain constraint factors that cause organizational structures. 3. Explain correlation between the organizational structure and the constraint factor.	Contingency theory does not explain its central idea: why organizations are structured the way they are.	Contingency theory does not provide a good framework for deriving classification attributes (Reeves et al. 2003, p. 33), because external factors are primarily considered.

Figure 8. Overview of the contingency theory⁹

Population ecology/ organizational evolution

The underlying assumptions of population ecology are derived from biological evolutionism. The concepts of biological mutation, reproduction and selection are applied to organizations. The main objectives lie in the identification and explanation of the different types of organizations as a result of an evolutionary process. Population ecology delivers a more comprehensive theoretical framework for the understanding of differences in organizations and the classification of organizations than other organization theories (see Figure 9). Based on this theory, McKelvey (1982) developed the organizational systematics framework, which also presents a theory of classification proposing a methodology on how to perform studies in the field of organizational classifications. This theory is called numerical phenetics and will be elaborated on later in this chapter.

⁹ Based on Kieser 1995, p. 155-183, 237-252; Morgan 1997, p. 388; Reichwald/Möslein 1999, p. 6-7.

Theory	Author(s)	Basic theoretical assumptions		
		Main objectives	Critique	Evaluation: General framework for the classification of organizations?
Evolutionary theory	Hannan/Freeman 1977; Aldrich 1979; Malik/Probst 1981; McKelvey 1982; Carroll 1984; Hannan/Freeman 1984; Hannan/Freeman 1989	Based on biological evolutionary theory, organizations are considered “populations” holding “gene pools” that form new “species” through “mutation,” “reproduction” and “selection.”		
		Explain organizational differences as the result of an evolutionary process.	The analogy to biology is not generally accepted as being appropriate in the organizational context; evolutionism is a postulate, rather than a subject for research.	Population ecology delivers a comprehensive and general framework for the classification of organizations. Based on the theories of evolutionism and numerical phenetics, McKelvey (1982) developed the organizational systematics framework, a comprehensive framework widely referenced in studies of organizational classification (see Section 2.3).

Figure 9. Overview of population ecology/organizational evolution¹⁰

New institutional economics

The new institutional economic theories expand on organization theory by defining organizations as one alternative institution within a spectrum of institutions that range from hierarchies to markets. The classification of organizations is neither a central matter of this theory, nor is a general framework for the classification of organizations available. In addition, the analysis and structuring of institutions primarily takes cost and efficiency factors into consideration (see Figure 10).

¹⁰ Based on McKelvey 1982, p. 219-252; Kieser 1995, p. 155-183, 237-252; Morgan 1997, p. 390f; Reichwald/Möslein 1999, p. 6-7.

Theory	Author(s)	Basic theoretical assumptions		
		Main objectives	Critique	Evaluation: General framework for the classification of organizations?
Property-rights-theory	Coase 1937;	The new institutional economics theories view organizations as one alternative form of coordinating value-generating activities in a spectrum of institutions that range from hierarchies to markets.		
Transaction-cost-theory	Coase 1960;	The basic questions are which institutional form causes the lowest costs while guaranteeing the highest rate of efficiency, and how institutions should be structured.	These theories can only be for studying institutions which hold formal agreements.	The classification of organizations is not explicitly conceptualized. Although different institutional forms are explained, developed classifications are primarily based on cost and efficiency factors.
Principal-agent-theory	Alchian/Demsetz 1972;			
	Williamson 1975;			
	Jensen/Meckling 1976;			
	Pratt/Zeckhauser 1985; Picot 1991, p. 153			

Figure 10. Overview of new institutional economics¹¹

Competitive strategy/strategic management

Strategic management theories are associated with the organization theory (Reichwald/Möslein 1999, p. 6-8). Within this field, Reichwald/Möslein (1999) list the theories of core competencies (Prahalad/Hamel 1990), business process reengineering (Hammer/Champy 1993) and mass customization (Pine II 1993; Pine II 1999) as the most prominent examples of modern strategic management approaches. However, none of these theories offer a general framework for the classification of organizations.

For the purpose of classifying organizations, the organization theories of the new institutional economics and competitive strategy do not offer appropriate theoretical frameworks, as argued above. The other four approaches of organization theory (classical management theories, human relations theories, contingency theory and population ecology) provide possible frameworks for the classification of organizations. However, only the population ecology theory presents a general and comprehensive theoretical framework for explaining the differences in organizations; the other theories offer no general theory of classification, and are rather focused on technical and formal (classical management theories), human related (human relations theories), or external (contingency theory) factors as possible classification attributes. This focus contrasts with the objective of this research of basing the development of a mass customization taxonomy on a comprehensive set of classification attributes.

¹¹ Based on Picot 1982, p. 267-284; Picot 1991, p. 143-170; Kieser 1995, p. 185-235; Reichwald/Möslein 1999, p. 6-8.

The advantage of applying the theory of evolutionism as the underlying theory of classification makes the outcomes of such classification work resistant against any changes in the objective or interest of the researcher: “Evolution is evolution,” (Rich 1992, p. 769) which means that organizational groupings do not occur by chance, but are a result of past variations and selection processes (McKelvey 1982, p. 241-243). The existence of groups of organizations is also the underlying assumption in the management theory of “strategic groups” (Hunt 1972; Porter 1980, p. 129). A strategic group is “defined as a group of firms within the same industry making similar decisions in key areas. [...] The identification of strategic groups has been used primarily to explore systematic differences in profitability among firms in the same industry.” (Reger/Huff 1993, p. 103)

Building on the population ecology theory, McKelvey (1982) developed organizational systematics as a general framework for classifying organizations. This framework is theoretically founded and provides a comprehensive methodology on how to perform organizational classifications. The next section presents McKelvey’s framework in more detail.

2.3 Organizational systematics framework

In his 511-page book, McKelvey (McKelvey 1982) critically discusses the theories and existing studies of organizational classification. He also presents his own comprehensive theory and methods for conducting research in the field of organizational classification. To grasp McKelvey’s basic critique of other classification approaches, as well as his arguments for proposing a comprehensive framework, the discussion of the different classification approaches from Section 2.1 (typology and taxonomy) are continued below. McKelvey expands this perspective by presenting four basic theories of classification (McKelvey 1982, p. 37-55): *essentialism* (the equivalent of *typology*), *nominalism*, *empiricism* (the equivalent of *taxonomy* in this work) and *evolutionism* (for an overview see Figure 11; for more details refer to Rich 1992, p. 762).

Essentialism, nominalism, empiricism and evolutionism

Classification studies based on the theory of *essentialism* make use of a few attributes, are often definitions themselves, and use existing knowledge to develop a classification. The inappropriateness of this approach was pointed out in Section 2.1.

While classification studies based on essentialism often lack sufficient validation and are mostly special classifications, the theory of *nominalism* does not accept the existence of classification studies. This theory generally negates the entity of groupings, accepting only the existence of individuals, and is

inappropriate for conducting classification research in the field of mass customization.

The advantage of classifications made according to the theory of *empiricism* is that this approach does not build on a priori existing theory. Instead, it aims at empirically analyzing organizations and examining as many business examples and attributes as possible in order to allow the emergence of groupings.

The final approach discussed by McKelvey is the theory of *evolutionism*. Based on this approach, existing schemes with knowledge about organizational groupings are applied when doing organizational classification. Classification research under this theory focuses on the reasons why specific groupings exist and attempts to explain their origins (McKelvey 1982, p. 49). The disadvantage of this theory is that it tends to focus on why organizations differ, as opposed to how. Figure 11 offers an overview of all of the above-mentioned approaches and their definitions according to McKelvey (McKelvey 1982, p. 455-458).

Basic theories of classification
<p><i>Essentialism</i> (definition of <i>typology</i> is identical with that of <i>essentialism</i>): “A theory of classification holding that groups of entities exist, each group being composed of members who share a few essential attributes; it is the basis of typological groupings of organizations.” (McKelvey 1982, p. 455) This theory of classification basically assumes that organizations hold one or a few simple and basic characteristics by which they can be grouped.</p>
<p><i>Nominalism</i>: “A theory of classification which ignores the possible existence of naturally occurring groupings, choosing instead to form groupings that serve the needs of the scientific community to have homogeneous classes.” (McKelvey 1982, p. 458)</p>
<p><i>Empiricism</i> (in this work the definition of <i>taxonomy</i> is identical with that of <i>empiricism</i>): “An approach to classification which posits the existence of naturally occurring groupings, tries to keep classificatory decisions as free from a priori theories as possible, weights all possible attributes equally, and assumes that repeated empirical studies using numerical clustering methods will ultimately define a classificatory framework.” (McKelvey 1982, p. 455)</p>
<p><i>Evolutionism</i>: “A theory of classification which groups entities according to their overall ancestral (genetic) affinities.” (McKelvey 1982, p. 456) Evolutionism believes in naturally occurring groups of organizations. These groups are identified by studying their common and most recent ancestors.</p>

Figure 11. Basic theories of organizational classification

Foundations of organizational systematics

McKelvey argues in favor of a combination of *empiricism* and *evolutionism* theories (McKelvey 1982, p. 60-64). The main advantage of such a combination is its consideration of both the phyletic (evolutionism: lines of descent) and phenetic (empiricism: observable attributes) characteristics of organizations (McKelvey 1982, p. 43, 50). Within this combination, the theory of evolutionism delivers a model for explaining why organizational groups exist, and the theory of empiricism provides a method for examining organizational groups and their differences. Evolutionism is a weak theory for studying organizational differences, since lines of descent are often unobservable, unlike classification attributes (empiricism). Empiricism, on the other hand, is disadvantageous because it does not sufficiently explain why organizational differences exist. Consequently, McKelvey bases his approach of organizational classification on the theories of empiricism (which he and other authors refer to as “numerical phenetics”) and evolutionism. Evolutionism and numerical phenetics “are bridged by a species concept, in which the individual organization is characterized as a member of the larger group that comprises the basic unit in the classification system.” (Rich 1992, p. 764)

Numerical phenetics: “A theory of classification that groups entities on the basis of most, if not all, known attributes, using numerical coefficients of resemblance and clustering or other grouping algorithms.” (McKelvey 1982, p. 458)

Biological systematics

In order to argue for the chosen theory of evolutionism, McKelvey firmly grounds his framework in biological systematics and transfers the theory of organics to organizational systematics (McKelvey 1982, p. 145-161).

Evolution: “The study of the process of environmental and organizational evolution, the study of the emergence and decline of different organizational forms, and the development of lineages showing the emergences of new forms over time.” (McKelvey 1982, p. 13)

McKelvey builds his framework on the understanding that organizations are entities like organisms. He proves the validity of this basic assumption and consequently applies the basic principles of natural selection theory: variation, heredity, natural selection and the struggle for existence (McKelvey 1982, p. 228f, 234-239). However there are three major differences between organic and organizational evolution. First, compared with organic evolution, organizational changes occur not only by random chance, but also by directly responding to certain needs. Second, organizational evolution is faster. And finally, organizations do not produce offspring. In this regard, however, the

idea behind McKelvey's framework is that employees possess knowledge and potentially pass it on to other or new organizations, e.g., when attending conferences or leaving the organization (McKelvey 1982, p. 196, 236-241). McKelvey's lengthy but well-founded discussion about the parallels of organic and organizational systematics will not be further elaborated on here, but his book is highly recommended for further reading.

Organizational systematics

Because McKelvey's comprehensive discussion of organizational classification was convincing, his theory was deemed the most promising approach for this work. Therefore, in order to examine the principle research question behind this work on mass customization classifications, McKelvey's theoretical framework of organizational systematics is applied here.

Organizational systematics: "The science given over to the study of the diversity of form." (McKelvey 1982, p. 462)

McKelvey (1982) establishes organizational classification on a theoretical construct, the species concept. This concept provides a central theory for explaining the differences between organizational groups, and forms a basic connection between the theories of empiricism and evolutionism (McKelvey 1982, p. 161).

Organizational "species" are "competence-sharing populations [organizational groups] isolated from each other because their dominant competencies are not easily learned or transmitted" (McKelvey 1982, p. 192). Species are the main focus of classification studies under the evolutionary theory.

This framework is used to explain the differences in organizations that apply the mass customization business strategy by examining the competencies of these organizations. McKelvey's framework builds on organizational and evolutionary theory. To bridge the internal and external perspectives of this classification framework, McKelvey introduces the "dominant competence" concept, which is related to the RBV theory, as discussed in the next Section 2.4. McKelvey argues that "dominant competence is the best basis for a theory of organizational differences" (McKelvey 1982, p. 192) and defines this central concept as follows:

Dominant competencies build a “link between environmental forces and organizational forms” (McKelvey 1982, p. 190) and are “the primary task or workplace-management task that directly affects the nature of its outputs or the level of resources necessary to produce them” (McKelvey 1982, p. 215). Primary tasks are activities that have a direct effect on the productivity of the organization and are critical for its survival. Workplace-management tasks refer to the design and technology of the workplace and are also important in regard to the productivity and existence of the organization (McKelvey 1982, p. 173-189). A more detailed definition is given in Section 4.3.6.2.

The existence of specific dominant competencies for an organization and their distinctive combination result in “a unique organizational form” (McKelvey 1982, p. 191). Dominant competencies themselves are also a combination of functions. The members of an organization are responsible for performing these functions. It is understood that dominant competencies consist of a specific combination of existing members of an organization, their activities, and a number of other “actions, activities, procedures, or processes [...]” (McKelvey 1982, p. 191).

Although McKelvey’s framework is applicable to research on organizational populations (see definition of the species concept in this section and McKelvey 1982, p. 3, 439), his framework and methods advise researchers to begin with the study of individual organizations in order to identify higher ranks of populations before finally deriving a taxonomy (McKelvey 1982, p. 38). This means that forms of mass customization exist on a level of groups (not single organizations), but to identify these groups, individual organizations have to be studied first.

In his book, McKelvey proves his framework is robust against an assessment by applying various commonly accepted criteria from the field (McKelvey 1982, p. 193-210). Moreover, he exemplifies his framework by studying the evolution of organizational forms in ancient Mesopotamia based on dominant competencies (McKelvey 1982, p. 295-335). The McKelvey framework has also been applied in a few studies of organizational classification up until now, which are discussed at the end of this section.

Basic theories, concepts and terms of organizational systematics

As a summary of McKelvey’s competence-based framework, all basic terms applied in this work are displayed in Figure 12. These terms also include the basic definitions of McKelvey’s framework that have yet not been presented here.

A summary of basic theories, concepts and terms of McKelvey's framework as applied in this work
<p><i>Dominant competencies</i> build a “link between environmental forces and organizational forms” (McKelvey 1982, p. 190) and are “the primary task or workplace-management task that directly affects the nature of its outputs or the level of resources necessary to produce them” (McKelvey 1982, p. 215).</p>
<p><i>Evolutionism</i> is “a theory of classification which groups entities according to their overall ancestral (genetic) affinities” (McKelvey 1982, p. 456). Evolutionism believes in naturally occurring groups of organizations, which are developed by studying their common and most recent ancestors.</p>
<p><i>Numerical phenetics</i> refers to the “theory of classification that groups entities on the basis of most, if not all, known attributes, using numerical coefficients of resemblance and clustering or other grouping algorithms” (McKelvey 1982, p. 458).</p>
<p><i>Organization</i> (defined the same as <i>company</i> and <i>firm</i> for this work): “Organizations are purposeful systems containing one or more conditionally autonomous purposeful subsystems.” (McKelvey/Kilmann 1975, p. 25) In this definition, organizations are seen as having subsystems that act autonomously, but are coordinated by managers so as to act as an entity (McKelvey 1982, p. 212). Variations originate from sources of planned and unplanned activities, and variations are initiated by the organization itself or caused by external forces (McKelvey 1982, p. 91f).</p>
<p><i>(Organizational) classification</i> is “the actual construction of a classification scheme and the identification and assignment of organizational forms to formally designated classes” (McKelvey 1982, p. 454). The result of an organizational classification is also referred to as a <i>classification</i> (definition for this work).</p>
<p><i>Organizational form</i>: “The internal structure and process of an organization and the interrelation of its subunits which contribute to the unity of the whole of the organization and to the maintenance of its characteristic activities, function, or nature.” (McKelvey 1982, p. 458)</p>
<p><i>(Organizational) types</i> (McKelvey uses <i>species</i> and <i>population</i> interchangeably; the expression <i>(organizational) groups</i> is also used in this work) are “[...] competence-sharing populations isolated from each other because their dominant competencies are not easily learned or transmitted” (McKelvey 1982, p. 192).</p>

A summary of basic theories, concepts and terms of McKelvey's framework as applied in this work
<p><u>Taxonomy</u> (defined the same as <i>empiricism</i> for this work) is “an approach to classification which posits the existence of naturally occurring groupings, tries to keep classificatory decisions as free from a priori theories as possible, weights all possible attributes equally, and assumes that repeated empirical studies using numerical clustering methods will ultimately define a classificatory framework” (McKelvey 1982, p. 455). The result of a classification applying this theory is also referred to as a <i>taxonomy</i> (definition for this work).</p>
<p><i>Taxonomic character</i>¹² (the expression <i>classification attribute</i> is used in this work) is “a property or attribute distinct enough to be formally recognized and named as definite category” (McKelvey 1982, p. 462). A better clarification of this term provides the following definition, which is also applicable for this research: “A character [...] is essentially any feature by which an individual can be compared against another.” (Rich 1992, p. 767)</p>
<p><u>Typology</u> (defined the same as <i>essentialism</i>) is “a theory of classification holding that groups of entities exist, each group being composed of members who share a few essential attributes; it is the basis of typological groupings of organizations” (McKelvey 1982, p. 455). This theory of classification basically assumes that organizations hold one or more simple and basic characteristics by which these can be grouped. The result of a classification utilizing this theory is also referred to as a <i>typology</i> (definition for this work).</p>

Figure 12. Basic theories, concepts and terms of McKelvey's framework

Existing research applying organizational systematics

In order to facilitate the research process of this work, studies applying the organizational systematics framework by McKelvey (1982) are discussed next (Huff 1999, p. 55). Following the calls for comprehensive and theoretically founded organizational classifications (Carper/Snizek 1980, p. 65; Rich 1992, p. 775f; Doty/Glick 1994, p. 230), the authors of these studies have aimed at satisfying the prerequisites of McKelvey's framework in order to fulfill the commonly accepted prerequisites of classification work. Figure 13 lists five studies; other classification research that utilizes the organizational systematics framework or its underlying concepts include Ulrich 1982; Lewis/Alexander 1986; Baum 1989; Miller/Roth 1994; Fiedler et al. 1996.

These authors have all worked on organizational classification applying empirical methods, and have examined a larger number of classification

¹² Instead of “character,” the terms “attribute, variable, characteristic, parameter, or dimension” are used interchangeably in the literature (Rich 1992, p. 767).

attributes and organizations. Methods of numerical phenetics have been applied to derive rich taxonomies for selected industries or organizational entities. The result of the analysis of these studies is that McKelvey's (1982) organizational systematics provide a valuable framework for generating comprehensive and theoretically founded taxonomies. This framework, though having had been formulated more than 20 years ago, is still applicable for these types of studies. This was the motivation for this research to also base its open questions about mass customization classification on this theoretical framework.

Taxonomy/ typology framework	Author	Result (summary)	Comment
Taxonomy	Ulrich/McKelvey 1990	78 classification attributes were examined and 813 organizations from the electronics industry were studied and classified. The outcomes of the study are 13 populations of organizations for the United States and nine populations for Japan.	This study fully applies the organizational systematics framework by McKelvey (1982). However, the authors state that a "more elegant theory about what attributes best help us identify populations of organizations is needed, thus leading to selection of taxonomic characters" (Ulrich/McKelvey 1990, p. 115). In their method, the authors use all available attributes, yet failed to examine the dominant competencies of this industry before defining the classification attributes.
Taxonomy	Koberg et al. 1996	A classification of high-technology firms is developed. 276 organizations from this industry were studied and 13 attributes were examined. Four groups of high-technology firms were identified.	The framework and research design of this study does not explicitly refer to the organizational systematics framework by McKelvey (1982), but follows its underlying concept.
Taxonomy	Priem et al. 2002	This study aims to classify sources of uncertainty on the management level of organizations. 29 uncertainty sources/items were examined and 39 managers were involved in the study. Six clusters of uncertainty sources were identified.	This study does not classify organizations per se, but applies the framework by McKelvey (1982) for clustering uncertainty sources.

Taxonomy/ typology framework	Author	Result (summary)	Comment
Taxonomy	Yeung et al. 2003	This study aims at finding groups of quality management systems. 225 firms in the electronic industry were studied and four groups of systems were identified.	The framework and research design of this study does not explicitly refer to the organizational systematics framework by McKelvey (1982), but follows its underlying concept.
Taxonomy	Reeves et al. 2003	20 classification variables for 77 health service organizations were studied. Five financially successful and five financially less successful groups of organizations were identified.	Although they apply the organizational systematic framework by McKelvey (1982), the authors also build their study on the contingency theory. These two approaches stand in contrast, since McKelvey said that "if a usable classification existed, there would be no need for contingency theory" (McKelvey 1975, p. 523). In this context, the authors state that contingency theory does not provide a framework that suggests which general classification attributes are to be considered (Reeves et al. 2003, p. 33). However, according to McKelvey's framework, there is no need to apply generally accepted attributes. Nonetheless, this study considers a selection of attributes from the contingency theory literature, and by doing so, neglects McKelvey's basic prerequisite of applying as many attributes as possible and not following a prior theories (Rich 1992, p. 759).

Figure 13. Existing research applying organizational systematics

2.4 Organizational systematics and the resource-based view (RBV)

The resource-based view

The resource-based view (RBV) of strategic management stresses the development of core competencies (Wernerfelt 1984; Barney 1986; Barney 1991; Grant 1991; Peteraf 1993; Rühl 1995). This theory has been concisely described by Prahalad/Hamel (1990), who achieved the scientific breakthrough of this theory although the idea originates from Penrose (1959). The RBV theory explains differences in company performance and competitiveness. In the context of this work, the RBV theory is applied to illustrate the reasons behind the successful and unsuccessful implementation

of the mass customization business strategy, and to broaden the understanding of the organizational systematics framework by McKelvey (1982).

The RBV theory contrasts with the dominating theory of strategic management from the 1980s, the market-based view of strategic management. This theory explains the strategic behavior and success of a company with primarily exogenic factors (Porter 1991, p. 95). In contrast to this idea, the resource-based view assumes that competitive advantage and profits above the industry average can be achieved on the basis of superior internal resources (Bamberger/Wrona 1996, p. 130f). “The RBV of the firm focuses on the role of strategic resources and capabilities as sources of economic rents and therefore competitive advantage.” (Squire et al. 2003, p. 3) According to the conception of the RBV theory, firms are bundles or portfolios of tangible and intangible resources. Some of these resources are of particular relevance for creating a competitive advantage and allow for differentiation between competitors—these are the core competencies of a firm (Prahalad/Hamel 1990, p. 71).

Definition of the term competence for this work

There is no consensus on a common term for *competencies*; different authors use different expressions. A basic differentiation between two distinct causal levels of the RBV theory is evident, however. Resources often refer to company assets (e.g., a technology), whereas capabilities describe the managerial ability of bundling existing resources in order to gain a competitive advantage (Prahalad/Hamel 1990, p. 82; Amit/Schoemaker 1993; Bogaert et al. 1994; Bamberger/Wrona 1996, p. 137). Grant (1991), for example, uses both the resource and capability terms, but in doing so, he differentiates between the two levels of a firm’s ability to create a competitive advantage. In Grant’s framework, capabilities are an aggregation of resources and a more direct mediator of creating a competitive advantage. Apart from the differentiation between resources and capabilities, a different understanding of the terms *capabilities* and *competencies* also exists (Wernerfelt 1984; Barney 1986; Barney 1991). Despite this academic discourse, a company’s *competencies* should be defined here as *capabilities*. Accordingly, Grant’s definition and conclusion on the understanding of firms’ *capabilities* is applied as a working definition for the term *competence*.¹³

¹³ Use of the term *competence* warrants consistent terminology that corresponds with the concept of the *dominant competencies* by McKelvey (1982).

The *competencies* “of a firm are the central considerations in formulating its strategy: they are the primary constants upon which a firm can establish its identity and frame its strategy, and they are the primary sources of the firm’s profitability” (Grant 1991, p. 133). In the context of this work, the conception of competencies emphasizes the following aspect of the definition: “they are the primary sources of the firm’s profitability” (Grant 1991, p. 133).

Figure 14. Definition of the term competence

Organizational systematics and the resource-based view (RBV)

By introducing this second definition in addition to that of *dominant competencies* (McKelvey 1982), a two-step evaluation scheme for analyzing empirical data from the industry research group on mass customization is possible, which will be introduced later in Section 4.3.6.4. While the term *competence* is applied in a rather broad sense in order to generate a common understanding within the industry research group on mass customization and facilitate coding of the empirical case data from that project, the definition of *dominant competence* forms a rigid theoretical framework for deriving the primary research findings of this work.

In the context of this research, the RBV theory is also used to expand the view of McKelvey’s dominant competencies concept, and to offer easier access to this concept for a broader audience (McKelvey’s framework is comprehensive and not very well known). Other researchers have also studied mass customization competencies by applying the concept and terms of the RBV theory (Wikström 1996b; Zipkin 2001). Also, Rich (1992) has explicitly linked McKelvey’s framework to the RBV theory with the objective of emphasizing the dominant competencies concept for the organizational systematics framework (Rich 1992, p. 770).

