Zentrales Prüfungsamt
Für Sozial- und Geisteswissenschaften
Promotionsausschuss
Dr. rer. pol.

Postfach 330440, 28334 Bremen
Bibliothekstraße, 28359 Bremen
Tel: 0421/218-2177 – Fax: 218-7518
eMail: cohlsen@uni-bremen.de
Gebäude GW 2, Raum B 2325
Sachbearbeitung: Carmen Ohlsen
Gesch.-Z.: 62-10

Fachbereich Wirtschaftswissenschaft

Methodological Options in International Market Segmentation

Dissertation
zur Erlangung der Doktorwürde
durch den
Promotionsausschuss Dr. rer. pol.
der Universität Bremen

Vorgelegt von
Iryna Bastian

Bremen, den 1.11.2006
Erstgutachter: Prof. Dr. Erich Bauer
Zweitgutachter: Prof. Dr. Martin Missong

Contents

List of Figures V
List of Tables VII
List of Abbreviations X
1 Introduction 1
1.1 Problematic Issues 1
1.2 Research Objectives 3
1.3 Thesis Structure 5
2 International Business and Market Segmentation 8
2.1 Internationalization of Business – International Management – International Marketing 8
2.2 Standardization and Differentiation in the Context of International Marketing 11
2.3 International Market Segmentation 18
2.3.1 Concept of Market Segmentation 18
2.3.1.1 Market Segmentation Analysis 21
2.3.1.2 Market Segmentation Strategy 25
2.3.2 Segmenting International Markets 27
2.3.2.1 Exclusively Country-Related Market Segmentation 28
2.3.2.2 Country- and Consumer-Related Market Segmentation 30
2.3.2.3 Exclusively Consumer-Related Market Segmentation 37
3 Steps and Methodologies of International Market Segmentation Analysis ... 39
3.1 Defining Relevant Market 40
3.2 Deciding on Segmentation Approach and Methodology 40
3.3 Procuring Data 41
3.4 Selecting Basis and Descriptor Variables 48
3.4.1 Choice of Basis Variables 48
3.4.1.1 Study Goals 49
3.4.1.2 Quality of Basis Variables 50
3.4.2 Choice of Descriptor Variables 53
3.5 Conducting Analysis 54
3.5.1 Data Preparation 54
3.5.1.1 Preliminary Data Standardization 54

3.5.1.2 Data Preprocessing Using Factor Analysis 55
3.5.1.2.1 Constructing Correlation Matrix 56
3.5.1.2.2 Extracting Factors 58
3.5.1.2.3 Rotating and Interpreting Factors 65
3.5.1.2.4 Calculating Factor Values 67
3.5.2 Finding Cluster Solution 68
3.5.2.1 Cluster Analysis 69
3.5.2.1.1 Proximity Measures 70
3.5.2.1.2 Grouping Methods 76
3.5.2.1