Strategic focus of this work and definition of strategy

Another main objective of utilizing the RBV theory is to provide a framework for identifying the different existing types of mass customization (Chapter 7). In contrast to the existing classifications, which focus on mass customization operations (see Section 3.1), the classification attempt of this work focuses on identifying differences between organizations by primarily looking at the company’s strategy (see research questions presented in Chapter 1). With regard to the focus of McKelvey’s framework and its link to competitive strategy, this classification approach seems to be the most appropriate. Accordingly, this work assumes the following understanding of the term *strategy* (or *business strategy*, respectively):

“A **strategy** is the *pattern or plan* that integrates an organization’s *major* goals, policies, and action sequences into a *cohesive* whole. A well-formulated strategy helps to marshal and allocate an organization’s resources into a *unique and viable posture* based on its relative *internal competencies* and *shortcomings*, anticipated *changes in the environment*, and contingent movers by *intelligent opponents*.” (Quinn 1995, p. 7; emphasis in original)

Figure 15. Definition of the term strategy

Quinn’s (1995) definition adequately picks up on the basic framework of classification used in this work (the organizational systematics framework). Both the phyletic (environment and opponents) and phenetic (goals, policies, action sequences, resources and internal competencies) characteristics of organizations are also elements of this definition. The term *strategy* will be applied in Chapter 7 when introducing and labeling a *mass customization typology*; the developed types will be termed *mass customization strategies*. Such terminology is reference to the origin of this typology in the RBV theory.

2.5 Theoretical framework for the literature reviews

McKelvey’s (1982) theoretical framework is applied to perform two basic literature reviews of the two main topics of this research. Academic work on competencies for mass customization is reviewed in Chapter 3 by applying the basic definitions of McKelvey’s framework. Furthermore, work from the RBV theory supplements the framework of the literature reviews. To identify existing work on the classification of mass customization, McKelvey’s basic definitions deliver appropriate search terms for the literature review, and the theoretical framework provides a means for evaluation. The literature reviews of the subjects of mass customization classification and competencies will be presented in the next chapter (the term *literature review* is used in this work; the literature reviews aim at creating a conceptual context for the various research questions and projects of this work; cp. Maxwell 1996, p. 25-27).

2.5.1 General framework

Before presenting the specific frameworks for the literature reviews of mass customization classification and competencies, a general framework is proposed, as this work builds on and includes several literature reviews of various topics (e.g., the reviews of the literature on organizational classification presented in Sections 2.1 and 2.3 are also based on this general framework). A general framework helps establish the required consistency among all literature reviews (Maxwell 1996, p. 25-27).

The literature reviews’ general framework consists of seven steps: define objective, define analysis scheme, define search terms, perform literature search, select literature results and add from other sources, analyze literature results and present literature results. This framework and the subsequent steps guarantee the fulfillment of five goals:

- a) All literature reviews follow a defined objective.
- b) The scheme for analyzing search results is defined before the literature search is performed. This prevents a biased researcher from defining evaluation criteria by looking at the literature data.
- c) All literature reviews make use of the same databases, although relevant additional literature is added when available from other sources.
- d) All literature search results are analyzed and critically reviewed in the context of the overall research (as opposed to being just listed).
- e) The results from all literature reviews are presented in a comprehensive format.

See Figure 16 for more details on the applied framework for the literature reviews of this work. The rationale behind each step is given, and a corresponding example offers further clarification of the applied framework.

	Rationale/comment	Example (compare the Chapter 2 and Chapter 3)
Define objective		Objective: generate an overview of the existing literature about mass customization classification.
Define analysis scheme	Based on the objective and a theoretical framework, the analysis scheme is defined upfront in order to enable an unbiased analysis of the results later.	Nine dimensions defined (based on a theoretical framework).
Define search terms		Mass customization, systematics, taxonomy, classification, typology (type), category, form, structure, evolutionism, phylogenetics and phenetics.
Perform literature search	All literature searches of this work made use of the two databases EBSCO/database Business Source Premier and Sciencedirect.com.	The EBSCO/database Business Source Premier is searched.
Select literature results and add from other sources	Only those articles are selected that contribute to the defined objective. Literature from other relevant sources is added also. This first screening reduces the complexity and volume of the search results.	All articles are screened and selected (in regard to the topic of mass customization classification). Additional literature is added from other relevant sources.
Analyze literature results	The results from the literature review are related to the research question and conceptual context of the work (Maxwell 1996, p. 25-27).	All selected articles are analyzed following the defined analysis scheme.
Present literature results	Results are presented in an extensive format to improve intelligibility and comparability.	The results from the literature review are presented in tabular form and summarized in text format.

Figure 16. Framework for the literature reviews of this work

2.5.2 Theoretical framework for literature review of mass customization classification

The search terms for the second literature review are derived from the basic definitions¹⁴ in the context of organizational classification by McKelvey (1982), who uses the terms systematics, taxonomy, classification, typology (type), category, form, structure, evolutionism, phyletics and phenetics (cp. Appendix 2).

Based on the discussion of the required comprehensiveness of organizational classification at the beginning of this chapter, the evaluation of the reviewed organizational classification studies distinguishes between *special* and *general classifications*. *Special classifications* are “groupings of forms based on only one or a few attributes” (McKelvey 1982, p. 461). In comparison with the application of a limited number of attributes for deriving a classification, *general classifications* seek to utilize as many attributes as possible and generate better theory (McKelvey 1982, p. 20). “These are attempts to group entities together by taking into account most if not all of their important attributes” (McKelvey 1982, p. 456). However, upon closer inspection of the literature on applied organization theory, we see that most work on organizational systematics is not “offering anything more than a description of a few organizational differences, that is, special classifications,” not general classifications (McKelvey 1982, p. 162). Hence, this dimension should be carefully analyzed.

The evaluation of the existing classification studies also examines the dimension of the underlying theory of classification. This encompasses *essentialism* (the equivalent of *typology*), *nominalism*, *empiricism* (the equivalent of *taxonomy*) and *evolutionism*, as described in Section 2.3.

Apart from the theoretical framework by McKelvey, this literature review also builds on previous work on collections and comparisons of the different classification studies of mass customization (Da Silveira et al. 2001; Broekhuizen/Alsem 2002; MacCarthy et al. 2003; Piller 2003; Ruohonen et al. 2003; Rudberg/Wikner 2004; Blecker et al. 2005, p. 20f). The “critical comparison between the classification models for mass customization” by Blecker et al. (2005, p. 20) is the basis for deriving an analysis scheme for the literature review presented here. Blecker et al. (2005) “[...] identify five basic dimensions according to which [Blecker et al.] compare the different models, namely: research type, exclusiveness between strategies, main classification perspective, easiness of attribution, and specification of application suitability” (Blecker et al. 2005, p. 20). The five dimensions are applied according to the definitions given by Blecker et al. (2005):

¹⁴ See the definitions listed in this chapter and the glossary of McKelvey’s publication (McKelvey 1982, p. 453-462).

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- “*Research type* indicates the research method on which the basis of the model is established.” (Blecker et al. 2005, p. 20; emphasis in original)
 - “*Exclusiveness between strategies* captures whether the strategies in one model are mutually exclusive.” (Blecker et al. 2005, p. 20; emphasis in original)
 - “The *main classification perspective* refers to the basic criterion that is used in order to achieve the typology.” (Blecker et al. 2005, p. 20; emphasis in original)
 - “The *easiness of attribution* relates to the fact of whether difficulties arise when trying to assign a particular mass customizer to one category according to the model.” (Blecker et al. 2005, p. 20; emphasis in original)¹⁵
 - “The *specification of application suitability* means whether the researchers have specified in their original contributions the context, in which their classification makes sense.” (Blecker et al. 2005, p. 20; emphasis in original) In the context of this work, this dimension also covers the aspect of whether the presented research primarily intends to develop a classification, or if the displayed classification supports a different underlying main research objective.

From this list of dimensions, the examination of the *research type* is of special interest in order to differentiate between the different basic types of classifications. *Empirical* and theoretical (*conceptual*) models exist. As discussed in Section 2.1, the focus of most organizational classification work is conceptual, since researchers do not base their models on an adequate number of business cases by collecting sufficient data to build a typology. Or they don't use any empirical data, but theorize a model instead. This step of evaluation is captured by labeling the research type of each identified model from the literature as *empirical* or *conceptual*.¹⁶ The research type refers to the applied method of developing the model. Research including the empirical application of a conceptually derived model is still being evaluated as a conceptual type.

Apart from the dimensions *special/general classification* and *underlying theory* derived from McKelvey's (1982) framework and the five dimensions applied by Blecker et al. (2005), the evaluation of existing classification studies also includes the presentation of a *summary of the results* and a list of the *applied classification attributes*. In short, the analysis scheme for the literature review comprises nine dimensions as displayed in Figure 17.

¹⁵ Although “easiness of attribution” is a subjective evaluation criteria, it is also applied in this work in order to refer to all five dimensions defined by Blecker et al. (2005) for evaluating work on mass customization classification.

¹⁶ In addition, empirical research is differentiated according to the *empirical-case study* and *empirical-statistical* types.

Dimension/criteria of evaluation	Values
Summary of the results	–
Applied classification attributes	–
Research type	Conceptual, empirical-case study, empirical-statistical
Exclusiveness between strategies	Available, not available
Main classification perspective	<ul style="list-style-type: none"> • Degree of product customization (also described by the type of product modularity), • Degree of customer involvement (often refers to the “customer order decoupling point”¹⁷ or to the stage in the value chain in which customers are integrated), • Other
Easiness of attribution	Easy, not easy
Specification of application suitability	Done, none
Comprehensiveness of classification	Special classification, general classification
Applied theory of classification	Essentialism, nominalism, empiricism, evolutionism

Figure 17. Analysis scheme for the literature review of existing classification studies

2.5.3 Theoretical framework for literature review of mass customization competencies

The search terms for the literature review of competencies for mass customization are supplemented by terms from the literature on the resource-based view of strategic management (cp. Appendix 2). In addition to the term (*dominant*) *competence* based on the work by McKelvey (1982), which is applied in this research, the terms (core) capability (used by Winter (2003) or Eisenhardt/Martin (2000)), resource (used by Barney (1991) and Grant (1991)¹⁸) and (success) factors (used by Hansen/Wernerfelt (1989)) are also considered for this analysis (cp. the discussion on differences between the chosen terminology within the RBV theory in Section 2.4).

For the assessment of the articles, the *research type*, a *summary of the results*, and the types of competencies are analyzed and shown. The study on the types of competencies includes an evaluation if the discussed competencies are displayed in a (comprehensive) model of competencies, or focused on a selection of competencies (either a list of competencies or individual competencies). This criterion is selected in order to determine whether existing research in the literature already considers the research question articulated in this work—the formulation of a comprehensive model of competencies for mass customization. For the purpose of providing an overview of the *comprehensiveness* of the results, the considered *area(s)* of

¹⁷ For an explanation of the “customer order decoupling point” cp. the definition of postponement in Figure 57.

¹⁸ E.g., Grant 1991 uses both terms, resource and capability, but in doing so, he differentiates between two causal levels of a firm’s internal competencies in generating a competitive advantage (with capabilities being an aggregation of resources and a more direct mediator of creating competitive advantage).

discussed competencies are analyzed. The *areas of competencies* are defined as (1) product development, (2) customer interaction, (3) production, (4) logistics, (5) IT¹⁹ systems, (6) complexity management and (7) leadership & organization.²⁰ These seven *competence areas* were conceptually derived and are based on the underlying structure of the generic value chain by Porter (1985, p. 37).²¹ Porter’s generic value chain and the derived areas of competencies are shown in Figure 18, whereby Porter’s “value activities” are meant to represent generic areas of competencies.

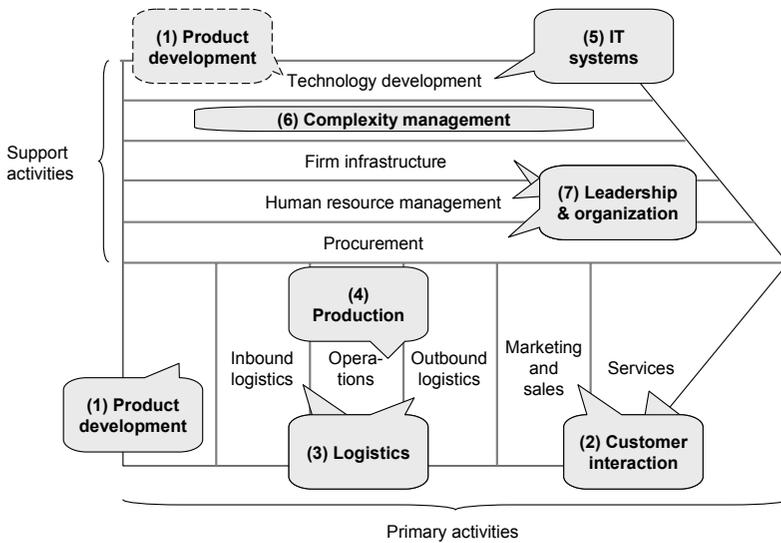


Figure 18. Porter’s generic value chain and areas of competencies²²

Product development, customer interaction, production and logistics are understood as the *primary activities of a mass customization organization*. Other than in Porter’s generic value chain, *product development* for mass customization is not considered a support activity here, but as a primary activity (product development for mass customization refers to Porter’s support activity, “technology development”). The reason for this is that mass customizers need to be able to quickly transfer customer demands into product design activities,

¹⁹ Information technology.

²⁰ In line with the research subject of this work, the literature review of competencies for mass customization focuses on internal competencies and neglects external factors (literature also discussing external factors includes: Pine II 1993; Broekhuizen/Alsem 2002).

²¹ Though Porter’s work focuses on the market-based view of strategic management, he describes important areas of generic activities or competencies, which he puts into the context of a generic value chain (Porter 1985).

²² Based on Porter 1985, p. 37.

and this can only be achieved by linking product development to customer interaction processes and the primary value chain (cp. Hart 1995, p. 43; Blecker et al. 2005, p. 37, 40). *Customer interaction* includes the activities “marketing and sales,” as well as “services,” which Porter defines as primary activities (Porter 1985, p. 37). In contrast to the generic value chain, marketing and sales—customer interaction (e.g., product configuration) in this case—occur before logistics and production activities are carried out (Piller 2003, p. 204). Mass customization *logistics* are not differentiated by “inbound” and “outbound logistics” for this work, and instead of Porter’s “operations” term, the term *production* is used for the mass customization value chain. The *support activities of mass customization* are defined as *IT systems*, *complexity management*, and *leadership & organization*. *IT systems* are valued as a separate support activity due to their importance for mass customization businesses (Peters/Saidin 2000, p. 110f; Reichwald et al. 2000, p. 5, 8); the same holds true for *complexity management* (Tseng/Jiao 2001, p. 696-698; Blecker et al. 2005, p. 38f, 45-62). *Leadership & organization* is comprised of the support activities “firm infrastructure,” “human resource management” and “procurement,” which are described by Porter (1985, p. 37). The conceptually derived mass customization value chain and areas of competencies are displayed in Figure 19.²³ These seven competence areas are used as a structure for deriving the mass customization competencies throughout this work.

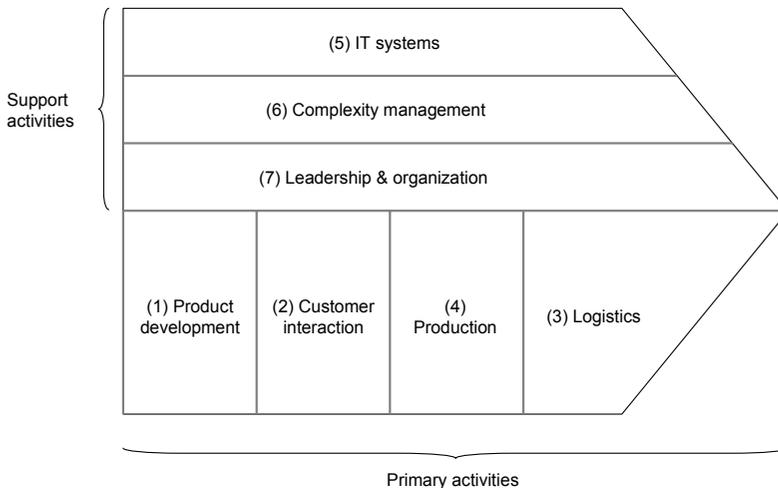


Figure 19. Mass customization value chain and seven areas of competencies²⁴

²³ Piller (2003) suggests a more detailed, yet similar mass customization value chain. The main difference compared to the model applied in this work is that Piller defines product development as a support activity (Piller 2003, p. 205).

²⁴ Based on Porter 1985, p. 37.

Figure 20 provides an overview of the resulting analysis scheme for the literature review of competencies. The analysis of literature on mass customization competencies covers the evaluation of the research type, a summary of the results, the evaluation of the comprehensiveness, and the considered areas of competencies for each article.

Dimension/criteria of evaluation	Values
Research type	Conceptual, empirical-case study, empirical-statistical
Summary of the results	–
Evaluation (of comprehensiveness)	Comprehensive model, model of competencies, list of competencies (list or individual competence)
Areas of competencies considered	(1) Product development, (2) customer interaction, (3) production, (4) logistics, (5) IT systems, (6) complexity management, (7) leadership & organization

Figure 20. Analysis scheme for the literature review of competencies

3 Literature reviews

This chapter presents the two central literature reviews of this work covering the pre-studies of mass customization classifications and competencies. For the applied method of the literature review, please refer to the framework presented in Section 2.5.

3.1 Mass customization classifications

Literature review

There are numerous articles presenting classification work in the field of mass customization. To establish a more detailed understanding, a literature review of existing classifications of mass customization was conducted. Articles were first identified by using the EBSCO Business Source Premier database and applying pre-defined search terms (for details on these search terms, see Appendix 2 and Section 2.5). From an overall total of 569 articles on the subject of mass customization, which were identified by the same literature review method, the EBSCO database search resulted in six articles presenting a classification of mass customization. The results of the literature search performed with the EBSCO database are supplemented by literature on mass customization classifications identified by other databases and sources (see applied framework in Section 2.5). An analysis of the conducted literature review and all articles is displayed in the table below (Figure 21).

For the assessment of the articles, the defined analysis scheme described in Section 2.5.2 is used. The focus of this literature review lies in the analysis of the applied research design, underlying theories and derived classification attributes. Less attention is paid to a detailed and comprehensive presentation of each article or its application to business examples, as this would go beyond the scope of this literature review. Following the overview provided by the table below, all articles are discussed, compared and evaluated in further detail.

Author	Overview	Research type	Evaluation dimensions Blecker et al. ²⁵	Evaluation dimensions McKelvey
Author	Summary of the results			
	Applied classification attributes	Conceptual, empirical-case study, empirical-statistical	Exclusiveness between strategies	Special classification, general classification
			Main classification perspective	
			Easiness of attribution	Applied theory of classification: essentialism, nominalism, empiricism, evolutionism
Specification of application suitability				
Amaro et al. 1999	<p>Amaro et al. argue that the classification method of applying the customer order decoupling point covers many traditional models. After discussing these different types of models (e.g., Hill 1993), Amaro et al. arrive at four basic degrees of product customization (which also hold classification aspects of different degrees of customer involvement): “pure,” “tailored,” “standardized,” and “none-standard product.” The authors add two more attributes to this classification: the degree of company responsibility (defines which of the following activities are pursued internally: design, specification and purchasing), and the scope of internal activities when fulfilling an order (defines which of the following activities are pursued internally: delivery, assembly, processing, purchasing, routing, specification and design). The result is a typology comprising three attributes and eleven possible categories. Amaro et al. empirically validate the model by applying it to 22 company cases.</p>			
	Degree of customer involvement; degree of product customization; degree of company responsibility; scope of internal activities when fulfilling an order	Conceptual (though empirically validated)	Not available (Amaro et al. 1999, p. 357)	Special classification
			Imprecise combination of: degree of customer involvement/ degree of product customization; scope of internal responsibility/ activities	Essentialism
			Not easy (Amaro et al. 1999, p. 358)	
None				

²⁵ Evaluation by Blecker et al. used with some modifications, cp. Blecker et al. 2005, p. 21.

Author	Overview	Research type	Evaluation dimensions Blecker et al. ²⁵	Evaluation dimensions McKelvey
Da Silveira et al. 2001	The classification study by Da Silveira et al. combines a number of models from the literature, which are discussed in their work. The result is a generic typology comprising eight “generic levels of mass customization”, which is not empirically validated (Da Silveira et al. 2001, p. 3). Similar to the model by Piller 2003, this classification applies a combination of the degree of product customization and the degree of customer involvement as the classification attribute. In contrast to Piller 2003, however, these two aspects of product and customer focus are evidently not differentiated, which makes the application of this model difficult.			
	Customer order decoupling point; degree of product customization	Conceptual	Available	Special classification
			Imprecise combination of: degree of customer involvement/ degree of product customization	
			Not easy	
None				
Duray et al. 2000 and later publications presenting same study: Duray 2002; Duray 2004	Duray et al. (2000) conceptually derive their model by partly founding it on that of Lampel/Mintzberg (1996), and by introducing the type of modularity as a second classification attribute. In doing so, the product and customer focus are differentiated for classification purposes. An examination of 126 mass customizers empirically validates the model. The survey measures financial performance as well as process, technology and manufacturing attributes for the different types of mass customization (Duray et al. 2000, p. 620).			
	Point of customer involvement; Type of modularity	Conceptual (though empirically validated)	Available	Special classification
			Degree of customer involvement; degree of product customization (described by the type of product modularity)	
			Easy	
None				
Gilmore/Pine II 1997	Gilmore and Pine develop a typology based on empirical observations of mass customization business cases. The derived model focuses on an attribute as an imprecise combination of the degree of product customization and the degree of customer involvement. The model embraces four so-called approaches: “ <i>collaborative, adaptive, cosmetic, and transparent</i> ” (Gilmore/Pine II 1997, p. 92; emphasis in original). The authors do not present an empirical validation of the model.			
	Degree of customer involvement; degree of product customization	Empirical-case study (only a few case examples are examined)	Available	Special classification
			Imprecise combination of: degree of customer involvement/ degree of product customization	
			Not easy	
None				

Author	Overview	Research type	Evaluation dimensions Blecker et al. ²⁵	Evaluation dimensions McKelvey
Lampel/Mintzberg 1996; Mintzberg 1988, p. 30f	Degree of customer involvement; degree of product customization	Conceptual (though the authors apply a few cases)	Not available	Special classification
			Imprecise combination of: degree of customer involvement/ degree of product customization	Essentialism
			Not easy	
			None	
Lee et al. 2000	Classification attributes are not explicitly stated, but the development of the three different types focuses on distinguishing different degrees of customer involvement and product customization.	Conceptual (literature-based, but some case studies are also referenced)	Not available	Special classification
			Degree of customer involvement; degree of product customization	Essentialism
MacCarthy et al. 2001	The authors suggest a larger number of classification attributes including internal and external factors.	Empirical-case study (but only a few case examples are examined)	Available	Special classification
			Not available	
			Easy	Essentialism
			None	
MacCarthy et al. 2003	Three factors and six processes of mass customization.	Empirical-case study (but only a few case examples are examined)	Available	Special classification
			Focus: degree of product customization; degree of process flexibility	Essentialism
			Easy	
			None	

Author	Overview	Research type	Evaluation dimensions Blecker et al. ²⁵	Evaluation dimensions McKelvey
Piller 2003, p. 249f	Piller derives a typology based on an analysis of a larger number of business cases. His two classification attributes are the degree of product customization and the degree of customer-oriented activities (Piller 2003, p. 249f). Compared to other authors (Lampel/Mintzberg 1996; Gilmore/Pine II 1997; Amaro et al. 1999; Da Silveira et al. 2001), Piller differentiates between these two attributes instead of merging them into one attribute. The degree of customer-oriented activities shows two distinct specifications: whether the company allows individualization in the manufacturing processes or not. If customization is done outside the company (e.g., at retailers), Piller speaks of “soft customization.” “Hard customization” on the other hand allows customization within the company’s manufacturing processes. As a result of this dual differentiation and second attribute (the degree of product customization) Piller’s model embraces six mass customization concepts, which are partly complementary (Blecker et al. 2005, p. 21).	Empirical-case study	Not available	Special classification
			Degree of customer-oriented activities; degree of product customization	
Piller et al. 2004a (see also Piller/Stotko 2003, p. 84-86)	Piller et al. present a version of the traditional classification based on the customer order decoupling point resulting in five systems of customer integration (Piller et al. 2004a, p. 443). However, this model is one-dimensional and only imprecisely combines a product and customer focus.	Empirical-case study	Not available	Special classification
			Degree of customer integration; degree of product customization	
Potter et al. 2004	Potter et al. present a holistic model, which is empirically applied, but builds on theory. They conceptually develop a model comprised of two levels. The first level encompasses the “stakeholder,” “process” and “technology.” The model is empirically applied by studying two business cases from the steel/timber industry and illustrating the application of “vendor-managed inventory (VMI)” for achieving mass customization (Potter et al. 2004, p. 473).	Conceptual (though empirically validated by applying two cases)	Available	Special classification
			The second classification level of the model covers the six attributes: “Customer differentiation,” “power,” “process capabilities,” “process requirement,” “ICT capabilities” and “information accuracy.”	
			Easy (since the definition of positions in the classification matrix is qualitative)	
			None	

Author	Overview	Research type	Evaluation dimensions Blecker et al. ²⁵	Evaluation dimensions McKelvey
Rudberg/Wikner 2004	Production customer order decoupling point: make-to-order (MTO), assemble-to-order (ATO) and make-to-stock (MTS). Engineering customer order decoupling point: engineer-to-order (ETO), adapt-to-order (ATO) and engineer-to-stock (ETS).	Conceptual	Available	Special classification
			Degree of customer involvement; degree of product customization	Essentialism
			Easy	
			None	
Spring/Dalrymple 2000	Main classification attribute: importance of mass customization compared to the non-customized business expressed by "volume required" (volume of the mass customization).	Empirical-case study	Not available	Special classification
			Differently rationales of strategically positioning mass customization within the company (importance of mass customization compared to non-customized business)	Essentialism
			Easy	
			Done	

Figure 21. Results from the literature review (classifications)

A variety of additional literature presents classification studies of mass customization or other customization strategies (Shapiro 1977; Sharma 1987; Reichwald/Dietel 1991; Konijnendijk 1993; Mayer 1993; Fisher et al. 1994; Reiß/Beck 1994; Coates 1995; Goldhar/Lei 1995; Dufour/Forte 1996; Spira 1996; Anderson 1997; Schnäbele 1997; Wortmann 1997; Kirschke/Nöken 1998; Alford et al. 2000; Reichwald/Piller 2002). The results of these works

are not discussed in further detail here, as they offer no significant contribution to the current overview and include similar or identical concepts of classification. Piller (2003, p. 246-249) presents a critical comparison of existing mass customization classifications comparable with the discussed review by Blecker et al. (2005, p. 12-23; see Section 2.5.2). All studies evaluated by Piller are also covered in this section.

Discussion of the literature review of mass customization classifications

With the exception of the *summary of the results*, which will not be further discussed here, the discussion of the literature review follows the applied analysis scheme and nine dimensions of evaluation. The identified articles show that there are many different approaches to classifying mass customization in research. Classification models mainly differ by the types of applied attributes, although many models utilize product and customer-oriented attributes. Only a few models are empirically derived (Gilmore/Pine II 1997; Spring/Dalrymple 2000; MacCarthy et al. 2001; MacCarthy et al. 2003; Piller 2003; Piller et al. 2004a), but most have been empirically validated. No researcher has specified any application suitability of the presented models, and no classification model, or the development of a classification model, fulfills McKelvey's (1982) rigorous evaluation dimensions. Ultimately, this means that no model based on the theory of empiricism leads to a general classification.

Discussion of the dimensions applied classification attributes, exclusiveness between strategies, and main classification perspective

Chronologically seen, the focus of classification studies of mass customization first shifted from an initial product and manufacturing focus to a customer focus, and later to models with a broader set of classification attributes. The first classification studies that were ever published had an exclusive product and manufacturing focus, applying the degree of product customization as the only classification attribute. Literature presenting models of this type include Maruchek/McClelland (1986), Vollmann et al. (1988) Dilworth (1989), Hendry/Kingsman (1989), Bertrand et al. (1990), Cox et al. (1992), Wortmann (1992), Handfield (1993), Schroeder (1993) and New/Szwejczewski (1994).

Classification studies later introduced the degree of customer involvement to the value chain as a suitable classification attribute, but most literature of this type (Lampel/Mintzberg 1996; Gilmore/Pine II 1997; Amaro et al. 1999; Da Silveira et al. 2001; Piller et al. 2004a) is problematic because no explicit differentiation is made between the two attributes of the degree of product customization and degree of customer involvement (see also Kreuzer 2005, p. 56f). Instead, these studies combine both dimensions into one attribute, resulting in classifications that cannot be easily applied. The models by Duray et al. (2000), Lee et al. (2000), Piller (2003) and Rudberg/Wikner (2004) utilize both of these attributes, but differentiate between the two aspects of

classification. An ideal classification of mass customization must include a product and customer focus, but should obviously differentiate between the two dimensions by applying two separate attributes (Broekhuizen/Alsem 2002, p. 313).

The objective of classification studies that do not simply have an exclusive product or customer focus is to provide a classification of mass customization with a more comprehensive set of attributes. See the evaluation dimension *applied classification attributes* in Figure 21 for more details on the attributes used in each model. One classification with a broader perspective is that of Rudberg/Wikner (2004), who argue that the production-oriented customer order decoupling point (CODP) must be extended by a second dimension, and introduce the engineering CODP. The resulting typology makes a more precise differentiation between mass customization examples by separately evaluating production and engineering aspects. In the above-mentioned models that use CODP as a main attribute for classification, these two aspects are not closely related.

Amaro et al. (1999) have also extended the product/customer focus of the existing classification models by adding two more attributes that define the scope of internal activities. The result is a more comprehensive model that serves more precise classification means (Amaro et al. 1999, p. 355). Yet although it's more comprehensive, this model has its limitations. "[Four out of 22] companies did not exactly match the specification of the category to which they were allocated in every detail" (Amaro et al. 1999, p. 358). As a consequence, the authors suggest adding four additional attributes to the classification mode: the number of customers, the nature of the relationships with the customers, the number and type of usage of materials, and the nature of the buying process (Amaro et al. 1999, p. 361). However, these attributes have not been incorporated in the typology.

MacCarthy et al. (2003) have also expanded the pure product or customer focus by implementing process-oriented classification attributes (in an earlier study, the authors make a different attempt of broadening the scope of applied classification attributes: MacCarthy et al. 2001). One typology with completely new attributes compared to older studies is given by Potter et al. (2004), who apply a wider set of classification attributes.

The work of Spring/Dalrymple (2000) represents an exceptional typology within the group of reviewed studies, since its focus is strategic and is not based on a number of operational classification attributes like all the other models. This typology primarily seeks to answer the question as to what strategic reason a company has for pursuing mass customization. The underlying assumption of all other typologies analyzed in this section is that companies pursue mass customization as a business that generates profits. Based on this, these typologies aim at identifying different types of profitable mass customization businesses and, thus, focus on operations instead of strategic attributes. The typology by Spring/Dalrymple (2000) is rooted in the rationale that there are different strategic roles of mass customization. The

four proposed types of mass customization do not all just represent profitable business strategies, but also concepts for supporting other business goals²⁶ such as the operation of a mass or craft manufacturing business (Spring/Dalrymple 2000, p. 463). The study by Spring/Dalrymple (2000) will be discussed in greater detail in Chapter 7.

The existing classification models in the literature all focus on a selection of classification attributes. In summary, it can be said that the classifications presented here are lacking a sufficient level of comprehensiveness in regard to applied classification attributes and are therefore typologies (as opposed to taxonomies). The existence of such a large number of classification models is the result of the very fact that these models are typologies, as each model builds on a different selection of classification attributes (Christensen et al. 2002, p. 11).

Discussion of the dimensions easiness of attribution and specification of application suitability

The ease of applying the studied typologies by attributing business cases to the respective types is low for those models that build on imprecise combinations of product and customer focused classification attributes (Lampel/Mintzberg 1996; Gilmore/Pine II 1997; Amaro et al. 1999; Da Silveira et al. 2001; Piller et al. 2004a). These models do not offer a clear distinction between the two classification dimensions, which results in a low degree of practicality. Generally speaking, it can be said that most models do not offer the well-defined attributes and values necessary for guaranteeing a simple and practical application.

Many researchers have developed a typology within the framework of other research objectives and have not primarily aimed at identifying different mass customization types. Duray et al. (2000), for example, develop a classification for being able to study the financial and operational performance of mass customizers as the primary research objective, and Potter et al. (2004) lay out a more comprehensive model in order to examine the application of vendor-managed inventory for achieving mass customization. Yet neither of these studies was primarily focused on the subject of organizational classification per se.

Discussion of the dimensions research type, comprehensiveness of classification and applied theory of classification

No existing classification model is based on the theory of empiricism, though researchers have often applied their conceptually developed model to business

²⁶ “Other business goals” relates to business strategies outside the primary focus of operating a profitable and sustainable mass customization business. See also the definition of *strategy* in Chapter 2 and the discussion of the mass customization strategies in Chapter 7.

examples. No research has empirically derived a classification scheme resulting in a comprehensive set of classification attributes. As discussed above, all identified classification studies utilize a limited number of attributes and often focus on the degree of product customization and/or the degree of customer involvement. The more comprehensive models (Amaro et al. 1999; MacCarthy et al. 2003; Potter et al. 2004; Rudberg/Wikner 2004) still do not make use of a sufficient number of attributes or the application of methods of numerical phenetics. As a result, all reviewed models are special classifications or typologies, not taxonomies. This conclusion is not surprising; while reviewing classification studies in the management research in general, McKelvey (1982) also found that “[...] all of the major typologies and empirical classifications were inadequate in terms of at least one of the essential elements of an ideal classification [...]” (McKelvey 1982, p. 167).

Apart from the absence of a profound theoretical foundation in all of the presented classification studies, as well as their lack of comprehensiveness, the existing models also pose limitations in regard to their practical applicability (Blecker et al. 2005, p. 22). Blecker et al. argue that “[...] each model in the literature reflects a particular definition of mass customization and therefore a specific perspective when dealing with mass customization” (Blecker et al. 2005, p. 43). In the context of this research and the question of deriving a taxonomy, the author cannot support this argumentation, since taxonomies should be based on the analysis and grouping of actual organizations, and are not intended to provide a specific perspective of reality. In comparison to this work, Blecker et al. focus their understanding of classification on typologies—in this case, a few simple and basic characteristics are applied for grouping organizations (see Sections 2.1 and 2.3).

Summary of the literature review of mass customization classifications

The major limitations of the existing mass customization classifications are their lack of empirical foundation and their focus on a small number of classification attributes. All of the identified classification models are special classifications, and most models focus on a product and customer perspective for classification purposes. Moreover, these models lack sufficient practicability and ease of use. Finally, most studies on classifying mass customization do not seek to explicitly derive a comprehensive model for general use, but utilize the developed models primarily for other research purposes.

The fundamental question of an empirically derived and comprehensive model for classifying mass customization has not yet been sufficiently answered by existing research on mass customization. The lack of such a study presenting a mass customization taxonomy motivates and supports the research behind this work.

3.2 Mass customization competencies

Literature review

Many studies in the field of mass customization cover the question of mass customization competencies. A literature review of competencies provides a detailed view, which is derived from an analysis of the EBSCO Business Source Premier database. A pre-defined list of search terms was used to identify the relevant articles (for details on these search terms, see Appendix 2 and Section 2.5). 47 articles discuss capabilities and resources for mass customization.

An analysis of the conducted literature review is displayed in Figure 22. The table shows the types of competencies that are presented and examined in the underlying study. To assess the articles, the framework presented in Section 2.5.3 is applied. The conceptual structure of the seven competence areas was derived from the generic value chain by Porter (1985, p. 37). Following the overview provided in these tables, all articles on mass customization competencies are discussed, compared and evaluated further below.

Author	Research type	Evaluation	Areas of competencies considered						
			(1) Product development	(2) Customer interaction	(3) Production	(4) Logistics	(5) IT systems	(6) Complexity management	(7) Leadership & organization
	Conceptual, empirical-case study, empirical-statistical	Comprehensive model, model of competencies, or list of competencies (list or individual competence)							
Akkermans et al. 2003	Conceptual	List of competencies				X	X		
Alfnes/Strandhagen 2000	Empirical-case study	List of competencies			X	X	X		
Bak 2003	Empirical-case study	List of competencies			X				
Barnett et al. 2004	Conceptual	List of competencies		X	X	X	X	X	X
Bourke/Arts 1999	Conceptual	List of competencies	X	X			X		
Bramham/MacCarthy 2004	Empirical-case study	List of competencies		X		X			
Brown/Bessant 2003	Empirical-case study	List of competencies			X	X			X
Byrd 2001	Empirical-case study	List of competencies					X		
Chatha et al. 2003	Empirical-case study	List of competencies	X						
Duray 2004	Empirical-statistical	List of competencies	X	X	X				

Author	Research type	Evaluation	Areas of competencies considered							
Economist 1998	Empirical-case study	List of competencies						X		
Ettlie/Ward 1997	Empirical-case study	List of competencies			X					X
Ettlie 2000	Empirical-case study	List of competencies			X					X
Feitzinger/Lee 1997	Empirical-case study	List of competencies	X		X	X				
Frutos/Borenstein 2004	Conceptual	List of competencies						X		
Fung et al. 2002	Empirical-statistical	List of competencies	X	X						
Gershenfeld 2005b	Empirical-case study	List of competencies	X							
Gilmore/Pine II 1997	Empirical-case study	List of competencies	X	X						
Helander/Jiao 2002	Conceptual	List of competencies	X							
Jameson 2001	Empirical-case study	List of competencies		X						
Kotha 1995	Empirical-case study	List of competencies	X	X	X	X	X	X		X
Larson 1998	Empirical-case study	List of competencies						X		
Ma et al. 2002	Empirical-statistical	List of competencies			X	X				
Mankikar 1998	Empirical-case study	List of competencies	X	X	X					
Mann 2000	Empirical-case study	List of competencies			X			X		
Melnyk et al. 2000	Conceptual	List of competencies					X			
Napoleon/Gaimon 2004	Empirical-statistical	List of competencies						X		X
Oleson 1998	Empirical-case study	List of competencies			X	X				
Parker 2000	Empirical-case study	List of competencies								X
Peters/Saidin 2000	Empirical-case study	List of competencies								X
Potter et al. 2004	Empirical-case study	Model of competencies	X	X	X	X	X	X	X	X
Rangarajan 2000	Empirical-case study	List of competencies					X			
Robertson/Ulrich 1998	Empirical-case study	List of competencies	X							
Rudberg/Wikner 2004	Conceptual	List of competencies	X		X					
Sahin 2000	Conceptual	List of competencies		X	X					X
Shalvi 2004	Empirical-case study	List of competencies	X		X					
Smith/Rupp 2003	Conceptual	List of competencies						X	X	
Su et al. 2005	Empirical-statistical	List of competencies			X	X				

Author	Research type	Evaluation	Areas of competencies considered							
Tu et al. 2001	Empirical-statistical	List of competencies			X					
Tu et al. 2004a	Empirical-statistical	List of competencies	X	X	X					
Tu et al. 2004b	Empirical-statistical	List of competencies			X					
van Hoek 2000	Empirical-statistical	List of competencies			X	X				
Vrechopoulos 2004	Empirical-case study	List of competencies		X						
Wathen 1993	Conceptual	List of competencies			X					
Weil 1999	Empirical-case study	List of competencies					X			
Yao/Carlson 2003	Conceptual	List of competencies			X	X				
Zipkin 2001	Empirical-case study	Model of competencies		X						X

Figure 22. Results from the literature review (competencies)

The identified articles show that most research focuses on the analysis of a selection or even only on individual competencies. Two articles present models of competencies (Zipkin 2001; Potter et al. 2004), yet these works are rather conceptual, because the models are empirically applied, not empirically founded. When validating their model, Potter et al. (2004), for example, apply only two business cases from two similar industries.

However, this literature review does also show the relevance of all pre-defined competence areas, although competence area (6), complexity management, is covered in only three articles, whereas competence area (3), production, is discussed in 23 of the 47 analyzed articles. Between 11 and 14 articles cover the other five competence areas. Finally, this overview illustrates that most work on mass customization competencies is done empirically by means of case study research; very few articles present quantitative work on competencies.

Before discussing the articles in more detail, the literature review is extended by other studies left unmentioned in the literature review based on the EBSCO database. The following table (Figure 23) uses the same format as the presentation of the literature review in Figure 22, but also includes short summaries of the results of each article and shows supplementary work on mass customization competencies, thus extending the view of the previously discussed articles (some articles from above are repeated and discussed in more detail). Although these articles present more comprehensive work on competencies, their assessment still arrives at the same conclusion: empirically founded work on comprehensive models of competencies for mass customization is insufficiently covered in the literature on mass customization.

Author	Research type	Summary of the results	Evaluation	Areas of competencies considered						
				(1) Product development	(2) Customer interaction	(3) Production	(4) Logistics	(5) IT systems	(6) Complexity management	(7) Leadership & organization
(*) These articles are also discussed and evaluated in the literature review by Blecker et al. (2005)	Conceptual, empirical-case study, empirical-statistical		Comprehensive model, model of competencies, or list of competencies (list or individual competence)							
Amaro et al. 1999	Empirical-case study	To define a classification of mass customization, the application of different competencies is empirically measured (e.g., the degree of internal activities).	Model of competencies	X	X	X	X			X
Berman 2002 (*)	Conceptual	Expands on the work by Zipkin (2001) and presents a checklist with a large number of capabilities concerning the areas of customer and market characteristics, as well as technical, organizational and personal skills (Berman 2002, p. 59).	Model of competencies	X	X	X	X	X		X
Blecker et al. 2005	Conceptual	A conceptual model covering “necessary conditions for achieving mass customization” is presented. Conditions include those before and after having implemented mass customization, as well as internal and external factors (Blecker et al. 2005, p. 23).	Model of competencies	X	X	X	X		X	X

Author	Research type	Summary of the results	Evaluation	Areas of competencies considered							
Broekhuizen/Alsem 2002 (*)	Conceptual	A conceptual model of success factors includes views on customer, product, market, industry and organizational factors (Broekhuizen/Alsem 2002, p. 326).	Model of competencies	X	X	X	X	X			X
Da Silveira et al. 2001	Conceptual	Da Silveira et al. present six success factors of mass customization systems: 1. " <i>Customer demand for variety and customization must exist.</i> " 2. " <i>Market conditions must be appropriate.</i> " 3. " <i>Value chain should be ready.</i> " 4. " <i>Technology must be available.</i> " 5. " <i>Products should be customizable.</i> " 6. " <i>Knowledge must be shared.</i> " (Da Silveira et al. 2001, p. 4; emphasis in original)	Model of competencies	X	X	X	X	X			X
Duray et al. 2000; Duray 2002; Duray 2004	Empirical-statistical	Empirically analyzed competencies comprised of product strategies, customer interaction, product modularity, manufacturing and IT systems (Duray et al. 2000, p. 620).	Model of competencies	X	X	X		X			X
Feitzinger/Lee 1997	Empirical-case study	Key competence is postponement (Feitzinger/Lee 1997, p. 116).	List of competencies	X		X	X				

Author	Research type	Summary of the results	Evaluation	Areas of competencies considered						
Fung et al. 2002	Empirical-statistical	The optimization of product characteristics to achieve customer satisfaction is crucial to product design. A model is proposed to support Quality Function Deployment (QFD) (Fung et al. 2002, p. 598).	List of competencies	X	X					
Gilmore/Pine II 1997	Empirical-case study	The key competence for mass customization lies in simultaneously managing the four approaches to customization (“collaborative,” “adaptive,” “cosmetic,” and “transparent” approach; Gilmore/Pine II 1997, p. 95).	List of competencies	X	X					
Haddock et al. 2005	Empirical-case study	Haddock et al. present five principles of Smart Customization: “1. Approach customization strategically 2. Quantify value of variety 3. Root out costs of complexity 4. Align the business model 5. Manage change programmatically” (Haddock et al. 2005, p. 2).	Model of competencies	X	X			X	X	

Author	Research type	Summary of the results	Evaluation	Areas of competencies considered								
Hart 1995 (*)	Conceptual	Four key decision factors describe the capability of management to implement mass customization: “customer [customization] sensitivity,” “process amenability,” “competitive environment,” and “organizational readiness” (Hart 1995, p. 39).	Model of competencies		X	X	X	X	X	X	X	X
Kotha 1995 (*) Kotha 1996a (*)	Empirical-case study	Success depends on external conditions (industry factors) and internal conditions: manufacturing/information technologies, leadership and organization, process technology, and marketing expertise (Kotha 1996a, p. 449).	Model of competencies		X	X	X	X	X			X
MacCarthy et al. 2001	Empirical-case study	Key performance measures of mass customization are identified in (MacCarthy et al. 2001, p. 2f): “environment” (industry factors), “type of customization,” strategy (“product structure,” etc.) and “operations” (process design, “product development,” etc.).	Model of competencies		X	X	X	X				

Author	Research type	Summary of the results	Evaluation	Areas of competencies considered						
Mchunu et al. 2003 (*)	Conceptual	In this publication, Mchunu et al. (2003) present five factor variables as key competencies: (1) “variety management effectiveness,” (2) “communication and information management efficiency,” (3) “top management support,” (4) “supply chain management efficiency,” and (5) “new product development ability” (Mchunu et al. 2003, p. 431).	Model of competencies	X			X	X	X	X
Peters/Saidin 2000	Empirical-case study	This study presents a framework “to assist firms in prioritizing implementation requirements” (Peters/Saidin 2000, p. 103).	Model of competencies	X			X			X
Piller et al. 2004a	Conceptual/ Empirical-case study	Competencies described as “sources and drivers of economies of integration”: decoupling and postponement, access to sticky information and generation of customer knowledge, efficient utilization of the customer base, and the optimal extent of customer interaction (Piller et al. 2004a, p. 439).	Model of competencies	X	X	X	X	X	X	X

Author	Research type	Summary of the results	Evaluation	Areas of competencies considered								
Pine II 1993 (*)	Empirical-case study	Pine's "market-turbulence map" indicates external conditions of mass customization (Pine II 1999, p. 56, 67).	(Model of external conditions)									
Potter et al. 2004	Empirical-case study	A typology of mass customization is conceptualized. This typology is comprised of classification criteria covering competencies related to the aspects "stakeholder," "process," and "technology" (Potter et al. 2004, p. 476).	Model of competencies		X	X	X	X	X	X	X	X
Su et al. 2005	Empirical-statistical	Key competence is postponement.	List of competencies			X	X					
Tu et al. 2001	Empirical-statistical	High competence in time-based manufacturing is vital for mass customization success.	List of competencies				X					
Wikström 1996a	Empirical-case study	A list of competencies in design/ development, production, marketing, consumption and destruction is developed from case study research (Wikström 1996b, p. 363-370).	Model of competencies		X	X	X		X			X
Yunfeng/Minglei 2005	Conceptual	This study presents a model of success factors from a literature review (Yunfeng/Minglei 2005, p. 4).	Model of competencies	X	X	X	X	X				X

Author	Research type	Summary of the results	Evaluation	Areas of competencies considered						
Zipkin 2001 (*)	Empirical-case study	Mass customization builds on three key capabilities: "elicitation," "process flexibility," and "logistics" (Zipkin 2001, p. 82).	Model of competencies		X	X	X	X		X

Figure 23. Results from an extended literature review (competencies)²⁷

Discussion of the literature review of mass customization competencies

Literature that discusses, compares and evaluates existing work on competencies is scarce. Blecker et al. (2005) presented the results of such a research, but included only a small selection of eight articles (Blecker et al. 2005, p. 23-29)²⁸. One can criticize the lack of an applied theoretical framework in the literature evaluation of Blecker et al. Other studies that reviewed and compared existing literature on mass customization competencies also failed to apply a uniform theoretical framework in their evaluation, though some did use comparative measures (Da Silveira et al. 2001; Berman 2002; Broekhuizen/Alsem 2002; Yunfeng/Minglei 2005). Due to this fact, the following discussion reviews the results of the above-mentioned literature utilizing the theoretical framework by McKelvey (1982).

McKelvey's definition of dominant competencies concerns internal factors: "a primary task" or "a workplace-management task" (McKelvey 1982, p. 174, 179). Following this definition, none of the external factors presented by some of the above-mentioned authors are considered dominant competencies. Pine II's (1999) market turbulence map and the external factors described by Hart (1995), Kotha (1996), Da Silveira et al. (2001), MacCarthy et al. (2001), Berman (2002), Broekhuizen/Alsem (2002), Potter et al. (2004) and Blecker et al. (2005) are irrelevant in this context. However, this also shows that many researchers consider external factors important in the context of mass customization factors and competencies.

The internal competencies presented in the literature are often difficult to relate to specific tasks or activities, and can hardly be associated with an effect on the output of an organization or the resources required (McKelvey 1982, p. 174, 179). Zipkin (2001) postulates the key capability of "process flexibility"

²⁷ Literature study performed in addition to the literature reviews presented in Figure 22. This literature study made use of databases other than the EBSCO Business Source Premier database and also includes some of the previously mentioned articles.

²⁸ Cp. Figure 23 for an overview of the literature discussed by Blecker et al. (2005; marked with *).

(Zipkin 2001, p. 83), but does not clarify what activities generate which level of flexibility, or how process flexibility results in an increased output or a decreased level of required resources. More promising results are presented by Wikström (1996), who offers a long list of empirically derived competencies and also describes the specific tasks and activities on a more operational level. He explains that in order to realize customer integration, a “specially trained salesperson” (Wikström 1996b, p. 364) is needed and marketing activities must include “interactive media” (Wikström 1996b, p. 367). It remains unclear, however, exactly how these activities directly affect the company’s performance (a confirmation of this effect would be needed in order to identify the dominant competencies for mass customization; compare the theoretical framework presented in Chapter 2). This also holds for most of the other research work, which presents a model of competencies, but does not correlate these with specific tasks or effected output and resources (Amaro et al. 1999 and Piller et al. 2004a).

In summary, this literature review illustrates that most work on mass customization competencies is based on empirical research using case study research, but no work presents a comprehensive model of mass customization competencies. Very few articles reveal any quantitative work on competencies at all. Although Blecker et al. (2005) call their model comprehensive, they only present a list of “main conditions” (Blecker et al. 2005, p. 30) that are conceptually, not empirically, derived.

The literature study on competencies motivates research of an empirically founded comprehensive model of competencies, as the existing literature does not adequately cover this open field. Most notably, none of the studies present a model of mass customization competencies that can be applied within the chosen theoretical framework (McKelvey) as a basis for deriving the dominant competencies for mass customization.

This literature review builds the basis for discussing the results from empirical studies on mass customization competencies presented in this work. In particular, Chapter 6 will refer to most of the studies mentioned here in Section 3.2.

4 Empirical research design

Before discussing and presenting the *empirical research design* of this work, the basic terms in the methodological section of this work are defined. These definitions include commonly used terms and are based on existing views and definitions in the literature (particularly Easterby-Smith et al. 2002).

This work distinguishes between two levels of terminology:²⁹

- *research design* and
- *research method* or *technique*.

The term research design

Research design “is the logic that links the data to be collected (and the conclusions to be drawn) to the initial questions of study” (Yin 2003, p. 19). The specific setup of applied methods and techniques, the type of involvement by researchers, and the research questions and subjects result in different research designs for every study. The definition given by Easterby-Smith et al. (Easterby-Smith et al. 2002, p. 43) summarizes this understanding: “Research designs are about organizing research activity, including the collection of data, in ways that are most likely to achieve the research aims.”

Typical research designs include case study research, grounded theory, or survey research (for an overview, see Easterby-Smith et al. 2002, p. 56). Research designs are widely described and discussed in the management research literature, and there are often different viewpoints of how to conduct research utilizing a specific research design. As a consequence, researchers not only have to apply a specific research design like case study research to their work, but also link it to previous work (e.g., that of Yin 2003 in the instance of case study research).

The term research method/technique

The second level of terminology refers to the terms *research method* or *technique*. A research method is an individual instrument that enables researchers to collect and analyze data (Easterby-Smith et al. 2002, p. 86). Research methods are “individual techniques for data collection” (Easterby-Smith et al. 2002, p. 31).

Management research generally distinguishes between quantitative and qualitative research techniques. Quantitative techniques primarily cover

²⁹ Although Easterby-Smith et al. (2002) also use the term methodology defined as a “combination of techniques used to enquire into a specific situation” (Easterby-Smith et al. 2002, p. 31), the term methodology is not used in this work, so as to reduce the complexity of too many different, yet indistinguishable, terms.

questionnaires and surveys (Easterby-Smith et al. 2002, p. 130), whereas qualitative techniques, which are used in this work, include “interviews, observation and diary methods” (Easterby-Smith et al. 2002, p. 86).

Empirical research projects of this work

This research builds on the results of two separate, but coordinated empirical research projects within the field of mass customization. Both projects were initiated by the Institute for Information, Organization and Management (IOM) at the TUM Business School, Technische Universität München. The first project examined mass customization cases in a broader business context. This research project, titled *international mass customization casebook project (casebook project)*, offers a deeper understanding particularly of hypotheses on the different types of mass customization, and also presents results concerning applied competencies. The second project, the *industry research group on mass customization (industry research group)*, mainly presents empirical case data for deriving dominant competencies for mass customization, which denote the conceptual basis for developing a classification (cp. Chapter 2). In addition, the empirical results of this project offer access to mass customization case studies for studying the different mass customization types. Both projects build on case study research. This empirical research method is introduced in this chapter. The *international mass customization casebook project* is conducted together with an international research group and conceived as part of the overall research presented with this work (Yin 2003, p. 150). Both projects generally provide empirical case data on mass customization competencies and cover empirical data for examining the different types of mass customization. However, while the casebook project emphasizes classification and identification of types, the industry research group stresses the identification of competencies.

Research agenda of this work

In order to structure the applied empirical research design of this work, the following research agenda offers an overview (see Figure 24). The theoretical framework (Chapter 2) and the empirical research design in this chapter are the underlying basis of this research agenda.

In the *first research step*, the work with the industry research group results in an empirically derived preliminary set of mass customization competencies. The content analysis method is used to obtain these results, which are presented in Chapter 4.

In the *second research step*, the international mass customization casebook project and case data from the industry research group project deliver empirical evidence for verifying the dominant competencies from the competence list derived in the *first step*. The applied evaluation scheme building on the within-case analysis is presented in this chapter; results are presented in Chapter 6.

The *third research step* of this work includes the shaping of hypotheses on different mass customization strategies (types). Again, both research projects provide empirical insights for forming these hypotheses, which will be discussed in Chapter 7. To derive the hypotheses, a cross-case comparison of all cases is performed.

A subsequent *fourth research step* would comprise the undertaking of a quantitative empirical research study in order to empirically identify the different strategies (types) of mass customization and verify the hypotheses from the *third research step*. This fourth research step, possibly encompassing survey techniques, is not part of this work and will be outlined as a proposal for future research in more detail in Chapter 9.

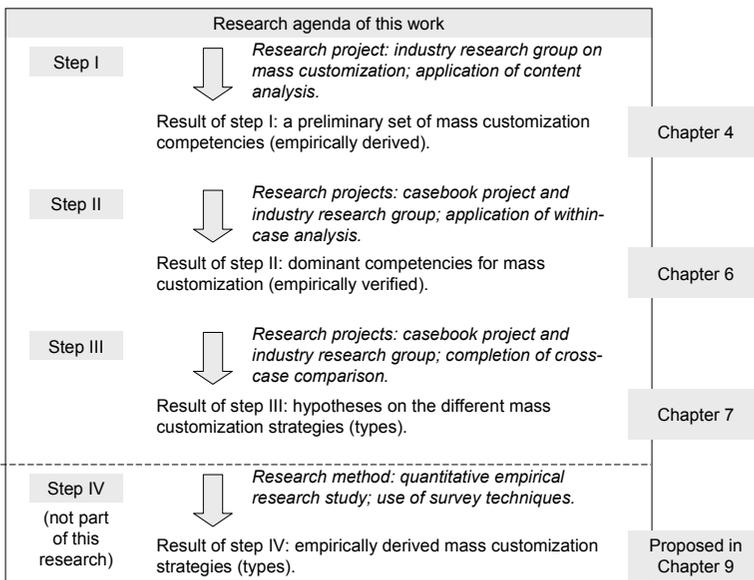


Figure 24. Research agenda of this work

4.1 Case study research

Yin (2003) defines case study research as “an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident” (Yin 2003, p. 13).

Since the central question of this research is the identification of the existing types of mass customization, the phenomenon of mass customization (undoubtedly contemporary) and the context of organizational classification

can hardly be separated for this research. In such, case study research seems to be an appropriate empirical research design. Moreover, it is recommended for studying such a new phenomenon as mass customization, since research in this field is still in an early stage (Eisenhardt 1989, p. 548; Yin 2003, p. 1; Piller 2005c, p. 328; see also Section 1.2).

4.1.1 Introduction to case study research

Most studies applying case study research in the current literature refer to Eisenhardt (1989), Hamel et al. (1993), Miles/Huberman (1994), Stake (1995), or Yin (2003), though this research design goes back the work of Glaser/Strauss (1967). Basically, there are two different types of case study research: teaching case studies and research case studies (Yin 2003, p. 10). Teaching cases are used to teach about specific aspects of management research and due to this objective, the content of these cases is often changed to point out a specific aspect. In contrast to this, research case studies accurately document all empirical data in order to build a foundation for explorative research. In this work, the primary objective is to develop research case studies even though the developed case descriptions may also denote a basis for teaching cases (but certainly no case data are altered for teaching purposes).

Research case studies can be characterized as having five different objectives. The primary objective of this work is to “explain” and “explore” (Yin 2003, p. 15). The rich data of both projects are used to build a basis for the explorative research described in the work (see also Gummesson 2000, p. 75). The case study research presented here also aims to “describe” and “illustrate” existing mass customization companies (Yin 2003, p. 15) in order to develop a case collection. The fifth possible objective of research case studies mentioned by Yin, to “meta-evaluate,” is of less relevance in both of the above-mentioned empirical case study projects.

4.1.2 Case study research in management research

Case study research is a widely accepted form of research design in today’s social sciences, despite having had been the subject of major critique in the past. Yet the increasing use of this research design in management research shows that the times have changed (Gummesson 2000, p. 191; Yin 2003, p. xiii): today, case study research is also a commonly accepted form of research design in the field of mass customization. As shown in Section 3.2, a literature review of competencies revealed that 27 studies from 47 identified articles are based on case study research. This means that 47 percent of the studies covering this particular topic applied case study research.

Figure 25 presents representative studies that implement case study research in the mass customization field. These studies are analyzed in order to support the development of a case study research framework for this work.

The selection is intended to present all studies with a research objective similar to that of this work and all of them were previously discussed in greater detail in Chapter 3.

In all reviewed studies, data sources are not only accessible documents, but also interviews or direct observations made by the researchers, who are all from academia with the exception of a manager in one case. The number of studied cases varies, depending on the research question. Pillier's (2003) work builds on a large number of cases, as its purpose is to develop a classification. With the exception of one study covering a number of cases (Zipkin 2001), all studies focus on the in-depth examination of only one case. The relevant conclusion of these studies for this work is that multiple data sources are a success factor for these types of studies, and direct interaction with the studied company via interviews seems to be the most promising technique for data collection. Close collaboration with the researched companies helps derive empirical data.

Author/ Study	Description of cases	Research problem	Data sources	Re-searchers	Results
Feitzinger/Lee 1997	One case: Hewlett-Packard.	How does a large electronics manufacturer deploy mass customization?	Interviews, qualitative assessment.	Joint team of researchers and one manager.	Postponement is identified and described as the key enabler of mass customization.
Kotha 1996a	One case: the national industrial bicycle company of Japan.	Identify the competencies of a pioneering mass customization company.	Interviews, qualitative assessment.	Academic.	Success of mass customization companies depends on external (industry factors) and internal conditions.
Peters/Saidin 2000	One case: IBM Malaysia (IT vendor).	Identify the internal and external factors supporting and hindering the adoption and implementation of mass customization.	Documentation, interviews, direct observations and participant observations.	Academic.	This study presents a framework on how "to assist firms in prioritising implementation requirements" (Peters/Saidin 2000, p. 103).

Author/ Study	Description of cases	Research problem	Data sources	Re-searchers	Results
Piller 2003	About 140 cases: various industrial sectors (about 60% B2C and 40% B2B) and locations (approx. 40% German, 40% U.S. and 20% rest of world).	Develop a classification of mass customization.	Interviews, qualitative assessment.	Academic.	Mass customization companies can be classified applying the two classification attributes of the degree of product customization and the degree of customer-oriented activities (Piller 2003, p. 249f).
Zipkin 2001	Around a dozen cases from various industries.	Identify the competencies of mass customization companies.	Not documented.	Academic.	Mass customization builds on three key capabilities: elicitation, process flexibility, and logistics (Zipkin 2001, p. 82).

Figure 25. Studies utilizing case study research in the mass customization field³⁰

4.1.3 Forms of case study research

Different forms of case study research exist, depending on the underlying method of access to case data, which is also determined by the different roles researchers can hold. Classical case study research requires a detached researcher (Eisenhardt 1989; Yin 2003) and typical data collection methods include “archives, interviews, questionnaires, and observations” (Eisenhardt 1989, p. 534). In contrast, as another form of case study research, action research requires an involved researcher (Gummesson 2000) and its proposed collection methods also include researcher participation in the studied context, usually in the scope of a project. “An action scientist is both an academic researcher and a management consultant taking on the role of change agent.” (Gummesson 2000, p. 108) A new form of case study research is the industry research group where the researcher is involved in a long-term project that is conducted together with managers from the industry. The degree of the researcher’s involvement is not as high as in an action research context and the applied methods of data collection are basically the same as in classical case study research. With this work, the industry research group is introduced to management science as a form of case study research. See Figure 26 for an overview of the forms of case study research.

³⁰ Analysis scheme by Eisenhardt 1989, p. 535 applied.

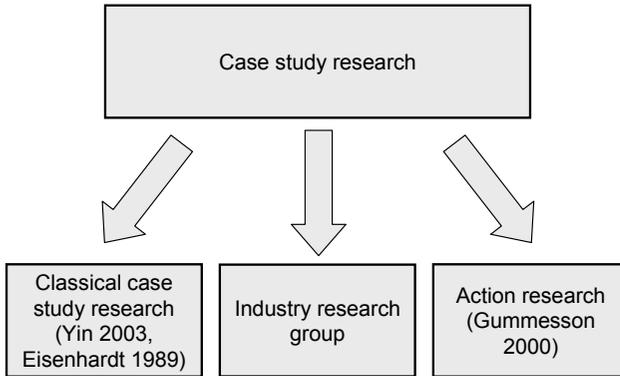


Figure 26. Forms of case study research

Of the above three forms of case study research, action research will not be pursued within the *empirical research design* of this work. The international mass customization casebook project is based on classical case study research, and the second project presented in this work is based on the industry research group form. The resulting *empirical research design* is summarized in Figure 27 and will be introduced in this chapter in detail.

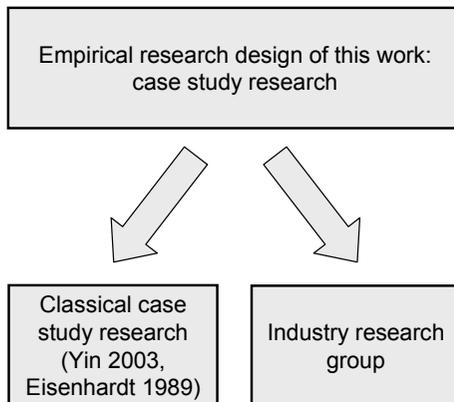


Figure 27. Empirical research design of this work

4.1.4 Stages of case study research

Eisenhardt (1989) defines eight steps of doing case study research, which are modified for the research purposes of this work (Eisenhardt 1989, p. 533). The “shaping hypotheses” step is not emphasized in either project of this work and is therefore omitted as a separate step and included in “analyzing

data.”³¹ Due to the involvement of a large research consortium within the international mass customization casebook project, and the complexity and volume of the empirical data from the industry research group project, the research step “documenting data” is added to Eisenhardt’s (1989) framework. The resulting eight steps of conducting case study research in this work are (1) “getting started,” (2) “selecting cases,” (3) “crafting instruments,” (4) “entering the field,” (5) “documenting data,” (6) “analyzing data,” (7) “enfolding literature” and (8) “reaching closure” (Eisenhardt 1989, p. 533).

The research process and activities within both projects differentiate between four steps. The research steps “getting started,” “selecting cases” and “entering the field” are also focused on in the industry research group context, but termed differently. In this work, our respective research steps are (1) *defining the research objective and scope*, (2) *recruiting the industry research group* and (4) *holding the industry research group meetings*. The step “reaching closure” is irrelevant in the context of the industry research group, as this form of case study research requires a fixed research objective and scope which is agreed on by all participants at the beginning of the project (and remains unaltered throughout, e.g., the process terminates at an agreed point of time). A comparison of the two research projects in regard to pursued research steps is given in Figure 28.

Research steps in conducting case study research in the context of the international mass customization casebook	Research steps in conducting case study research with an industry research group
1. Getting started	1. Defining the research objective and scope
2. Selecting cases	2. Recruiting the industry research group
3. Crafting instruments	3. Crafting instruments
4. Entering the field	4. Holding the industry research group meetings
5. Documenting data	5. Documenting data
6. Analyzing data	6. Analyzing data
7. Enfolding literature	7. Enfolding literature
8. Reaching closure	<i>n/a</i>

Figure 28. Process of conducting case study research³²

As a basis for conducting research in the context of the international mass customization casebook project, the process of conducting case study research is outlined in further detail based on the framework by Eisenhardt (see Figure 29). The described activities are organized according to the research question of this work and the research context of the international mass customization

³¹ The research step “shaping of hypotheses” primarily focuses on the iterative formulation and development of constructs which this work does not follow (Eisenhardt 1989, p. 541-544).

³² Based on the framework by Eisenhardt 1989, p. 533.

casebook project (for further details, see the original framework by Eisenhardt 1989, p. 533). The process of conducting case study research with an industry research group is outlined in Section 4.1.5.3 further below.

Research steps in conducting case study research in the context of the international mass customization casebook	Activity	Reason/ comments
1. Getting started	Definition of research question.	Focuses efforts.
2. Selecting cases	Specified population. Theoretical, not random, sampling.	Constrains extraneous variation and sharpens external validity. Focuses efforts on theoretically useful cases – i.e. those that replicate or extend theory by filling conceptual categories.
3. Crafting instruments	Multiple data collection methods. Qualitative and quantitative data combined. Multiple investigators.	Strengthens grounding of theory by triangulation of evidence. Synergistic view of evidence. Fosters divergent perspectives and strengthens grounding.
4. Entering the field	Overlap data collection and analysis, including field notes. Flexible and opportunistic data collection methods.	Speeds analyses and reveals helpful adjustments to data collection. Allows investigators to take advantage of emergent themes and unique case features.
5. Documenting data	Document all case data in a structured case outline.	Builds a structured basis for enabling a cross-case analysis.
6. Analyzing data	Within-case analysis. Cross-case pattern search using divergent techniques.	Gains familiarity with data and preliminary theory generation. Forces investigators to look beyond initial impressions and see evidence thru multiple lenses.
7. Enfolding literature	Comparison with conflicting literature. Comparison with similar literature.	Builds internal validity and raises theoretical lever. Sharpens generalizability and raises theoretical lever.
8. Reaching closure	Theoretical saturation when possible.	Ends process when marginal improvement becomes small.

Figure 29. Process of conducting case study research in the context of the casebook project³³

³³ Copied from the framework by Eisenhardt 1989, p. 533.

4.1.5 The industry research group: A new form of case study research

The chosen term *industry research group* combines the business and academic character of this new form of case study research. See Figure 30 for a definition of *industry research group*.

Industry research group as a form of case study research is a collaboration of experts and academic researchers who work together on a defined topic of research covering practical and academic questions. Collaboration is defined through stated research objectives, a project plan and a defined group of those participating. Case data are derived in several joint workshops held by this group of people and stem from the participating industry managers through the open reflection and exchange of contributions and ideas regarding the research questions. The involved researchers lead the overall process, and document and analyze all case data.

Figure 30. Definition of industry research group

Before presenting the research with an industry research group and proposing a framework, existing studies that use industry research groups as a form of research design are presented. Also, the case study research form of action research is briefly reviewed and evaluated in regard to its contribution to the conception of research in this work, as well as the framework of an industry research group.

4.1.5.1 Evaluation of existing industry research groups

Apart from its focus on the primary research questions in the field of mass customization, this work also aims at contributing to the methodological discussion in management research. From his experience of utilizing the industry research group, the author regards this new research design as being a distinctive and important form of case study research within qualitative management research.

The empirical research with an industry research group is applied at institutes other than the IOM institute (TUM Business School, Technische Universität München). The screening of the results from an Internet search with Google (search terms: “industry,” “research” and “group”; September 2005) delivers 17 relevant industry research group projects in Europe and the U.S., which are listed in Figure 31. The review and analysis of these projects facilitates the definition of a framework for doing research with an industry research group (see Section 4.1.5.3).

The identified projects cover research in different fields ranging from product configuration systems to innovation management and manufacturing topics. Most of the projects include full-day workshops as the main source for generating empirical data. These workshops often encompass expert presentations and open discussions. Researchers often facilitate the process and are seldom the main source of knowledge; in these projects, knowledge is chiefly generated through the interaction between research group participants. In all instances, researchers set the project framework and are responsible for the project management in addition to defining the research question, and documenting and analyzing the results in all of the screened projects. The results from the 17 identified projects have not been published. One academic publication that applies a research design similar to that of the industry research group described here was identified (Matthyssens et al. 2005; see Section 4.1.5.3).

Institution (source of representative material)	Description of study	Research problem	Data sources	Re-searchers	Results
DTU, Denmark (Danish Association for Product Modelling 2005)	The Association for Product Modelling facilitates an ongoing industry research group on the topic of product configuration systems.	“The Danish Association for Product Modelling is to disseminate the knowledge of new operational methods for product modeling among Danish companies” (Danish Association for Product Modelling 2005).	Full-day workshops including expert presentations and industry group discussions (3-5 meetings per year).	Joint collaboration between researchers from the DTU and participating companies.	Not published.
Fraunhofer IAO, Germany (Bauer/Kind 2005)	The Fraunhofer IAO started a German industry research group in 2004 and invited companies to work on concepts for managing mergers and acquisitions.	How to successfully integrate processes and IT systems when implementing mergers of organizations.	Short interviews conducted by the Fraunhofer IAO and industry group discussions.	Joint collaboration between the Fraunhofer IAO and participating companies.	Not published.

Institution (source of representative material)	Description of study	Research problem	Data sources	Re-searchers	Results
MIT, U.S. (von Hippel 2005b)	The innovation and entrepreneurship group at the MIT Sloan School of Management promotes the Innovation Lab as a joint research group of academics and practitioners.	Development of innovation concepts and methods fostering breakthrough innovations (such as the lead user idea generation process).	Two-day workshops including academic and expert presentations, as well as industry group discussions.	Joint collaboration between researchers from MIT and a maximum of six participating companies.	Not published.
RWTH Aachen, Germany (Merchiers 2005)	The institute WZL at the RWTH Aachen promoted an industry research group project on the topic of mobile factories in 2004.	Development of a business concept for globally distributed manufacturing facilities (mobile factories).	Workshops including expert presentations and discussions within the industry group to openly state and answer questions.	Joint collaboration between the RWTH Aachen and participating companies.	Not published.
University Hohenheim, Germany (Kirn 2005)	The institute of computer science at the University Hohenheim extended invitations to regularly held industry workshops on the topic of software quality in 2005.	Development of concepts on how to ensure quality in business software engineering projects.	Full-day workshops including expert presentations and industry group discussions.	Joint collaboration between the University Hohenheim, other research institutes from the field and medium-sized companies.	Not published.
University St. Gallen, Switzerland (Conreder 2005)	The institute of innovation management at the University St. Gallen promoted an industry research group project in the field of innovation management in 2005.	How to successfully setup and implement a cooperation for joint product development.	Full-day workshops including expert presentations and industry group discussions.	Joint collaboration between the University St. Gallen and 8-12 participating companies.	Not published.

Institution (source of representative material)	Description of study	Research problem	Data sources	Re-searchers	Results
University St. Gallen, Switzerland (Enkel/Kausch 2005)	The institute of innovation management at the University St. Gallen completed an industry research group project on customer integration in 2004.	How to integrate customers into the early product design process in order to facilitate innovation.	Full-day workshops including expert presentations and industry group discussions.	Joint collaboration between the University St. Gallen and participating companies.	Not published.
University St. Gallen, Switzerland (Enkel-Chouikh 2005)	Long-term industry research group project in the field of customer-driven innovation from 2004 to 2006 (in planning).	Development of concepts on how to systematically integrate customer knowledge into the product development process in order to foster new innovation fields.	Empirical data are derived from separate projects with individual companies and joint full-day workshops including expert presentations and industry group discussions.	Joint collaboration between the University St. Gallen, six participating companies and the Swiss commission KTI, supporting innovations.	Not published.
University St. Gallen, Switzerland (Institut für Technologiemanagement 2002; Institut für Technologiemanagement 2005)	Three active and six completed projects could be identified as further industry research group projects at the University St. Gallen.	The research questions of these nine projects cover the topics of <ul style="list-style-type: none"> • manufacturing and logistics in the automotive industry, • knowledge management, • intellectual property management, • the virtual factory, • collaborative manufacturing, and • R&D management. 	The data sources for all projects are full-day workshops including expert presentations and industry group discussions.	Joint collaboration between the University St. Gallen and participating companies.	Not published.

Figure 31. Identified industry research groups in management research³⁴

³⁴ Analysis scheme by Eisenhardt 1989, p. 535 applied.

4.1.5.2 *Action research*

The research conducted with an industry research group shows some similarities with the concept of action research (for details on action research, refer to Rapoport 1970, p. 499f; Gill/Johnson 1997, p. 59-63; Gummesson 2000, p. 47, 73, 102-108; Easterby-Smith et al. 2002, p. 10f ; Kock 2004). “Action research aims to contribute both to the practical concerns of people in an immediate problematic situation and to the goals of social science by joint collaboration within a mutually accepted ethical framework.” (Rapoport 1970, p. 499) Action research goes back to the work of Lewin (1946) and Argyris/Schön (1978). The purpose of action research is to link theory with practice. In this context, the term action refers to the change process initiated within companies participating in the research. The results of the joint collaboration between academics and business experts, which forms a collective learning process, are the main sources of this change process. Based on this close collaboration, action research aims to understand both “the concrete details of particular cases and to discover and test propositions of a general theory” (Argyris et al. 1985, p. 4). The advantage for researchers as an active participant in such a framework is that their learning experiences are higher than in the role of an observer or interviewer (Gummesson 2000, p. 70). As a research form, action research has been described in the literature as having different variations in research style (Waser/Johns 2003, p. 374). Based on a literature review, Waser/Johns (2003, p. 374) identify “three potential outcomes” resulting from an action research project: knowledge, organizational change and professional development.

Similar to action research, work with an industry research group aims at combining both business and academic objectives by establishing a connection between theory and practice. The result of such a project can also be a collective learning process. However, the change processes initiated within the companies participating in such research are limited. Also, when it comes to directly facilitating and contributing to the change process within the firm, researchers are not active participants. Together with managers from the industry, the researcher is a participant within a defined project in an industry research group setting. These are the two main reasons why the industry research group has to be distinctly differentiated from action research, though this new form of case study research builds on some of the ideas and understandings of action research. An industry research group has underlying research objectives similar to those of action research (e.g., high participation), but the applied methods differ.

With regard to the three possible outcomes of action research, industry research group projects primarily aim to generate knowledge in the defined research field (mass customization competencies in our case). The outcome pertaining to knowledge generation should be both of academic and practical relevance. Moreover, research with an industry research group seeks to foster organizational change in the participating companies as well. The project’s result should be directly implemented at the companies in order to measure the relevance of the identified knowledge in regard to its applicability in real

businesses contexts. For the purpose of motivating managers to participate in such a project and in order to facilitate the creation of change agents, professional development is also an objective of an industry research group project (Waser/Johns 2003, p. 374).

4.1.5.3 Framework for doing research with an industry research group

The basic research techniques embedded in this new form of case study research are group interviews for collecting data, and content analysis for analyzing empirical data. These techniques will be described within the proposed framework for doing research with an industry research group. Following the literature on case study research, the analyzed industry research groups in management research and the structure of the “process of building theory from case study research” by Eisenhardt (Eisenhardt 1989, p. 533), a framework for doing research with an industry research group is proposed. This framework is also based on the author's experience of working with the industry research group on mass customization, which was confirmed by research colleagues (an overview and summary of the seven research steps is provided at the end of this section).

Defining the research objective and scope

The first step of any research is to define its objective and scope (Morton-Williams 1985, p. 27-33; Walker 1985a, p. 177). This is usually done by preparing a written research proposal in order to “explain and justify your proposal to an audience of nonexperts on your topic” (Maxwell 1996, p. 100). In such, the proposed study has to be explained and justified to the potential corporate participants (audience and nonexperts) in order to gain their commitment to the research project, as well as finance it.

For *defining the research objective and scope (research step 1)*, the underlying research is framed as an industry research group project, which guarantees the collection of empirical data in an atmosphere of direct relevance for all participating institutions (similar to the framework of an action research setting; see Easterby-Smith et al. 2002, p. 10). In particular, the expected change process within the participating companies has to be explained.

Recruiting the industry research group

Within the context of an industry research group, the practical relevance of research can easily be communicated to professionals, with the result that companies gain interest in joining such a cooperative project comprised of researchers and business managers. Within this framework, professional experts are motivated to share their knowledge, as knowledge on this topic is generated on both sides, i.e., for and by both experts and researchers. This benefit should be communicated to potential business participants when *recruiting the industry research group (research step 2)*.

The recruited companies should have backgrounds covering many different aspects of the topic, which guarantees the foundation of an empirical basis enabling critical discussions and reflection on the specific topic(s) of the industry research project. The idea of forming a diverse group of workshop participants follows case selection criteria for classical case study research (Eisenhardt 1989, p. 537). For the project's success, it is important to formally define the cooperation between the research institute and the participating companies. This guarantees the formation of an established group of companies participating in the research throughout the project's entire period.

Crafting instruments

When *crafting instruments (research step 3)*, group interviews can be implemented as the most important technique in industry group meetings. A group interview is a loosely structured technique used for explorative research. The task of a researcher in a group interview is to motivate a group of people to speak about a defined topic in a structured manner. The results of group interviews can include the production of theories or formulation of hypotheses (Bortz/Döring 2002, p. 319f; Easterby-Smith et al. 2002, p. 105f; Atteslander 2003, p. 155f). Another term used for this technique is group discussion, which is commonly used in the German literature (Bortz/Döring 2002, p. 319f; Atteslander 2003, p. 155). The research technique of group interviews should not be confused with another technique of the same name, which involves the structured interviewing of groups (Bortz/Döring 2002, p. 319f). Researchers in group interview settings do not make use of questionnaires (Hedges 1985, p. 77), but are "conducting a 'steered conversation' rather than an interview" (Hedges 1985, p. 78).

There are several advantages of conducting group interviews in an industry research group project (in accordance with the concept of Hedges 1985, p. 72f):

1. Group interviews create a social context in which people are able to understand and intensely discuss a specific field when exposed to the views of others (members of the group are then able to understand other people's perspectives).
2. A group interview is very suitable for industry research group projects, since the researcher is able to study the field, as well as directly initiate change.
3. The members of the industry research group are able to listen to each other in group interviews and in such, contributions by each individual are stimulated by the whole group (see also Atteslander 2003, p. 156). An interesting aspect is that managers from companies of similar businesses evaluate this setting positively, as they are able to talk to a group of people also facing the same managerial problems. Within their company or industry, they are often not understood or listened to.

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4. The level of creativity is high in a group interview context, since members of the industry research group motivate each other (especially in comparison to single interview settings, where the motivating influence comes from the interviewer only).

Group interviews are a commonly applied research technique in management research. Recent examples of studies utilizing this technique are Coates/McDermott 2002; Yauch/Steudel 2002; Harmsen/Jensen 2004; Matthyssens et al. 2005. See Figure 32 for these studies in management research that have a similar research objective as this work and apply the group interview technique.

The analysis of studies utilizing the group interview technique facilitates the development of the framework of doing research with an industry research group. In all analyzed studies, data sources are not only group interviews, but also individual interviews and, in one case, an expert panel, which shows similarities to the industry research group project presented here. The researchers are academic research groups, one of which is supervised by a board of industry and government members. All studies are qualitative as well as explorative, and the group interviews generate a wealth of empirical data. This is of particular interest, as the examined studies all answer research questions similar to those of this work (which was also the selection criterion for these studies). Yet these studies also conclude that a group interview is a difficult technique to handle. In particular, the process of a group interview is not easy to steer, and an experienced moderator with knowledge of the respective field is necessary (Hedges 1985, p. 77f; Harmsen/Jensen 2004, p. 537).

Author/ Study	Description of study	Research problem	Data sources	Re-searchers	Result
Coates/McDermott 2002	This study examines the development of resources and competencies in a case study framework, where the investigated company was developing a new technology.	“How firms develop and leverage new capabilities.” (Coates/McDermott 2002, p. 435)	Four group interviews and 39 individual interviews as a basis for collecting case study data.	Academic research group.	This study offers a contribution to the understanding of the structure and development of competencies in manufacturing firms.
Harmsen/Jensen 2004	This study examines the relationship between the determinants of value creation in a specific market on one hand, and the company competencies on the other hand.	“The aim of this article is to describe a method for translating market demands into company competencies, and, through this, identify the determinants of value creation in a given market.” (Harmsen/Jensen 2004, p. 533)	Intensive literature study and three group interviews.	Two researchers, one of whom facilitates the group interview while the other documents the interview’s outcome.	The outcomes of this study are maps that link the external determinants of value creation with internal competencies.
Matthyssens et al. 2005	Study examines the concept of value innovation in the context of strategic management for the business-to-business market.	(1) Operationalization of the construct of value innovation. (2) Stages of value innovation.	Eleven group interviews, 30 individual interviews and an expert panel (similarities to industry research groups exist).	Academic research group supervised by a board of industry and government members.	“The paper is [...] a first effort to operationalize and integrate the concepts of value innovation and absorptive capacity, and this in a business marketing context.” (Matthyssens et al. 2005, p. 10)
Yauch/Stuedel 2002	This study examines key cultural factors that affect the process of implementing cellular manufacturing systems.	“How culture impacts the CM [cellular manufacturing] conversion process.” (Yauch/Stuedel 2002, p. 593)	Individual and group interviews, as well as observations.	Academic research group.	This study presents eight key cultural factors that impact CM implementation.

Figure 32. Management research using the group interview technique

Holding the industry research group meetings

When *holding the industry research group meetings (research step 4)*, the main conditions have to be determined in regard to defining an appropriate level of researcher involvement. Participating researchers should only define topics and roughly lay out discussion schemes. Seldom do they direct questions to the workshop participants so as to keep their level of direct intervention as low as possible (Hedges 1985, p. 77, 81; Atteslander 2003, p. 156). There are similarities with an action research setting here, though continuous participation by the researcher in such a research project is generally high and is also a key element (Walker 1985b, p. 5; Gummesson 2000, p. 107; Easterby-Smith et al. 2002, p. 43f). “The task of the group interviewer [...] is not to conduct individual interviews simultaneously but to facilitate a comprehensive exchange of views in which all participants are able to ‘speak their minds’ and to respond to the ideas of others.” (Walker 1985b, p. 5)

Additionally, expert invitees can hold presentations in the respective field, followed by discussions covering questions from industry members. These presentations are meant as a stimulus for stimulating discussions on the topic (Hedges 1985, p. 78, 83f). The workshop characteristic of the meetings ensures that industry members express and answer open questions in the research objectives’ context, arriving at results through the reflection and exchange of other managers’ views (Atteslander 2003, p. 156).

Documenting data

When *documenting data (research step 5)*, all meetings should be recorded so that in-depth documentation is available in addition to the official meeting protocols. Even in this phase, the documentary technique should include the evaluation and coding of all contributions. To ensure this, notes on the workshop’s contributions are supplemented by notes on the frequency of identical or similar contributions, the duration and intensity of discussions about identical contributions, as well as notes on the number of workshop participants involved in conversations about specific topics (Maxwell 1996, p. 79; Gummesson 2000, p. 110f). This method of documenting the data forms the pre-analysis for performing an in-depth analysis at a later stage (see the next research step). This chosen method is advantageous because based on the analysis of past workshops, the overall process of conducting the industry research group workshops can be steered and focused (Maxwell 1996, p. 77).

Not only the notes from meetings, but also presentation material from the expert and industry group member presentations (e.g., company profiles and flipchart paper documents) build the empirical basis for transcribing the industry group meeting case data (Hedges 1985, p. 87f; the industry research group as a form of case study research includes a collection of information from many different sources: Eisenhardt 1989, p. 534; Gummesson 2000, p. 121; Yin 2003, p. 85).

Analyzing data

For *analyzing data* (*research step 6*), the content analysis technique is suggested (Easterby-Smith et al. 2002, p. 118-122). This method is favorable for evaluating all contributions from workshop participants in regard to their scientific validity (Hedges 1985, p. 89). The chosen evaluation scheme should also ensure a generalization of empirical results. This technique is in line with classical case study research where a generalization is reached by studying more than one case in order to confirm a hypothesis. In the research context of an industry group, topic-relevant contributions by the participating managers must be confirmed by more than one workshop participant's statement in order to attain generalization. The thorough documentation technique proposed above delivers the data for confirming individual contributions with similar contributions on the same topic (Glaser/Strauss 1967, p. 30; Gummesson 2000, p. 84; this method has similarities with cross-case comparison: Yin 2003, p. 133-137).

Enfolding literature

As a final *research step 7* (*enfolding literature*), the project results have to be compared with both conflicting and similar literature; these gain validity and generalizability if linked to existing literature. Moreover, by comparing the results with the literature, deeper insights into the field can be obtained. Although industry research groups already include a large number of business examples and produce a wealth of case data, the empirical evidence and level of scientific contribution can be increased if further business examples from the literature are added to the discussion (Eisenhardt 1989, p. 544f). See Figure 33 for an overview of the proposed process of doing research with an industry research group.

Research steps in conducting case study research with an industry research group	Activity	Reason/comments
1. Defining the research objective and scope	Write a research proposal addressed to potential corporate participants.	The research proposal is the required document for recruiting the industry research group and getting the project formally started.
2. Recruiting the industry research group	Invite potential corporate participants from a wide range of backgrounds to join the industry research group project and formally define the degree of collaboration.	The diversity of the research group ensures broad empirical evidence. The overall success of the project depends on the commitment of an established group of companies participating in the research throughout the project's entire duration.
3. Crafting instruments	Outline the basic research techniques (group interviews are proposed as a main technique for this type of research).	Project work and results should be well grounded on research techniques commonly applied in management research.
4. Holding the industry research group meetings	Facilitate a structured research process with a generally low degree of researcher involvement.	The low degree of researcher involvement ensures the reflection and exchange of different executives' views on the defined topic.
5. Documenting data	Document all meeting contributions in a comprehensive format that enables the researcher to utilize a pre-defined evaluation scheme later on.	The documentation of information should include all available sources to broaden the scope of empirical evidence. The objective is to maintain the richness of qualitative data while documenting the research data.
6. Analyzing data	Analyze the case data by applying a pre-defined evaluation scheme, which ensures a generalization of the results (the content analysis technique is suggested for this form of case study research).	The analysis step is important in order to reach a scientific contribution based on a large data pool. The evaluation scheme must be pre-defined.
7. Enfolding literature	Compare project results with conflicting and similar literature.	Project results gain validity and generalizability if linked to existing literature.

Figure 33. Process of conducting research with an industry research group³⁵

³⁵ Structured according to the framework by Eisenhardt 1989, p. 533.

4.2 The international mass customization casebook project: Research stages

The *international mass customization casebook project* (casebook project) aimed at determining and verifying the dominant competencies for mass customization from the preliminary set of mass customization competencies derived from the industry research group project. In addition, the developed case data denote the basis for enfolded hypotheses on the different types of mass customization companies (see Chapter 7).

The basic characteristics of the international mass customization casebook project are listed in following.

1. This project is primarily a *research case study project* (Yin 2003, p. 10).
2. Case data are developed and studied within a large *research consortium*.
3. The derived cases *describe and illustrate* mass customization practice, but data are also used to *explain* and *explore* theory (Yin 2003, p. 15).
4. The project investigates *individual firms*, not industries (Eisenhardt 1989, p. 534).

The structure of the project description builds on the described framework of doing case study research (see Section 4.1.4). Project steps have been undertaken and are described according to the process of shaping theories from case study research (Eisenhardt 1989, p. 533).

4.2.1 Getting started

The international mass customization casebook project was formed by a group of five researchers at the INFORMS conference in October 2004. This group of researchers decided to work together on the development of case studies from practice. By March 2006, the project group grew to a number of 25 people, thus forming a rather large research consortium.

The primary objectives of the casebook project were initially defined as follows: this project should fill the gap of a non-existent mass customization case collection in English and results were to be published in book format, the *international mass customization casebook* (Yin 2003, p. 143-149). Case studies were developed for possible use as teaching cases, but primarily as an explorative basis for facilitating additional research questions. Generally speaking, this project gained deeper insights into the field by focusing on four aspects:

1. The international mass customization casebook project aimed to identify the current business practice and build a basis for applied research.
2. This project put together a collection of cases for developing and deepening the theory of different types of mass customization and comparing the way this business concept is implemented across different cultural contexts.

3. This project aimed at identifying the competencies applied by mass customization companies operating this business concept.
4. Finally, this casebook project also set out to present a wide collection of different approaches to mass customization. The hypothesis that mass customization is present in many different industries from industrial goods to services and consumer industries was to be validated.

4.2.2 Selecting cases

In order to deepen the theory on the different types of mass customization, enlighten current business practices and succeed in answering all the above stated research questions, companies of many different types had to be selected (Eisenhardt 1989, p. 536f; Pettigrew 1990, p. 275f; Gummesson 2000, p. 84f). Existing classifications of mass customization were applied for selecting a broad collection of examples (the models of Lampel/Mintzberg 1996; Amaro et al. 1999; Duray et al. 2000 were particularly considered; see Section 3.1). In order to investigate the extreme ends of the concept, the initial objective was also to include unsuccessful cases. Yet this could not be accomplished because the researchers could not obtain any agreements from companies to present their failed business ventures. The resulting list of researched companies demonstrates the international scope of this project. The companies are of different sizes, operate in different industries and have different market focuses. The selection process applied was non-random, but focused on deriving an extensive list of cases in support of the objectives of this project.

The 18 cases within the scope of the project are the results of a lengthy and iterative case selection process (see Figure 34; for further case details on the types of companies selected for this project, see Appendix 3). The primary and final decision on the selection of each individual case was always separately made by each involved researcher. In doing so, all researchers applied their conception (and definition) of *mass customization* when selecting the targeted companies for examination (see the discussion on the definition of mass customization in Section 1.2). This procedure ensured and supported a selection of a broad range of different case studies from the mass customization field, which was unbiased due to strict selection criteria or definitions.

Companies examined in the international mass customization casebook project (as of March 2006)
121TIME (wristwatches), Switzerland
Adidas (athletic shoes), Germany
Airborne (bicycles), The Netherlands
AmericasMart (wholesaler marketplace/trade fair), U.S.
APC: American Power Conversion (data center infrastructure equipment and services), Denmark
Build-a-Bear (toys), U.S.
Delance (women's wristwatches), Switzerland
Design & Mass Customization Laboratory for shoes (D&MC Lab ITTA-CNR), Italy
F.L.Smith (process plant construction), Denmark
INDO, Industrias de Óptica (optical lenses), Spain
Left Foot Company (men's shoes), Finland
Marelli Motori (electric motor manufacturer), Italy
North American furniture industry, U.S./Canada
ORONA (elevators), Spain
Steppenwolf (bicycles), Germany
Turo Tailor (apparel/men's suits), Finland
UROLA (PET stretch blowmoulding and extrusion blowmoulding rotary machines), Spain
ZUBIOLA (cutter-heads, cutters, drills, saws), Spain

Figure 34. Companies examined in the casebook project

4.2.3 Crafting instruments

A number of researchers were involved in the entire project as a joint research team and consortium. The advantage to involving multiple researchers lies in the potentially higher creativity of a team, as well as validation of results (Eisenhardt 1989, p. 535, 537). The research setting was primarily conceived as the formation of a large team working on numerous cases, though most of the individual cases were each prepared by multiple investigators (but not by the whole team, of course). The team peer-reviewed all cases, cross-evaluating the findings of each (particularly in the process of the case publications). See Figure 35 for an overview of the involved researchers. There were 25 people (mostly academic researchers) involved in this project, thus forming quite a large research consortium.

Name	Institute/company (project partner as of March 2006)
Fazleena Badurdeen	Center for Manufacturing, University of Kentucky, U.S.
Juan Carlos Beñalarrangoitia	Mass Customization Research Team, Design and production processes unit, IKERLAN, Arrasate-Mondragón, Spain
Christoph Berger	adidas, Herzogenaurach, Germany
Claudio R. Boer	ITIA-CNR Institute of Industrial Technologies and Automation of National Council of Research, Milano, Italy
Cipriano Forza	Dipartimento di Ingegneria Meccanica e Civile, Università di Modena e Reggio Emilia, Modena, Italy
Lars Hvam	Centre for Product Modelling, Dept. of Manufacturing Engineering and Management, DTU, Denmark
Jose Angel Lakanza	Mass Customization Research Team, Design and production processes unit, IKERLAN, Arrasate-Mondragón, Spain
Roland Lieritz	Steppenwolf, Germany
Torsten Låhra	Forintek Canada Corp., Québec, Canada
Saku Mäkinen	Tampere University of Technology, Tampere, Finland
Begoña Mateo-Martínez	Instituto de Biomecánica de Valencia, Universidad Politécnica de Valencia, Spain
Daniel Morf	Factory121, Switzerland
Klaus Moser	Technical University Munich, TUM Business School, Institute for Information, Organization and Management, Munich, Germany
Melanie Müller	Technical University Munich, TUM Business School, Institute for Information, Organization and Management, Munich, Germany
Linnea Peltonen	Tampere University of Technology, Tampere, Finland
Frank Piller	MIT Sloan School of Management, BPS / Technological Innovation and Entrepreneurship Group, Cambridge, U.S.
Matheus Pinotti	Centor Research Centre, Laval University, Québec, Canada
Claudia Redacchi	ITIA-CNR Institute of Industrial Technologies and Automation of National Council of Research, Milano, Italy
Ralf Reichwald	Technical University Munich, TUM Business School, Institute for Information, Organization and Management, Munich, Germany
Giselle Rufer	Delance, Switzerland
Fabrizio Salvador	Department of Operations and Technology Management, Instituto de Empresa, Madrid, Spain
Matti Sievinen	Tampere University of Technology, Tampere, Finland
Marzio Sorfani	ITIA-CNR Institute of Industrial Technologies and Automation of National Council of Research, Milano, Italy
Alessio Trentin	Dipartimento di Tecnica e Gestione dei sistemi industriali, Università di Padova, Vicenza, Italy
Mitchell Tseng	Hong Kong University of Science & Technology, China

Figure 35. Researchers involved in the casebook project

All researchers used multiple sources of data collection, i.e., information was collected from many different sources. This collection method increased the internal validity of the data and ensured a higher level of proof of the derived hypotheses (Eisenhardt 1989, p. 534; Gummesson 2000, p. 121; Yin 2003, p. 85-101). The objective of using multiple sources “is to draw on the particular and different strengths of various data collection methods” (Pettigrew 1990, p. 277). In general, the data sources were interviews conducted with managers, archive sources provided by the companies, and secondary or external information. The selection of specific sources depended on each company-researcher setting, and whether or not there had been any previous collaboration between the two parties. Some researchers, such as the research group at the IOM institute, were already involved in project work

with the targeted companies (in past or current cooperation). In such settings, they could also derive information from direct observations (e.g., during company visits or workshops) or existing material (protocols, presentation material, project reports, etc.).

4.2.4 Entering the field

The collection, documentation and partial analysis of the case data was all done in parallel. Based on the collected data, researchers continuously documented the cases by applying the case outline (see next section). In an iterative process, these documents were sent to the involved company representatives who validated them. Over the course of these validations, new aspects arose and were added to the case descriptions. This procedure guaranteed the continuous documentation of data and a parallel analysis during data collection, with the benefit of a high degree of flexibility in adapting the case format to suit relevant new case data. In addition, this resulted in a higher level of validity and comprehensiveness of the final case descriptions (Eisenhardt 1989, p. 539).

4.2.5 Documenting data

In order to be able to coordinate the development of the case data within the research consortium and, more notably, derive hypotheses on the different types of mass customization, the documentation of each case and collection of all data followed a semi-structured case outline. This case outline provided a rough framework of the chapters to be covered by each case and was used as a template for documenting the cases (Yin 2003, p. 67-77). This framework also represented a basis for the semi-structured interviews conducted by each researcher to collect data (or to validate existing data if archive sources were available). The applied case outline consists of seven chapters.

The first two chapters introduce each case in regard to the market, industry and company background. Chapters three and four deal with products and operations and cover current business practices, which are a relevant source for comparing different business strategies and identifying different types of mass customization. Chapter five aims to present empirical evidence of the different types, allowing room for the illustration of a case-specific focus (e.g., product configuration technology). Apart from a SWOT analysis, the applied competencies for mass customization are illustrated in chapter six. The competencies of each company are ranked according to their importance based on a common structure of seven competence areas, which in turn have been conceptually derived based on the generic value chain by Porter (1985, p. 37; see Section 2.5.3). See Figure 36 for additional explanations of the case outline and Appendix 4 for an overview of the entire framework.

Chapter of case study documentation	Explanation
1. MC market and industry/environment	The first chapter provides a framework for the case study from a market and industry perspective (e.g., individualization trends are explained).
2. Brief company description	A brief company description introduces the case study.
3. MC product	The mass customization product offer is explained in detail in chapter three.
4. MC operations	In chapter four, all capabilities and internal processes of the company are described.
5. Open chapter	An open chapter leaves room for the illustration of a case-specific focus (e.g., product configuration technology).
6. Case study assessment: SWOT analysis and MC competencies	The case assessment in chapter six is presented in a common format for all case studies (including a SWOT analysis and an assessment of the most important competencies based on a common structure of seven competence areas).
7. Figures and references	The last chapter presents the references (e.g., secondary information or interview protocols).

Figure 36. Overview of the applied case outline

4.2.6 Analyzing data

Analyzing case data within the international mass customization casebook project

Simple case documentation was the first step of the case analysis for this project. Each single case was described and illustrated in detail, since one objective of the casebook project was to generate a collection of case descriptions (as a basis for the case publications). The within-cases analysis was a suitable analysis technique for this first step (Eisenhardt 1989, p. 540). In a narrative form, the cases were analyzed and documented utilizing the defined case outline (see Figure 36). The text was supplemented by tables, graphs and pictures (Yin 2003, p. 111). The within-cases analysis ensured the validity, reliability and comprehensiveness of the results after having transcribed, analyzed and coded the case data from many different sources (interview protocols, archive sources, secondary information and direct observations, e.g., of meetings). The within-cases analysis also supported the identification of similarities and differences between the different case data (Coates/McDermott 2002, p. 439f).

Analyzing case data in the context of this work

In the context of this work, the case study project aims to support two research sub-questions and therefore has two distinct objectives. The mass customization case descriptions offer empirical evidence

1. for determining and verifying the dominant competencies for mass customization presented in Chapter 6 (cp. proposed evaluation scheme for the identification of the dominant competencies presented in Figure 46; see also Figure 45), and
2. for validating existing mass customization typologies and deriving hypotheses on the different existing mass customization strategies (types) presented in Chapter 7.

While the first objective of the case analysis is primarily explanatory, the second objective is mainly explorative (Yin 2003, p. 15). Both objectives build on the initial descriptive work, which was also the chief objective of the casebook project.

In regard to the research question of identifying the dominant competencies for mass customization, the results of the case analysis process represent the main empirical evidence. When coding the case data, the analysis process aims to identify the competencies of each analyzed company, as well as any possible direct effects these competencies have on the company's success (see evaluation scheme presented in Figure 46). If an identified competence is the equivalent of a competence identified in the industry research group project, and a direct effect on the company's success can be proved by case data, a dominant competence is verified by the respective case. The defined seven competence areas build a rough framework in the process of coding the case data and identifying the different types of competencies.

In a second analysis step, the case data are re-examined in order to shape hypotheses on the different types of mass customization. Case study research design is generally valued for generating theory. A comparative method is able to shape hypotheses as explained below (Gummesson 2000, p. 84f). The appropriate analysis technique for exploring the existing types of mass customization is cross-case comparison (Eisenhardt 1989, p. 540f; Miles/Huberman 1994, p. 57; Yin 2003, p. 133-137), which generally intends to identify cross-case patterns and "force investigators to go beyond initial impressions, especially through the use of structured and diverse lenses on the data" (Eisenhardt 1989, p. 541). Eisenhardt proposes three tactics in cross-case comparison (Eisenhardt 1989, p. 540), one of which seems to be most appropriate for shaping hypotheses on mass customization types. This "tactic is to select categories or dimensions, and then to look for within-group similarities coupled with intergroup differences" (Eisenhardt 1989, p. 540). Following this technique and McKelvey's framework for deriving a taxonomy (McKelvey 1982), a promising approach would be to use the dominant competencies for mass customization (presented in Chapter 6) as categories or dimensions in order to examine the within-group similarities and intergroup

differences. Different applied patterns of dominant competencies will then help shape hypotheses on different types. Furthermore, an existing typology (Spring/Dalrymple 2000, p. 461-463) and its extension provides additional categories and dimensions for structuring the case analysis (cp. Chapter 7). As a result, the combined framework for the case analysis in this work includes the typology by Spring/Dalrymple (2000) and the dominant competencies for mass customization as dimensions so that within-group similarities and intergroup differences of all mass customization cases can be examined. The underlying argumentation of shaping hypotheses on the different types is displayed in Figure 37.

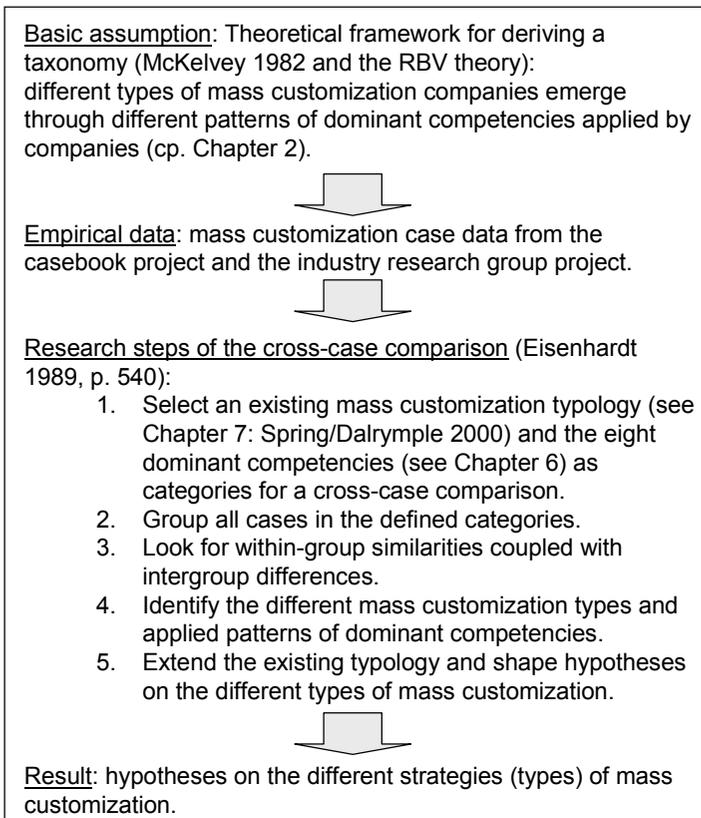


Figure 37. Method for shaping hypotheses on the types of mass customization

4.2.7 Enfolding literature

This research steps falls together with the identical step in doing research with an industry research group, since both empirical research projects were coordinated and are presented with this work (see introduction to Chapter 4). Also, the casebook project's outcomes regarding dominant competencies for mass customization are verified with conflicting and similar literature (see Chapter 6). In particular, the hypotheses on mass customization types are mirrored with existing literature on classifications (see Chapter 8). The purpose of the performed literature reviews is to increase the validity of the project's overall results (Eisenhardt 1989, p. 544f).

4.2.8 Reaching closure

Six of the case studies researched within this project and one initial case analysis were already presented at the MCPC 2005 conference in Hong Kong (Forza et al. 2005; Hvam 2005a; Moser et al. 2005a; Moser et al. 2005b; Moser et al. 2005d; Redaelli et al. 2005; Rufer et al. 2005). The six cases were:

- 121TIME (wristwatches), Switzerland (Moser et al. 2005b),
- Delance (women's wristwatches), Switzerland (Rufer et al. 2005),
- Design&MC Lab (research lab for mass customized shoes), Italy (Redaelli et al. 2005),
- F.L.Smidth (process plant construction), Denmark (Hvam 2005a),
- MarelliMotori (electric motor manufacturer), Italy (Forza et al. 2005), and
- Steppenwolf (bicycles), Germany (Moser et al. 2005a).

The research team viewed the empirical evidence these six cases yielded for answering the initial project questions as too limited in scope (Eisenhardt 1989, p. 545), and therefore decided to include additional cases in the project. Up until March 2006, 18 mass customization cases had to be researched and documented (see case overview in Figure 34). Eight of these cases are published as a special edition of the International Journal of Mass Customization (IJMassC). Some of the eight cases overlap with those presented at the MCPC 2005 (for an overview, see Moser/Piller 2006b):

- Adidas (athletic shoes), Germany (Moser et al. 2006),
- APC (data center infrastructure and services), U.S./Denmark (Hvam 2006a),
- Design&MC Lab (research lab for mass customized shoes), Italy (Redaelli et al. 2006),
- F.L.Smidth (process plant construction), Denmark (Hvam 2006b),
- Left foot (men's shoes), Finland (Sievänen/Peltonen 2006b),
- MarelliMotori (electric motor manufacturer), Italy (Forza et al. 2006),
- Steppenwolf (bicycles), Germany (Moser/Piller 2006a), and
- Turo Tailor (apparel/men's suits), Finland (Sievänen/Peltonen 2006a).

Although all of the 18 cases will be published in the *international mass customization casebook* mid-2006 (Moser/Piller 2006c; to be published after the completion of this work), only those ten case studies will be analyzed and referenced throughout this work that were presented at the MCPC 2005 or published in the IJMassC. This guarantees the validity of all applied empirical data for this work, since all referenced case studies have already been discussed in the academic research community (Huff 1999, p. 45).

From these ten case studies analyzed here, the 121TIME, Adidas and Steppenwolf cases build on the author's research. The other seven cases were originally researched and documented by researchers from the casebook consortium, but close interaction with the research team ensured that the case data of these seven cases were also made available for this work. In addition, all of these cases studies have been published in the above cited conference and journal papers. Together with the four cases that were researched in the context of the industry research group on mass customization (see the next section), the ten cases will be presented as short company descriptions in Chapter 5 as well.

4.3 The industry research group project: Research stages

With the primary objective of deriving empirical case data on the topic of mass customization, the IOM institute (TUM Business School, Technical University of Munich) initiated an industry research group project on mass customization in the East German industry research group on

The company has never done before

**Full Chapter 4 not included
in this publication**

Based on the proposed framework and an industry research group (see Section 4.1.5.3), the project on mass customization as conducted at the IOM institute during 2005 and 2006 is described in following. Each of the proposed seven research steps is explained in detail.

³⁶ Figure 91 in Appendix 6 presents descriptions of the participating companies.

5 Empirical data: Mass customization case studies

The following company descriptions cover all *14 mass customization case studies* applied in this work. As explained in Chapter 4, the case data presented in this chapter build on the author's case study research within the casebook project and industry research group project, as well as research by members of the research consortium of the casebook project. Figure 48 presents an overview of all 14 case studies applied in this work, and their origin and use (see Chapter 4 for the applied empirical research design and analysis method). Each of the following company descriptions follows a structure similar to that of the format used in the international mass customization casebook project (see Section 4.2.5).

Mass customization case study (company name)	Origin: data of case studies build on research by the author (from the casebook project and industry research group project)	Origin: data of case studies build on research by members of the research consortium of the casebook project	Use: case study applied for determining and verifying the dominant competencies for mass customization (Chapter 6)	Use: case study applied for deriving hypotheses on the different existing mass customization types (Chapter 7)
121TIME	X		X	X
Adidas	X		X	X
APC		X	X	X
Audi	X		X	X
BMW ⁶⁰	X		X	X
Delance		X		X
Design&MC Lab		X		X
Deutsche Telekom	X		X	X
F.L.Smidth		X	X	X
Left foot		X	X	X
MarelliMotori		X		X
Selve	X		X	X
Steppenwolf	X		X	X
Turo Tailor		X	X	X

Figure 48. Fourteen mass customization case studies applied in this work

⁶⁰ The firm BMW was not a permanent member of the industry research group, but one manager of the firm participated at one of the meetings as a mass customization expert. Additional data were derived through interviews and the analysis of press articles.

5.1 121TIME



121TIME was introduced in 2001 as the first mass customized wristwatch product with a Swiss-made brand (121TIME is a member of the Federation of the Swiss Watch Industry). By implementing a mass customization business strategy, founders Frédéric Polli and Daniel Morf managed to enter a well-established, brand saturated market.

121TIME watches are sold on the Internet and the sales volume in the first four years of operations amounted to 4,300 watches (2001-2004). Today the company targets customers from all over the world while marketing efforts continue to focus on the Swiss market. Customers can configure their own customized watch online or choose from a wide range of pre-configured watches. The wristwatches are manufactured and assembled in Switzerland and sent directly to the customers by post within two weeks after ordering.

The core competence of 121TIME lies in its integration of information technologies (particularly online technology), mass customization business principles and Swiss watch design capabilities. The business strategy of 121TIME has proven to be sustainable, although substantial future growth is expected to come from outside the Internet and current core business. The company is currently evaluating several opportunities for integrating physical distribution and entering mass product markets.

121TIME (wristwatches): incorporated company Factory 121 AG, Switzerland.

Extended case study description: Moser et al. 2005b.

Sources and further reading: Factory121 2003c; Factory121 2003b; Factory121 2003a; Federation of the Swiss Watch Industry 2003; Pictet&Cie 2003; Verband der Schweizerischen Uhrenindustrie 2003; Bärhold et al. 2004; Factory121 2004b; Factory121 2004a; Focus medialine 2004; Morf 2004a; Morf 2004b and www.factory121.com.

5.2 Adidas



Adidas introduced the first “mi adidas” customized athletic shoe in 2000 in response to an increased trend towards innovativeness and individualization. Today a large number of mass customization offerings come from competitors, including individualized athletic shoes such as Nike iD or Puma Mongolian BBQ.

Customers purchase mi adidas shoes in a physical sales environment. At permanent store installations or temporary retail events, the so-called “sales kiosks” offer the possibility of customizing sport shoes in three different dimensions: fit, performance and aesthetic design. Once configured, shoes are manufactured in China and delivered to the retailer within three weeks for customer pick-up.

The main competence of Adidas for enabling mass customization is still a managerial and operational challenge and concerns the integration of its mass customization and mass production processes. Adidas’s initial strategy for introducing mass customization was to implement a marketing and brand-building instrument. The company also aimed to get closer to customers, since traditional wholesale and retail structures in the industry prevent direct customer interaction. Due to its market success, Adidas plans to implement mi adidas as a sustainable mass customization business by improving operational efficiency of the program further and extending the distribution network.

Adidas (athletic shoes): the mass customization offering is branded mi adidas; incorporated company Adidas AG, Germany.

Extended case study description: Moser et al. 2006.

Sources and further reading: Seifert 2002; Berger/Piller 2003; Berger 2004; Breithaupt 2004; Haberstroh 2004; Kieserling/Berger 2004a; Kieserling/Berger 2004b; Piller 2004b, p. 206-224; Berger 2005; Berger et al. 2005 and www.adidas.com.

5.3 APC



APC (American Power Conversion) is a global player and one of the leading business-to-business companies in the sector of constructing, equipping and data center maintenance. The construction of data centers typically requires highly customized product components and services, as there is wide range of different needs and requirements customers have in this product field. Due to this, the sales and engineering processes are usually time-consuming, manpower-intensive and costly.

In order to reduce costs and improve throughput time, APC implemented mass customization principles. In particular, business processes and product architectures were standardized. Also, a product configuration system was implemented. As a result, the total costs for the product and service offering were reduced while throughput time was significantly scaled down. The time to submit a quotation was reduced from three days to one hour. The newly implemented process requires customers to configure their own data center online as a first draft. Nonetheless, customers now view this new offering in a positive light because it enables quick, personalized service.

APC (data center infrastructure and services): incorporated company American Power Conversion Corp., U.S./Denmark.

Sources and further reading: Hvam 2005b; Schroeder 2005; Hvam 2006a and www.apc.com.

5.4 Audi

Audi is a German car manufacturer that sells premium cars in many countries throughout the world. Early in the course of the development of its current luxury brand position, the company recognized the importance of offering customization to its customers in order to distinguish its vehicles from competitors' products. Today there are many choices for customers when selecting the engine, interior and varnish color. In such, it is unlikely that Audi will ever manufacture two cars with exactly the same configuration. A large proportion of Audis are sold made-to-order, but customers are used to waiting about two to three months before receiving their customized car.



In order to be able to offer such a high degree of customization, Audi implemented mass customization principles such as modular product architecture, flexible manufacturing and logistics systems, and integrated IT systems so that a high degree of individuality could be offered at affordable prices. One recent effort to increase the operational efficiency of the business was the implementation of product variant management. The primary objective of this program is to reduce internal complexity and associated costs throughout the entire value chain while maintaining the product variety demanded by consumers.

The implementation of mass customization helped the company establish a luxury brand image. Furthermore, the company was able to implement a profitable mass customization business: A high degree of customization was made available at prices just slightly above comparable offerings with a lower degree of individualization.

Audi (automotive): incorporated company Audi AG, Germany.

Sources and further reading: Alders 2004b; Alders 2004a; Walker/Rivera 2004, p. 59-62; Andres 2006 and www.audi.com.

5.5 BMW



Freude am Fahren

BMW is a German car manufacturer that exports premium cars to markets all over the world. Much like Audi, a major strategic success factor of the company was the early introduction of customization to almost any part of a car, and today almost every car is a mass customized product. Efficient processes and technologies enable made-to-order, customized cars with a cycle time of ten days. In addition, this concept allows customers to change the configuration of a car up to six days before finalizing the product, and almost all customers receive their BMW on the promised delivery day.

Mass customization principles play a major role in facilitating efficient processes and guarantee the profitability of the pursued business strategy. Apart from having implemented modular product architecture, product configuration systems and flexible processes, BMW has particularly gained strong competencies in production and logistics planning, and management of both mass and individual production steps. A central planning authority guarantees the fulfillment of the high service commitment and enables the integration of suppliers in the just-in-time (JIT) oriented value chain. Based on a modular product architecture composed of standard and individual modules, BMW manages a clear separation of mass production activities (standard modules) and individual manufacturing steps. As a result, economies of scale are utilized where possible, leading to an overall higher degree of operational efficiency (as compared to the previous process design where a higher proportion of manufacturing tasks was individually performed).

Similar to Audi, BMW is a good example of a company applying mass customization as a profitable business. Moreover, the transformation towards customization helped the company build a premium car brand.

BMW (automotive): incorporated company BMW AG, Germany.

Sources and further reading: Vosberg/Hauser 1998; Schlammer 2004; Walker/Rivera 2004, p. 62-66; Queiser 2005 and www.bmw.com.

5.6 Delance



Since founded in 1996, Delance has supplied mass customized women's wristwatches. Delance targets the luxury segment of the watch market and its customized watches, adorned with diamonds, can cost up to 20 thousand euros. In order to create a new luxury brand, the company used the mass customization business strategy to differentiate its new offering from its competitors and enter a tight, well-established market.

Delance wristwatches are typically sold via independent and associated retailers; online purchases are also possible but have no significant relevance in the company's overall turnover. The unique design of the watches is geared to women who enjoy making a selection from many different watchcases, faces, dials and bracelets. A special customization element is the choice of one or more jewels of symbolic value.

All manufacturing and logistics processes are completed by partner firms. Delance basically coordinates all activities of its value chain partners and oversees the further development of the business strategy and watch design. Delance is another example proving that mass customization is a basis for creating a profitable and sustainable business. This concept also enables firms to enter mature markets by providing additional services to customers as a main differentiation factor.

Delance (women's wristwatches): incorporated company Delance Swiss Watches SA, Switzerland.

Extended case study description: Rufer et al. 2005.

Sources and further reading: www.delance.com.

5.7 Design&MC Lab



The Design&MC Lab is a research laboratory for mass customized shoes associated with an academic institution (the Institute of Industrial Technologies and Automation-CNR, Italy). The objective of this lab is to develop future instruments and technologies enabling mass customization in the shoe industry. Although this laboratory does not operate as a facility in a day-to-day business environment today, the analysis of this case provides valuable insights into mass customization competencies and business strategies.

The Design&MC Lab has implemented an ideal mass customization environment in regard to shoe design, configuration systems, manufacturing and logistics technologies, as well as processes, organizational design and IT systems. There are several major competencies that are critical for the ideal layout of the Design&MC Lab. The modular shoe architecture forms the necessary basis for all of the lab's enabling technologies and processes. Process and information integration, as well as a flexible organization design, plays an important role in the operational efficiency. Several other technologies such as the “virtual shop” at the point of sales or robots in manufacturing increase the efficiency of a mass customization shoe business.

This case shows that to implement a profitable mass customization business, managers have to consider a wide range of new and challenging managerial instruments and technologies. However, the Design&MC Lab also provides practical tools to managers already working in mass production-oriented companies, which assist them in boosting the efficiency of their operations.

Design & Mass Customization Laboratory for shoes: Design&MC Lab, Italy (research lab for mass customized shoes).

Extended case study descriptions: Redaelli et al. 2005; Redaelli et al. 2006.

Sources and further reading: Cruz Garcia Belenguier et al. 2001; EuroShoe Consortium 2002; Jovane et al. 2003; EU Commission 2004; EuroShoe Consortium 2004; Boer 2005; Chiodi et al. 2005; Liao et al. 2005.

5.8 Deutsche Telekom



The multinational Deutsche Telekom not only offers standardized telecommunication services such as mobile phone service to end consumers, but is also specialized in customized business-to-business solutions. In particular, its subsidiary Deutsche Telekom Network Projects & Services GmbH is a business line that provides business customers in Germany with individual voice, IP and network security services.

These services are usually customized in such that for each dedicated customer and ordered service implementation, a separate project team of project managers and engineers is formed. All customers receive services and products typically comprised of unique elements. Because of this, the entire service process is costly, as no standard modules are shared among different customers or service applications.

In order to increase operational efficiency while still providing the same degree of customization and service, the Deutsche Telekom aims to standardize and reduce its product spectrum, and introduce a product and service configuration system. In doing so, the company will eventually shift its current business model towards a mass customization model.

Deutsche Telekom (telecommunication products and services): incorporated company Deutsche Telekom AG, Germany.

Sources and further reading: Czorny 2004 and www.telekom3.de.

5.9 F.L.Smith



The company F.L.Smith constructs, builds and maintains entire process plants for cement manufacturing and is the world's market leader in this specific industry. Due to the high number of possible variations of such a cement plant, each is highly customized and its construction requires the setup of a unique project. These types of plants are sold via tenders and the preparation of quotations consumes a substantial amount of the company's resources.

Due to the increasing demand to submit accurate and timely quotations, F.L.Smith looked for new business strategies and technologies for increasing operational efficiency. The answer was found in a range of mass customization principles such as process standardization, product modularization and the use of configuration systems. Today customers can configure a basic rough layout of a cement plant online by themselves, and the system is able to offer a binding quotation for every request. Salespersons and engineers are no longer involved in answering any such initial inquiries. In addition, further development shifted the product database towards standardized solutions and cement plants are now constructed based on both standardized and individual modules. Standardization was also introduced to the area of process design with the result of lower response times to customer inquiries.

The type of business F.L.Smith is doing today still follows craft manufacturing principles, as a large share of activities is project-based and highly customized. Yet the company was able to incorporate basic mass customization principles in order to increase the operational efficiency of sales and engineering processes by simultaneously improving customer service.

F.L.Smith (process plant construction): incorporated company F.L.Smith A/S, Denmark.

Extended case study descriptions: Hvam 2005a; Hvam 2006b.

Sources and further reading: Hvam 2005b and www.flsmith.com (the company F.L.Smith was represented by a mass customization expert invitee at one of the workshops held by the industry research group on mass customization).

5.10 Left foot



In its 45-year history, the company Pomarfin Ltd. has gone through several downturns but was always able to regain profitability by focusing on the latest innovations in shoemaking. The latest breakthrough was the introduction of the Left foot company in 2001, which offers mass customized men's shoes. The company also still continues to offer mass produced shoes.

In mid-2005, Left foot shoes were available as three different basic categories and in nearly 3,000 possible variations. These mass customized men's shoes were sold at six retail outlets at the time. The entire value chain from configuration to delivery is integrated, supported by technology in particular IT systems, and builds on modular product architecture. Customers' feet are measured with 3D scanners and CAD/CAM cutting machines somewhat automate the traditionally labor-intensive manufacturing process. To ensure a good fit, customers try on a pair of prototype shoes at the point of sales. Only when the customer feels the shoe has a perfect fit is the measurement data transferred to the Finland-based factory, together with the data on the chosen color, leather, sole and lining type. Customers receive their custom-made shoe within three weeks after ordering. After having bought their first pair of shoes in a store, customers often order additional pairs online—the system stores their individual feet measurements.

Today the Left foot company is a profitable and sustainable mass customization business. The concept is currently being introduced in many countries throughout the world and continued growth is expected. When introducing mass customization, the company Pomarfin Ltd. primarily aimed to protect its high-quality shoemaking business and Finnish production facilities against low price offerings from China. In providing additional services to customers by offering mass customized shoes, this strategy has been a success.

Left® foot company (men's shoes): incorporated parent company Pomarfin Ltd., Finland.

Extended case study description: Sievänen/Peltonen 2006b.

Sources and further reading: Mäkipää et al. 2005 and www.leftfootcompany.com.

5.11 MarelliMotori



MarelliMotori, an FKI group company, is a globally operating industrial goods manufacturer. This company produces electric motors of all kinds and supplies

them to business customers who demand a high degree of customization. Due to the increasing number of globally active low cost manufacturers, the competitive pressure in the industry has recently grown. The implementation of mass customization principles enabled MarelliMotori to offer customization at competitive prices while maintaining the standard product range and gaining synergies from offering both standard and customized motors.

The key competencies of MarelliMotori's mass customization business are "the implementation of a software-based product configuration system and the postponement of product differentiation along the material flow" (Forza et al. 2005, p. 18). This concept enables MarelliMotori to offer customization at acceptable prices, as well as quick throughput and delivery times.

Today MarelliMotori offers the highest degree of customization in the industry and customers are willing to pay a slightly higher price to get a product that best suits to needs. The standard motor product range is also maintained. This product strategy helped distinguish the firm from its competition, since customers prefer to make their purchases from as few suppliers as possible. On the whole, the case of MarelliMotori proves that mass customization enables the establishment of a profitable business.

MarelliMotori, Italy (electric motor manufacturer): incorporated parent company FKI Energy Technology, U.K.

Extended case study descriptions: Forza et al. 2005; Forza et al. 2006.

Sources and further reading: www.fki-et.com.

5.12 Selve



The company Selve is a mass customizer of shoes and offers these at two retail outlets in Munich and London, in addition to an online platform. Since 2006 the company also supplies men's shoes. When customers purchase a Selve shoe, they first choose from a range of models displayed in the store or on the Internet, respectively. Feet are then measured with a scanner in the next step. The configured model of the shoe is then displayed on a screen. Women can choose from a wide variety of colors, leather types, soles and heels. Available leather and color samples help customers select their desired shoe configuration and design. Salespeople guide customers through the entire purchasing process.

After the customers have decided on their custom configuration, all data are transferred online to an Italian manufacturing partner. This company performs all made-to-order activities based on modular product architectures. The shoe is then sent to customers within two to three weeks after placement of the order. To promote re-orders (particularly via the Internet) and derive fashion trend data for product development, all shoe configurations are stored in a database, as well as used and analyzed accordingly.

Selve is a good example of turning a start-up company in the mass customization field into a profitable business. This company has not simply gained awareness for its innovative product on the market, but has also grown to a significant size. The mass customization business strategy enabled Selve to enter the difficult and price sensitive shoe market in Germany.

Selve (shoes): incorporated company Selve AG, Germany.

Sources and further reading: KPMG 2003; Bärhold et al. 2004; Bundesministerium für Wirtschaft und Arbeit Germany 2004; Kieserling 2004; Kieserling/Berger 2004a; Kieserling/Berger 2004b and www.selve.net.

5.13 Steppenwolf



Steppenwolf is a pioneer in mass customization. Founded in 1995, the company introduced “Custom-made” bikes at a time when a declining market situation in Germany and Europe was evident. The business strategy of mass customization helped distinguish the new brand from the many existing offerings on the market. Several competitors have now copied the business strategy, but Steppenwolf is still considered the company with the highest degree of customization.

Today customers can choose from a large number of different base models when configuring their Steppenwolf bikes at one of 300 independent retail partners in Germany, Austria and Switzerland. The individual configuration basically includes a selection of different shifts and derailleurs, brakes, suspension forks, handlebars and saddles. The final but often most important choice that customers make is that of the bike frame’s color. After the order is taken by the retailer, the assembly of the Steppenwolf bike is completed by a German manufacturer. The assembled-to-order bike is then ready for pick-up at the retailer after no more than ten days.

In order to increase the overall efficiency of the mass customization business, Steppenwolf has implemented a flexible organization. The management of flexible processes is particularly important in order to efficiently integrate all external value chain partners such as suppliers and retailers.

Ten years of profitable operations have shown that mass customization is a model for building a sustainable business. Furthermore, the Custom-made concept enabled Steppenwolf to enter a declining market with an unknown brand that is now considered to be of high quality and innovativeness. Yet in order to continue growth and overcome the position of a niche player, the company intends to gradually transform its business into a mass product-oriented offering in the future.

Steppenwolf (bicycles): incorporated company Steppenwolf AG, Germany.

Extended case study descriptions: Moser et al. 2005a; Moser/Piller 2006a.

Sources and further reading: DKV 2003; Voswinkel 2003; Bärhold et al. 2004; Liertz 2004a; Liertz 2004b; Schuwirth 2004; Zweirad-Industrie-Verband e.V. 2004, www.steppenwolf-bikes.de, and xxpo.de (for information about body scanning systems for the bicycle industry).

5.14 Turo Tailor

TURO TAILOR

Turo Tailor is the market leader for (mass produced) men's suits in Finland. In the mid-1990s, the company began offering custom-made suits and introduced a so-called "measurement day" at retail partners. Although this includes standardized measuring, the process of offering tailored suits is mainly based on craft manufacturing principles. A more recent offer of customized suits called the "Windowshop" service builds on mass customization principles and was introduced together with one of Turo Tailor's major retailers in 2001.

When shopping for a mass customized Turo Tailor suit at a retail store, customers first choose from a base model, which is identical with a mass produced suit available in the same store (a shop-in-shop environment is implemented). Based on the fitting of the standard suit, a salesperson takes the measurements. Customers can choose from 15 fabrics, one or two colors, and certain design elements depending on the selected base model. The suit is then manufactured at the same Finnish factory that produces the mass and tailored suits (the latter from the "measurement day" special). Two weeks later, customers can pick up their custom-made suit at the retail store.

Turo Tailor sees the "Windowshop" service primarily as a marketing tool. On one hand, this mass customization service increases brand awareness and on the other hand, it makes it easier to convince retailers to offer Turo Tailor products only. In this regard, Turo Tailor protects its mass product offering against competitors (e.g., Hugo Boss) by investing in innovative mass customization services that retailers can provide to their customers. The main objective of Turo Tailor is to allow retailers to offer any suit a customer wants, especially when potential customers are unable to find the desired suit in the limited collection of pre-manufactured suits at a retail store.

Turo Tailor (apparel/men's suits): incorporated company Oy Turo Tailor Ab, Finland.

Extended case study description: Sievänen/Peltonen 2006a.

Sources and further reading: Kiley 2006 and www.turotailor.fi.

6 Data analysis: Dominant competencies for mass customization

This chapter presents the *model of the eight competencies for mass customization*, which is based on the empirical data derived from the project of the *industry research group on mass customization* (see Chapter 4 for the empirical research design). The *dominant competencies for mass customization* are discussed as a basis for developing a taxonomy for mass customization (cp. theoretical framework presented in Chapter 2). The generation of empirical data on *competencies for mass customization* was facilitated through the introduction of a common understanding and definition of the terms *competencies* and *mass customization* in the project. As presented in Chapters 1 and 2, the industry research group's working definitions for these two terms are repeated here as an introduction to this chapter.

Mass customization corresponds to “the technologies and systems to deliver goods and services that meet individual customers’ needs with near mass production efficiency” (Tseng/Jiao 2001, p. 685).

Competencies “of a firm are the central considerations in formulating its strategy: they are the primary constants upon which a firm can establish its identity and frame its strategy, and they are the primary sources of the firm’s profitability” (Grant 1991, p. 133).

The project of the *industry research group on mass customization* is a new form of case study research and represents the central empirical basis for deriving the *dominant competencies for mass customization*. This project consisted of a diverse group of participants including managers from 13 companies; a total of 40 individuals participated in the project. This ensured a broad overview of the research question of competencies for mass customization (Eisenhardt 1989, p. 537). Following a defined research objective and project plan, which in itself was derived from the research questions of this work, the industry research group held ten working meetings from September 2004 to September 2005. These all-day meetings were dedicated to presentations and discussions about competencies for mass customization (Hedges 1985, p. 86).

The group interview was the predominantly applied research technique—a loosely structured technique used for explorative research (Bortz/Döring 2002, p. 319f; Easterby-Smith et al. 2002, p. 105f; Atteslander 2003, p. 155f). In addition to the managers from the 13 companies, researchers from the IOM institute and mass customization expert invitees participated in the workshops. The scholars’ tasks included steering the overall process of the project and documenting all statements (Hedges 1985, p. 84f). In order to limit their own direct participation, the researchers only very rarely directed questions to workshop participants (Hedges 1985, p. 77, 81; Atteslander 2003, p. 156). To incite discussions, the invited experts held presentations on the

subject of mass customization competencies, which were followed by discussions (Hedges 1985, p. 78, 83f).

The resulting process of case data generation was interactive and involved all members of the industry group. The workshop characteristic of the meetings ensured that the industry members stated and answered open questions themselves in the context of the research objectives. They arrived at results through the reflection and exchange of insights (Hedges 1985, p. 79; Atteslander 2003, p. 156; for further details on the applied research design, see Sections 4.1.5.3 and 4.3).

6.1 Identification and description of the eight dominant competencies for mass customization

Empirical data, analysis and findings

As described in detail in Section 4.3.6, the empirical case data from the industry research group project were analyzed following a two-step approach. This method of data analysis was enhanced by recording all meetings so as to generate an in-depth documentation; case data from all other available sources were also collected (Eisenhardt 1989, p. 534; Gummesson 2000, p. 121; Yin 2003, p. 85). The technique of documentation included the assessment and coding of all contributions and it delivered the empirical data necessary to confirm contributions on mass customization competencies (Glaser/Strauss 1967, p. 30; Maxwell 1996, p. 79; Gummesson 2000, p. 84, 110f; Yin 2003, p. 133-137).

The identification of the *dominant competencies for mass customization* followed a two-step approach, pursued the content analysis technique, and aimed to attain a generalization of the results (Glaser/Strauss 1967; Hedges 1985, p. 89; Gummesson 2000; Easterby-Smith et al. 2002, p. 118-122; Yin 2003). To evaluate the meeting contributions on competencies, all workshop documentation was coded in a first step. This coding was primarily based on the understanding and definition of the term competencies (see definition above). Competencies for mass customization were identified by evaluating workshop contributions according to two criteria: whether a contribution had either been frequently discussed or debated for a longer period of time during one meeting, and whether it had interested at least three workshop participants. The result was a *preliminary set of mass customization competencies* (for details see Section 4.3.6.6). In a second step of evaluation, the purpose of which was to identify the *dominant competencies for mass customization*, the derived *preliminary set of mass customization competencies* was evaluated by applying the definition of dominant competencies (McKelvey 1982) and by examining case studies that document a direct effect between competence and a company's success. These case studies were also derived from the *industry group project*, but

primarily originated from the case data examined in the *international mass customization casebook project*.

Figure 46 in Chapter 4 shows an overview of the applied two-step evaluation scheme for identifying *dominant competencies*. The presentation of all empirical data in Appendix 9 enables the reader to follow the process of deriving the *dominant competencies for mass customization* (Gephardt 2004, p. 460; for further details on the applied research design, see Chapter 4).

Overview of the eight dominant competencies for mass customization

The *eight dominant competencies for mass customization* identified through the empirical study of the industry research group project and derived in the second step of data analysis are summarized in Figure 49 (see also Figure 106, which presents the dominant competencies in Appendix 9). The eight dominant competencies are labeled I. to VIII. This prioritization is based on the structure of the information cycle of mass customization by Reichwald/Piller (2000), which will be presented later in Section 6.2.1.

The eight dominant competencies for mass customization
I. Customer integration
II. Application of product configuration systems
III. Employment of product modularity
IV. Product variant management
V. Central production and logistics planning
VI. Management of mass and individual production
VII. Management of flexible organization and processes
VIII. Process documentation and IT support

Figure 49. The eight dominant competencies for mass customization

In following, these empirical results are explained in detail by providing comprehensive insights. The discussion includes verbatim workshop

citations⁶¹ from the industry research group meetings as a valuable source of empirical evidence (Hedges 1985, p. 90), as well as conflicting and confirmative literature statements (Hedges 1985, p. 90; Eisenhardt 1989, p. 544f; for further details on most of the cited literature, see Section 3.2). Also, for each dominant competence, case studies that document a direct effect between competence and corporate success are outlined. These case studies provide empirical evidence for verifying McKelvey's definition of a dominant competence (McKelvey 1982, p. 215; see the theoretical framework and method of analysis presented in Sections 2.3, 4.3.6 and this section above). For an overview of all company descriptions and case studies used in this work, see Chapter 5.

The following evaluation of dominant competencies presents and discusses those case studies (of the 14 mass customization case studies) that provide empirical evidence with the highest validity (e.g., data on competencies are confirmed by several sources). In the context of a discussion of mass customization types, additional case studies will be allocated to the eight dominant competencies (see Section 8.1 and Appendix 10). This analysis amplifies the discussion presented below.

6.1.1 Customer integration

Explanation and definition, comparison with literature, and workshop citations

... that mass customization is the perfect tool for
 ... the value chain." (Citation #38 at 10th
 ... on
 ... pr
 ... er
 the success
 integration, see Figure

**Full Chapter 6 not included
 in this publication**

Customer integration means that "[...] consumers now take part in activities and processes which used to be seen as the domain of the companies" (Wikström 1996b, p. 361; cp. Tseng/Piller 2003b, p. 8).

Figure 50. Explanation of customer integration

⁶¹ All citations from the industry research group meetings will be indicated by the reference "citation" (and numbered accordingly). See Appendix 9 for all workshop citations.

⁶² All industry research group citations are numbered from #1 to #164 and correlate with a workshop number (see Appendix 9 for details on all workshop quotes).

7 Mass customization strategies

The research findings of the eight dominant competencies for mass customization presented in the previous chapter are an important step for deriving a comprehensive, empirically founded taxonomy. The existence of particular dominant competencies in a mass customization company and their distinctive combination result in “a unique organizational form” (McKelvey 1982, p. 191). By utilizing the developed model, mass customization can be analyzed in a structured manner and different types of companies can be identified.

The model of the dominant competencies does not imply a taxonomy comprising universal mass customization types due to the lacking final research step of a quantitative study utilizing the theory of numerical phenetics, as proposed by McKelvey (1982), which is not presented in this research. However, the empirically rich data of this research build a basis for validating and expanding on existing typologies. Together with the *model of the eight dominant competencies*, the data from the *mass customization case studies* are applied for deriving hypotheses on types in this chapter.

As discussed in Section 3.1, there are several different approaches to classifying mass customization, all of which result in typologies. A promising typology for investigating the types from a strategic point of view are the four “roles of customization” developed by Spring/Dalrymple (2000). This typology focuses on the strategic question as to why companies pursue mass customization and is used as a basis for the discussion of mass customization types, as it follows the idea of this work’s theoretical framework. The rationale of the four roles of customization is similar to the underlying rationale of the RBV theory of gaining competitive advantage by developing superior internal resources. In the context of the study by Spring/Dalrymple, mass customization is seen as a competence in itself, as well as a vehicle for developing other competencies (Spring/Dalrymple use the term capabilities) in order to gain competitive advantage. The idea of developing the different roles of customization based on different competencies is also analogous with the competence-based organizational systematics framework by McKelvey (1982).

In the following, the typology by Spring/Dalrymple (2000) is presented in detail and applied by classifying the 14 mass customization case studies presented in this work. Furthermore, this typology is enhanced by suggesting additional types and offering in-depth descriptions of case studies on the different strategies.

7.1 Study by Spring & Dalrymple: Roles of customization

Spring/Dalrymple (2000) developed a mass customization typology from case study research (see also Section 3.1). Four case studies from the industrial goods sector formed the basis for identifying different “roles of customization” (Spring/Dalrymple 2000, p. 461-463).

From their case study research, Spring/Dalrymple (2000) find that companies use mass customization not simply as a profitable business strategy but also as a means to protect their business from competitors or as “a way of forcing themselves to develop new capabilities” (Spring/Dalrymple 2000, p. 462). Mass customization also offers the opportunities of creating a “symbol to industry” (Spring/Dalrymple 2000, p. 462) and increasing brand awareness for the whole business. The typology the authors derived from these analyses differentiates between the “profit-taker” and companies that use the concept as an “entry barrier,” a “vehicle for learning,” or as a “symbol to industry” (Spring/Dalrymple 2000, p. 463). The main question this typology seeks to answer is that of the strategic reason behind a company’s pursuit of mass customization. Consequently, the typology aims to distinguish between different rationales of strategically positioning mass customization within an organization. The central parameter for differentiating the four different roles is “how much customized business to take on, and this will depend on the role customization plays” (Spring/Dalrymple 2000, p. 462). In other words, the main classification perspective is the degree of importance of mass customization as compared to the non-mass customized business. This parameter is expressed by the classification attribute “volume required,” which is the volume of the mass customization business particularly in comparison to the non-mass customized business.

Taken from the publication by Spring/Dalrymple (2000, p. 463), Figure 74 provides an overview of this typology. For each of the four mass customization roles, the rationale is described in accordance with the case study research. The central classification attribute “volume required” also acts as a descriptive parameter illustrating the required volume of mass customization for operating the respective role. The other three parameters are less relevant for functioning as classification attributes and are rather of explanatory value for the four roles in regard to sustainability, accounting and manufacturing issues. One problem with Spring/Dalrymple’s (2000) typology is that the four roles are not mutually exclusive. As seen in the following, some case studies can be associated with more than one role.

Role	Entry barrier	Vehicle for learning	Symbol to industry	Profit-taker
Rationale	Product may be unprofitable, but will keep competition out	Product may be unprofitable, but new organizational or technological capabilities will be learned	Product may be unprofitable, but suitably communicated, will enhance standing/brand in industry	Customized product attracts high price and makes profit in its own right
Timing of benefit	Medium-term effect	Very long-term	Long-term effect	Immediate
Costing philosophy	Cost of account?	Indirect costs as product line overhead	Indirect costs as general overhead	Indirect costs charged to customer per product
Volume required	Depends on balance of potential loss of revenue and cumulative effect on manufacturing costs	Enough in various/ demanding applications to accelerate learning	Minimum to achieve effect	Any profitable
Possible manufacturing issues	Identify all costs; develop shared understanding of rationale	Capture learning and involve potential disseminators	Develop shared understanding of rationale	

Figure 74. The Spring/Dalrymple typology⁶⁶

Due to the limited number of underlying case studies, Spring/Dalrymple (2000) point out that the developed typology has more practical than academic relevance (Spring/Dalrymple 2000, p. 464). In order to increase the validity of this typology, the 14 mass customization case studies presented in this research are applied to it. Since the four case studies presented in the study by Spring/Dalrymple (2000) are industrial goods cases only, the 14 case studies covering industrial and consumer goods companies build a good basis for validating the roles. The term “role of customization” (Spring/Dalrymple 2000, p. 461) is changed to the term *mass customization strategy* here and will be used henceforth when referring to the mass customization types developed in this chapter and throughout this work.

⁶⁶ Figure copied from Spring/Dalrymple 2000, p. 463.

7.2 Empirical investigation of mass customization strategies

In order to deepen the insights on the different mass customization strategies, 14 case studies are classified by distinguishing between today's mass customization strategy from past and future strategies. This differentiation is available, because most of the companies analyzed in the following have implemented mass customization over the last couple of years and strategies have often changed throughout this process. This method of analysis increases the number of data points since each case is investigated at different stages of the mass customization implementation process (if respective data is available).

7.2.1 Application of Spring & Dalrymple's typology

Figure 75 shows that all mass customization case studies can be associated with at least one of the four mass customization strategies. As indicated by Spring/Dalrymple, the central classification attribute is the percentage of the volume of mass customization business from the total business (shown as an approximate percentage). For companies that have implemented mass customization as a profitable business strategy and companies that only offer mass customized products, this percentage is roughly 100%. The other values employed as rough figures are < 10% and > 50% (relative mass customization volume).

With the exception of the Design&MC Lab case study, which is a research lab and sees mass customization as a so-called "vehicle for learning," the respective strategy of all case studies with a 100% share of mass customization volume is that of a "profit-taker" (121TIME, Audi, BMW, Delance, Left foot, Selve and Steppenwolf). For most companies with a low mass customization volume (< 10%), the mass customization strategy is a "vehicle for learning" (Adidas, APC, Deutsche Telekom, and F.L.Smidth).

Adidas sees mass customization today not only as "vehicle for learning," but also as a "symbol to industry" because its mass customization offering is viewed as an effective marketing campaign for increasing the modern, innovative image of the Adidas brand. Because it plans to expand the importance and volume of the mi adidas business in the near future, Adidas intends to define the strategy of its mass customization business as a "profit-taker."

At the time customization was introduced to their automobile business 20 to 30 years ago, Audi and BMW saw the mass customization strategy as a "symbol to industry" in order to build the premium brand position they have established today. This strategy has paid off; today the full product range of both companies builds on a profitable mass customization business and the strategy has become a "profit-taker."

The company MarelliMotori sees mass customization as a “profit-taker” because it is able to offer customization of its entire product range at competitive prices. Particularly for its small motors business, MarelliMotori also sees mass customization as an “entry barrier” since other suppliers are unable to offer such a high degree of customization for a typically standardized product.

Protecting the business against competition (entry barrier) was also an important strategic objective for the Finnish firms Left foot and Turo Tailor when launching their mass customization business. These two firms managed to distinguish their businesses against foreign low cost competitors by offering customized products. With the same concept, Turo Tailor was also able to increase the brand image of its traditional mass production business (“symbol to industry”).

Mass customization case study (company name)	Volume of mass customization business in percent of total business (< 10%; 10%-50%; approx. 50%; > 50%; approx. 100%)	Mass customization strategies (Spring/Dalrymple 2000)
121TIME	approx. 100%	Profit-taker (today)
Adidas	< 10% (focus mass production)	Vehicle for learning & symbol to industry (in the past and today) & profit-taker (future)
APC	< 10% (focus craft manufacturing)	Vehicle for learning
Audi	approx. 100%	Profit-taker (today) & symbol to industry (in the past)
BMW	approx. 100%	Profit-taker (today) & symbol to industry (in the past)
Delance	approx. 100%	Profit-taker (today)
Design&MC Lab	approx. 100%	Vehicle for learning
Deutsche Telekom	< 10% (focus craft manufacturing)	Vehicle for learning
F.L.Smidth	< 10% (focus craft manufacturing)	Vehicle for learning
Left foot	approx. 100%	Profit-taker & entry barrier
MarelliMotori	> 50%	Profit-taker & entry barrier
Selve	approx. 100%	Profit-taker (today)
Steppenwolf	approx. 100%	Profit-taker (today)
Turo Tailor	< 10%	Symbol to industry & entry barrier

Figure 75. Fourteen case studies classified according to the Spring/Dalrymple typology

7.2.2 Extension of Spring & Dalrymple's typology

The analysis of the 14 mass customization case studies is incomplete, especially when looking into the past and future strategies of these 14 companies. 121TIME, Delance, Selve and Steppenwolf used the mass customization concept to enter the market in the past, but this strategy is not captured by Spring/Dalrymple's (2000) typology. The strategy *vehicle for market entry* should therefore be added to the original typology. The rationale behind this strategy is that companies enter the market by introducing customizable products when they lack a well-known brand or other differentiation factors needed to attract profitable customer segments and gain a sufficient market share.

121TIME and Steppenwolf have made plans to use the concept of mass customization to convert their companies into a mass production-oriented business in the future. The motivation for this strategy is to create superior organizational processes and structures for a mass production business by also implementing mass customization principles and competencies. The application of basic principles such as product modularity, postponement or a flexible organization will guarantee a competitive advantage over the industry's average mass producer. Moreover, the exclusive brand of the mass customization business can also be used to promote the mass production business. This mass customization strategy is not captured in the typology by Spring/Dalrymple (2000). Hence, the strategy *path to mass producer* should be added to the original typology.

APC, Deutsche Telekom and F.L.Smidth are utilizing mass customization particularly as a *vehicle for learning*. But the intention of learning is not to primarily generate customer and market data as was in the case study of Adidas, but to improve internal efficiency and reduce costs. In order to distinguish between these two fundamental reasons for pursuing learning, i.e., for deriving marketing data and for improving operational efficiency, the strategy *vehicle for increasing operational efficiency* should also be added to the original typology. Under this extended typology, the strategy of the three companies APC, Deutsche Telekom and F.L.Smidth should be associated with the mass customization strategy *vehicle for increasing operational efficiency*, whereas Adidas's mass customization strategy follows a *vehicle for learning strategy*. The objective of the mass customization activities of the Design&MC Lab is to generate a learning platform for deriving market data, as well as for developing concepts and technologies towards the improvement of the operational efficiency in a mass customization shoe business.

Figure 76 offers an overview of the classification of the 14 mass customization case studies. The figure is split into two columns differentiating between the original typology by Spring/Dalrymple (2000) and the extended typology. The extended typology covers the three additional mass customization strategies *vehicle for market entry*, *path to mass producer* and *vehicle for increasing operational efficiency*. As noted in Section 7.1, a company can pursue more than one mass customization strategy.

Mass customization case study (company name)	Mass customization strategies (Spring/Dalrymple 2000)	Extended list of mass customization strategies
121TIME	Profit-taker (today)	Vehicle for market entry (in the past) & path to mass producer (future)
Adidas	Vehicle for learning & symbol to industry (in the past and today) & profit-taker (future)	
APC		Vehicle for increasing operational efficiency
Audi	Profit-taker (today) & symbol to industry (in the past)	
BMW	Profit-taker (today) & symbol to industry (in the past)	
Delance	Profit-taker (today)	Vehicle for market entry (in the past)
Design&MC Lab	Vehicle for learning	Vehicle for increasing operational efficiency
Deutsche Telekom		Vehicle for increasing operational efficiency
F.L.Smith		Vehicle for increasing operational efficiency
Left foot	Profit-taker & entry barrier	
MarelliMotori	Profit-taker & entry barrier	
Selve	Profit-taker (today)	Vehicle for market entry (in the past)
Steppenwolf	Profit-taker (today)	Vehicle for market entry (in the past) & path to mass producer (future)
Turo Tailor	Symbol to industry & entry barrier	

Figure 76. The Spring/Dalrymple typology extended and applied to 14 case studies

7.2.3 Seven mass customization strategies

Figure 77 summarizes the proposed extended typology. For each of the *mass customization strategies*, the rationale and volume required are discussed. Furthermore, the seven *mass customization strategies* are allocated to two different *primary mass customization strategies*. The primary strategy of mass customization as a *sustainable business* covers the three possible *mass customization strategies*: *profit-taker*, *vehicle for market entry*, and *path to mass producer*. If a company pursues a primary mass customization strategy of *supporting a non-mass customized business*, the respective possible strategies are *entry barrier*, *symbol to industry*, *vehicle for learning* and *vehicle for increasing operational efficiency*.

Mass customization strategy	Rationale	Volume required
Sustainable mass customization business (primary strategy)		
Profit-taker	“Customized product attracts high price and makes profit in its own right.”	“Any profitable.”
Vehicle for market entry	Offering a customized product attracts customers when other differentiation factors are missing for a market entry.	Enough to attract a sufficient share of the market, create a profitable business and become a profit-taker.
Path to mass producer	The basic principles and competencies for mass customization are applied to generate a superior mass production organization.	Enough to be able to implement the basic mass customization competencies, pursue a profitable business today (profit-taker) and create a profitable mass production business in the future.
Support of a non-mass customized business (primary strategy)		
Entry barrier	“Product may be unprofitable, but will keep competition out.”	“Depends on balance of potential loss of revenue and cumulative effect on manufacturing costs.”
Symbol to industry	“Product may be unprofitable, but suitably communicated, will enhance standing/brand in industry.”	“Minimum to achieve effect.”
Vehicle for learning	“Product may be unprofitable, but new organizational or technological capabilities will be learned.” Focus of learning: marketing data.	“Enough in various/demanding applications to accelerate learning.”
Vehicle for increasing operational efficiency	Product may be unprofitable, but organization is able to capture data for improving operational efficiency.	“Enough in various/demanding applications to accelerate learning.”

Figure 77. The seven mass customization strategies⁶⁷

The aggregation of the seven *mass customization strategies* to two *primary strategies* creates a more easily applicable typology of mass customization. Figure 78 shows the results of allocating all 14 case studies to the typology of the *mass customization strategies*. Based on the classification attribute of whether or not a company pursues a profitable mass customization business, all case

⁶⁷ Based on Spring/Dalrymple 2000, p. 463.

studies can be allocated. Companies that primarily view mass customization as a profitable business strategy (strategy profit-taker) are associated with the primary strategy of pursuing a *sustainable mass customization business*. Companies primarily aiming at *supporting a non-mass customized business* are representatives of the second group of a primary mass customization strategy.

Primary strategy of mass customization	Mass customization case study (company name)
Sustainable mass customization business Relevant classification attribute: a company pursues the profit-taker strategy for profitable mass customization (today)	121TIME
	Audi
	BMW
	Delance
	Left foot
	MarelliMotori
	Selve
	Steppenwolf
Support of a non-mass customized business Relevant classification attribute: a company does not pursue the profit-taker strategy (today)	Adidas
	APC
	Design&MC Lab
	Deutsche Telekom
	F.L.Smith
	Turo Tailor

Figure 78. Fourteen case studies classified applying the two primary strategies

This model provides a basic framework for evaluating different mass customization strategies, but it does not offer a good method for classification. Although it presents a structure for differentiating between different types of mass customization, it does not build a basis for identifying mass customization companies because it lacks appropriate classification attributes. The proposed attribute, whether or not a company pursues a profitable mass customization business strategy, is weak in its usage and difficult to measure. Moreover, the application of this attribute brings the classification problem back to the initial question of how a mass customization business is actually defined. This is also true for the above-presented allocation of the 14 case studies to the *mass customization strategies*, as the central classification attribute used there is the percentage of the volume of mass customization business from the whole business.

In order to overcome the weakness of the typology, this model is discussed in the context of the *eight dominant competencies* in the following chapter. The objective is to introduce the dominant competencies as possible classification attributes to the typology of the *mass customization strategies*.

8 Discussion: A mass customization typology

8.1 Seven mass customization strategies and eight dominant competencies for mass customization: Model of a mass customization typology

*Chapter 8 not included
in this publication*

9 Conclusions and limitations

A statement from Chapter 2, Section 2.1 should be reiterated here, which referred to the theoretical framework for this work and theories of classification. It was noted that researchers evaluate classification systems as perhaps the most crucial step in any form of research if they are comprehensive (Crowson 1970, p. 1; Carper/Snizek 1980, p. 65; McKelvey 1982, p. 3). After having completed this work, the author genuinely supports this understanding. By working on the classification of mass customization, a lot of knowledge was gained on the topic of classification itself. By utilizing the competence-based framework of organizational systematics (McKelvey 1982), deep insights into the field of mass customization competencies were also obtained. This work summarizes these findings and provides an overview of the current state of research on strategic topics in the field of mass customization.

9.1 Results

There are two different categories of results from this work: those that are directly related to the study of the research questions presented here, and those that emerged from this project as additional findings.

9.1.1 Results regarding the study of the research questions in this work

The four research questions of this work concerned the topics of mass customization classification and competencies (see Section 1.3). All research questions were answered by the presented projects and studies. The following discussion summarizes the main results (for an overview, see the research process and structure of this work presented in Section 1.4).

Competencies for mass customization

The research on competencies for mass customization helps structure and prioritize the existing knowledge about competencies. This work has not conceptualized or presented a comprehensive overview of all potentially relevant competencies (this has already been done by Pine II 1993 and Piller 2003). Instead, the author focused on empirically identifying those competencies applied by today's mass customization companies, which managers see as the guarantors of their corporate success.

The main result was the *model of the eight dominant competencies for mass customization*, which was derived based on an explorative study together with

the industry research group on mass customization at the TUM business school. Following a theoretical framework considering the competence-based organizational systematics framework by McKelvey (1982) and building on the RBV theory as well, eight dominant competencies for mass customization were identified.

The eight dominant competencies for mass customization are I. customer integration, II. application of product configuration systems, III. employment of product modularity, IV. product variant management, V. central production and logistics planning, VI. management of mass and individual production, VII. management of flexible organization and processes, and VIII. process documentation and IT support (see Chapter 6).

The identified *model of the eight dominant competencies for mass customization* was verified by analyzing 14 mass customization case studies in depth. The overall finding from this research step was that all eight dominant competencies are important, as they are all applied in practice. Apart from the eight dominant competencies, which are the basic concept for deriving a mass customization taxonomy (see below), eleven additional competencies were identified through the work with the industry research group (see Chapter 4). The presentation of the work of the *preliminary set of mass customization competencies* at various workshops and conferences was well received, and its findings were confirmed by scholars and business experts alike.

Classification of mass customization

The research in the field of mass customization classification came to the fundamental conclusion that mass customization is a unique organizational form.

Following the competence-based organizational systematics framework by McKelvey (1982), the main argumentation for confirming mass customization as a separate organizational form is the existence of case studies that document a distinct combination of the eight dominant competencies for mass customization (see Section 6.2.3).

This work developed *seven mass customization strategies* as a hypothesis of a mass customization typology. This typology focuses on the strategic question as to why companies pursue mass customization. The seven strategies result from the case study research and are an extension of an existing typology (Spring/Dalrymple 2000). These seven *mass customization strategies* are *profit-taker*, *vehicle for market entry*, *path to mass producer*, *entry barrier*, *symbol to industry*, *vehicle for learning* and *vehicle for increasing operational efficiency*. The first three *mass customization strategies* were aggregated to the primary strategy *sustainable mass customization business*; the later four strategies were grouped in the primary strategy *support of a non-mass customized business*.

This typology was applied by classifying 14 mass customization case studies. The case analysis confirmed the existence of all seven strategies and both primary strategies of mass customization. In order to achieve the operationalization of this typology, the *eight dominant competencies* were applied as classification attributes within the typology of the *mass customization strategies*. The combined model of the *seven mass customization strategies* and the *eight dominant competencies* led to a comprehensive and strategic *model of a mass customization typology* (see Chapter 8).

The combined *model of a mass customization typology* was based on and confirmed by rich case study data. The result is a broadened scope of the mass customization understanding; mass customization is not simply understood as a business strategy, but also as a concept for supporting other business goals⁷¹ such as the operation of a mass or craft manufacturing business. The *model of a mass customization typology* contributes to the understanding of mass customization, provides a comprehensive definition and facilitates future research in the field of mass customization.

This work also provides the basic pre-study for deriving a mass customization taxonomy (following the framework by McKelvey 1982) and validating the existing hypotheses on the different types. A research agenda and method for a quantitative, empirical classification study will be presented later in Section 9.2.

Current state of mass customization research

Besides developing new empirical findings in the context of mass customization classification and competencies, this work also documented and evaluated the current state of research in this field by completing two pre-studies. Chapter 3 presented the evaluation of a list of models covering the topics classification and competencies. These models were also used to confirm or extend the empirical findings of this work.

The *literature review of mass customization classifications* presented a comprehensive evaluation of existing models in the literature. In contrast to the large number of identified articles on mass customization classification that provide an evaluation or comparison, the results of this literature review were linked to a theoretical framework based on organizational theory. A theoretical framework formed the basis for a rigorous evaluation of classification studies. The organizational systematics framework by McKelvey (1982) was used together with previously applied evaluation schemes in order to systematically determine the advantages and disadvantages of existing classification studies.

⁷¹ “Other business goals” refers to business strategies outside the primary focus of operating a profitable and sustainable mass customization business. See also the definition of strategy in Chapter 2 and the discussion of the mass customization strategies in Chapter 7.

9.1.2 Results regarding the research design and collection of mass customization case studies

This research also revealed results outside its primary objectives. These included theoretical and methodological contributions about organizational classification, case study research and a new form of case study research, the industry research group. Moreover, this work documented a collection of mass customization case studies.

Competence-based framework for organizational classification

A framework for doing research on organizational classification was operationalized. Based on the organizational systematics framework McKelvey (1982), the necessary steps for deriving a taxonomy were outlined. In particular, the concept of the eight dominant competencies was outlined and further developed in order to emphasize the importance of this research step for deriving an organizational taxonomy (see Sections 2.3 and 4.3.6.2).

Case study research and the industry research group

The research design of case study research has been thoroughly operationalized with this work. Research design in management research was particularly extended by presenting a new form, the *industry research group*. This new form of conducting case study research in qualitative, explorative management research has been developed, applied and documented in depth (see Sections 4.1.5.3 and 4.3). The IOM institute's experience of conducting research together with an industry research group was positive and the industry members also gave overall positive feedback about their participation in this research setting. The change process resulting from the industry research group project was realized by most of the participating industry members. The following representative statements from the last working meeting prove the success of this project (see applied methods of data collection and analysis in Section 4.3):

One manager from the wristwatch mass customizer said: "I have received new impulses to improve my business at every single session." (Citation #166 at 10th workshop)

One manager from the automotive supplier stated: "This research project has provided us a checklist on how to implement mass customization." (Citation #167 at 10th workshop)

Five managers all concluded their participation at this research project with: "I have learned a lot in order to further improve and develop my mass customization business." (Citation #168 at 10th workshop)

One manager from the automotive company said: "I have learned that we all face the same problems no matter what size our mass customization company is." (Citation #169 at 10th workshop)

The IOM institute aims to continue the work with this research group to answer newly emerging questions in the field of mass customization. It is also considering extending the use of industry research groups to its other research fields. The presented studies of the University St. Gallen (see Section 4.1.5.1) prove that industry research group projects can become a commonly applied form of research.

This work also expanded on classical case study research by conducting case study research within a research consortium. The importance of pre-defined case outlines and pre-defined analysis techniques was emphasized and adequate concepts were developed. Providing fundamental empirical evidence in regard to the case study analysis for this work, the international mass customization casebook project was also documented in detail (see Section 4.2).

Mass customization case studies

Due to the importance of case study research design for this work, a collection of different case studies was developed. *Fourteen mass customization case studies* from different industries and countries pursuing various mass customization strategies were documented as short company descriptions (see Chapter 5). These case data were derived from the international mass customization casebook project and were also based on the work with the industry research group on mass customization. The case descriptions aimed at providing a concise overview of the *14 mass customization case studies*. Readers can find further material in the referenced publications.

9.2 Limitations of this research and indications for further research

This research and its presented findings have limitations. These have already been mentioned and discussed to some extent in previous chapters, but should be summarized here again in order to formulate a research agenda on the most important issue.

Limitation in regard to the validity of the empirical data

Research with an industry research group has limitations. To start with, these limitations lie in the limited number of participating companies in such an explorative research setting. Managers from 13 permanently involved companies participated in the ten working meetings. Together with mass customization experts and members from the participating research institutions, 40 people contributed the empirical data for identifying the competencies for mass customization.

Greater limitations are caused by the applied pre-selection process for forming the group of 40 people. Also, the authority of individual people in the workshop discussions creates biases. Some workshop participants dominated particular topics within the discussed field of mass customization competencies, whereas other topics were less intensely discussed. Here the involved researchers' strategy was to find a balance between the different topics and people, yet this could only be achieved to a certain degree since the scholars were required to maintain a generally low degree of involvement (see Sections 4.1.5.3 and 4.3).

There are also limitations in regard to the defined scope of the research question (within the work of the industry research group). The consumer perspective was studied from a supplier's point of view; competencies from an external perspective were not studied. This is also true in regard to external factors: factors outside organizational boundaries that influence the success of a mass customization company were not investigated (e.g., customers' individual competence in handling mass customized products). Moreover, the focus of the case analysis lies on the goods industry; services were not considered to a great extent. Additional research that focuses on this field is suggested and it should aim at identifying variations in different industries, particularly in regard to applied competencies. One proposal for extending the view of mass customization towards services and the "experience economy" is made by Pine II/Gilmore (Pine II/Gilmore 1999; see also Hongjun 2005; Pine II 2005).

The findings of this work are also limited due to existing biases of the involved researchers when documenting and analyzing the qualitative empirical data from the industry research group workshops. Due to the fact that two researchers documented and three researchers analyzed the empirical data, these biases were, however, reduced to a minimum.

In order to increase the validity of the project results, the findings from the industry research group were presented at different conferences and discussed with several different experts from the field (see Section 4.3). The conference meeting of January 2006 is most notable: as part of the industry research group project and hosting a total of 42 mass customization experts, this conference helped increase the validity of the dominant competencies for mass customization. The identified mass customization strategies were also discussed and verified at this meeting (Moser 2006).

There are also limitations regarding the empirical validity of the case data originating from the international mass customization casebook project. The number of case studies examined, analyzed and documented in the international mass customization casebook project was limited to 18. Due to the restricted availability of the case data at the time this work was written, only ten case studies could be taken into account. Together with the mass customization case data from the industry research group project, case data from a total of 14 companies were applied in this work (see Chapter 5).

The author's recommendations for future research are to conduct similar research projects and validate the empirical findings of this work with a second or even multiple industry research groups. This should include the analysis of a wider collection of mass customization case studies with a greater focus on services industries.

Limitation in regard to the completeness of the research towards a mass customization taxonomy

Not all of the proposed research steps for deriving an organizational classification were completed with this work (cp. Chapter 2 and the organizational systematics framework by McKelvey 1982). In particular, a quantitative empirical study based on the theory of numerical phenetics was not conducted in order to derive a mass customization taxonomy. Such a study might help evaluate and verify the model of the eight dominant competencies (as a basis for deriving classification attributes). Furthermore, a quantitative study could verify the model of the seven mass customization strategies, as the results regarding mass customization classification present a typology, not a taxonomy (see Chapter 8).

Summary of the limitations and next steps

Due to the applied research design and limited number of case studies, the derived mass customization strategies have to be understood as initial hypotheses; a different set of case studies might have provided the empirical evidence for identifying additional or different mass customization strategies. The same is true for the application of the eight dominant competencies within the typology of the mass customization strategies. Further research should focus on these open fields and validate or extend the findings of this work.

A framework for deriving a mass customization taxonomy—a research agenda

The final research step of a quantitative study applying the theory of numerical phenetics as proposed by McKelvey (1982) was not presented in this research, nor was a taxonomy comprising universal mass customization types developed here. This is due to the lack of a large number of mass customization case studies, for which a large number of classification attributes can be investigated.⁷² The case data of this research are qualitatively rich but quantitatively insufficient for developing a mass customization taxonomy. To conduct such a study, McKelvey (1982, p. 345f) suggests investigating a larger number than the 14 case studies investigated here. Moreover, classification attributes have to be empirically measured utilizing quantitative methods.

⁷² The members of the research consortium of the casebook project generally agree that for such a study, empirical data is not sufficient due to the low number of available mass customization case studies in business practice.

The organizational systematics framework by McKelvey (1982) suggests conducting a quantitative empirical study based on the theory of numerical phenetics in order to derive a taxonomy. McKelvey's (1982) basic methods and procedures for deriving a taxonomy are explained in the following. In doing so, the author seeks to develop a brief research agenda as a detailed framework (for further details, McKelvey 1982; Ulrich/McKelvey 1990 are suggested).

In order to link it to the pre-study completed with this work, this proposal is meant to primarily test the hypotheses on the developed typology by investigating a large number of companies. In such a study, a larger number of classification attributes than just the eight dominant competencies for mass customization must be considered. According to McKelvey (1982), a classification becomes richer the more attributes are considered for its development (McKelvey 1982, p. 345f). Nevertheless, the model of the eight dominant competencies builds an empirically-derived basis for obtaining operative classification attributes. Specifically speaking, this quantitative study must first break down the eight dominant competencies into a large number of operative classification attributes.

Based on the theory of numerical phenetics, McKelvey (1982) suggests a number of basic research steps for performing such a quantitative study. The following list of research steps should provide an overview of the scope of the study. McKelvey (1982) specifically outlines:

- rules for defining and selecting the number of case examples and classification attributes (McKelvey 1982, p. 345),
- rules for defining the kinds of characters applied (McKelvey 1982, p. 354),
- a model for the operationalization of the environment (McKelvey 1982, p. 121),
- methods for selecting and weighting the classification attributes (McKelvey 1982, p. 367),
- methods for coding and scaling the derived data (McKelvey 1982, p. 375, 384, 387, 398),
- frameworks for the visual representation of the results (McKelvey 1982, p. 415) and
- methods on how to display the results of classifications (McKelvey 1982, p. 256-262, 284).

9.3 Management implications

This closing section of this work is dedicated to *management implications* (for an overview see Figure 82). Some concluding ideas should be presented here, which do not suit the academic format of this work. The first area of management implication expands the discussion of the *seven mass customization strategies* and hypothesizes that *mass customization is a business strategy for every organization*. Second, the final discussion covers a notion about an important competence that could not be validated as an important competence by the applied method of analysis: *change management*. Finally, an *analysis scheme for classifying mass customization organizations* bridges the two central findings of this work again, the *seven mass customization strategies* and the *eight dominant competencies for mass customization*, and adds to the understanding of the *model of a mass customization typology*. In comparison to the *model of a mass customization typology*, the presented analysis scheme is schematic and hypothetical.

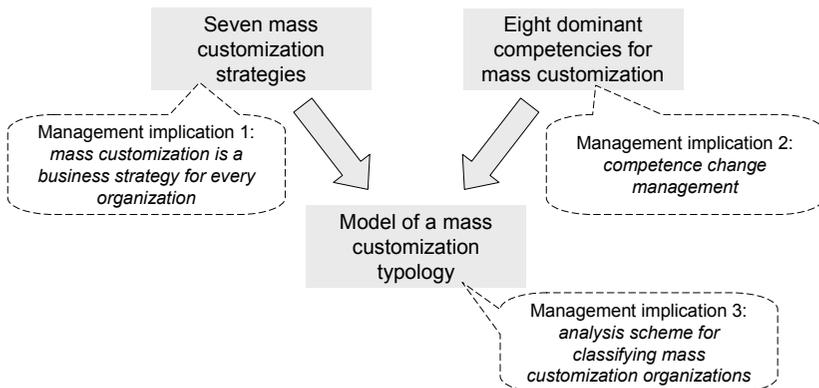


Figure 82. Management implications

9.3.1 Mass customization as a business strategy for every organization

“Mass customization can be considered to be a strategy in itself.” (Blecker et al. 2005, p. 43) Analogous to this quote, other researchers and managers associate a business strategy or a profitable business model with mass customization (Hart 1996, p. 21; Tseng/Piller 2003b, p. 1; Potter et al. 2004, p. 473; Kreuzer 2005, p. 42; Piller 2005c, p. 313). Most researchers do not consider mass customization a potential embodiment of a wide variety of strategies that are also applicable to mass or craft manufacturing environments.

The different *mass customization strategies* presented as a main result of this work stand in contrast to the current understanding of mass customization. Under the new developed understanding of mass customization, almost every organization is able to implement a mass customization concept depending on its primary business strategy. From this view, mass customization is a term for covering a range of possible strategic roles and not one uniform business strategy, an opinion that is also shared by Hart (1995, p. 36).

This concept can also be confirmed by the work of the industry research group. All of the workshop participants agree that mass customization is a concept applicable to every organization, as one manager stated:

“Mass customization is relevant for every company.” (Citation #170 at 10th workshop)

As illustrated, different degrees of mass customization are available, from a marketing instrument (*symbol to industry*) to a profitable business strategy (*profit-taker*).

In order to choose the appropriate mass customization strategy, managers have to define the business strategy first. In this context, mass customization is not seen as one single strategy, but as a concept to realize and implement certain business goals. Based on the chosen business goals, managers then select the appropriate strategy and focus on the relevant dominant competencies for introducing mass customization. The developed *mass customization strategies* linked to relevant dominant competencies help managers realize their business plans. This relationship between strategy and structure is often phrased as “structure follows strategy” in the management literature (Mintzberg et al. 1995, p. 140; see also Chandler 1962). The *preliminary set of mass customization competencies* helps managers further structure the business and stabilize its success.

With this new understanding, the implementation of mass customization becomes more focused when choosing a primary strategy that does not pursue a sustainable and profitable mass customization business. In this case, not necessarily all mass customization competencies have to be considered. For example, the competencies concerning the internal operation of mass customization become less relevant when the aim is to create a *symbol to industry* (cp. Adidas case study and the *model of a mass customization typology*).

In the context of implementing a business plan, business experts in particular will find the presented *model of a mass customization typology* utilizing the eight dominant competencies helpful when determining a mass customization strategy and when their goal is to put the basic pillars of a business into action. Moreover, the 14 applied case studies outlined in this work, which are related to the different strategies, can provide blueprints for mass customization business implementations.

Another remark concerns a trivial, yet important topic that has not been touched on in this work: the market potential for mass customization. The author believes that no matter which mass customization strategy companies pursue, the consumer acceptance of mass customization offerings is a key competence. This overview of management implications concludes with the following quotes, which should increase the awareness for this vital issue:

“The future of mass customization seems to depend highly on the interest of customers in buying customized products.” (Freund/Piotrowski 2005b, p. 4)

“It is critical that firms understand whether their customers (existing and potential) really do value customization.” (Squire et al. 2004, p. 469)

“The question on how big the market is, is still not answered.” (Piller 2005c, p. 320)

9.3.2 Beyond the eight dominant competencies: Change management

Change management is a promising competence for mass customization, but it could not be verified as a dominant competence on the basis of the examined case studies (for details see Appendix 9). Nevertheless, the importance of this competence from the *preliminary set of mass customization competencies* is evident, as it has been discussed in the literature over the last couple of years with an increasing intensity and interest, albeit without providing any promising answers (see references below).

“The question is how should change management work for mass customization?” (Citation #145 at 2nd workshop)

In the commonly cited literature, only a few authors discuss issues related to change management but often do not explicitly speak of “change management” (Hart 1995, p. 44; Hart 1996, p. 20; Pine II 1999, p. 213-239). Hart (1995) refers to organizational readiness, which basically means leadership and cultural capabilities in this context (Hart 1995, p. 44, see also Broekhuizen/Alsem 2002, p. 325). In his chapter on “Transforming the organization for mass customization” Pine II (1999) explains which “structural innovations” have to take place when implementing mass customization (Pine II 1999, p. 213, 221).

“Managing mass customization thus includes to manage the internal change in an existing organization that is moving from a closed production system towards a system of mass customization.” (Piller 2005a, p. 1). Change management can be successful in practice and the following collection of findings from the industry research group project and literature references

might help managers when working in this area (Thoben 2003, p. 79; Freund/Piotrowski 2005b, p. 3; Haddock et al. 2005, p. 5; Piller 2005c, p. 325-328; Piller 2005a, p. 1).

A collection of findings on change management for mass customization is a first step towards an understanding of this topic. The author recommends intensive research in this field, and believes that empirical research will not deliver the right answers and conceptual work therefore has to come first:

Top management support is essential since “change management requires strategic commitment” (citation #151 at 7th workshop; cp. Mchunu et al. 2003, p. 431).

Change management processes have to involve the entire organization and “[...] consider all involved parties, also retailers, suppliers, etc.” (citation #148 at 7th workshop).

Changes in the culture of the organization are required. Employees have to be enabled to fulfill new roles for performing in a mass customization organization, since a mindset towards customer orientation is still not present in most of today’s organizations (derived from several citations during the 7th workshop, see Appendix 9).

“To define targets and expectations, change management for mass customization means implementing completely new structures, technologies, etc.” (Citation #147 at 7th workshop)

One important objective is the installation of an open organization enabling processes and employees to acquire information directly from the environment (derived from several citations during the 7th workshop, see Appendix 9).

Change management for mass customization is an active process, and it “[...] is more successful if the target is to move a little bit into customization step-by-step rather than radically going from a mass production to a mass customization business model” (citation #149 at 7th workshop).

“Customers might be able to serve as change agents for a move from mass production to mass customization.” (Citation #150 at 7th workshop).

9.3.3 Analysis scheme for classifying mass customization organizations

This work has made a significant step in portraying a comprehensive picture of mass customization. The understanding that mass customization does not simply enable the creation of profitable businesses is new—it is also

a concept that supports other business goals and opens up a new perspective for business experts.

Although the combined *model of a mass customization typology*, which bridges the findings of the *seven mass customization strategies* and *eight dominant competencies*, does not represent a taxonomy, it serves as a model for the evaluation of the degree of implemented or pursued mass customization. For managers in particular, the *eight dominant competencies* offer such an indicator. Organizations that do not utilize any of the *eight dominant competencies* or do not focus a *sustainable mass customization business* should not be associated with mass customization, whereas organizations which implement one of the *seven mass customization strategies* and utilize all or most of the *eight dominant competencies* should be classified as mass customization firms. By applying this classification logic, a more solid context of the mass customization concept is available in comparison to the existing proposals for classification (see Section 3.1).

The dimension of *mass customization strategies* indicates whether or not organizations pursue mass customization. The number of employed *dominant competencies* indicates the degree of mass customization. Here the understanding is that firms intensify the degree and importance of the mass customization business the more *dominant competencies* they have taken into consideration. The final Figure 83 offers an *analysis scheme for classifying mass customization organizations* within the framework and context of this work.

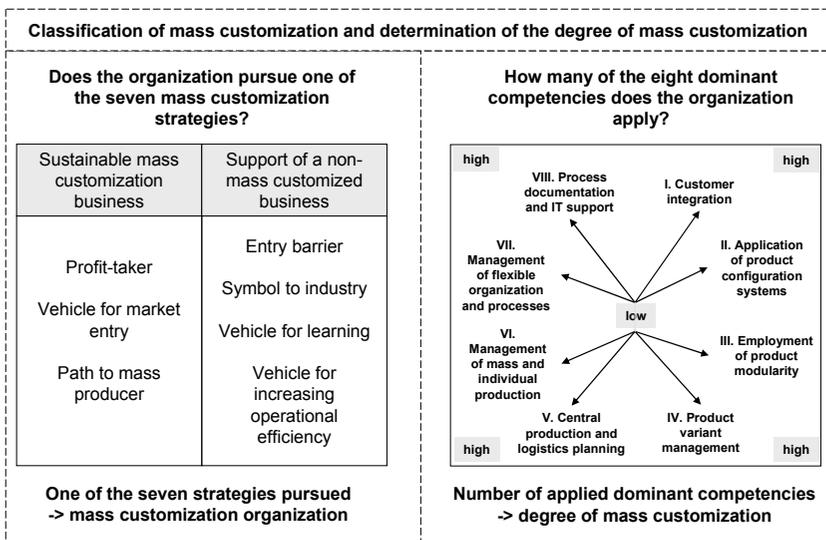


Figure 83. Analysis scheme for classifying organizations as mass customization businesses and for determining the degree of mass customization (schematic)

Appendix

Appendix, References and
Index not included
in this publication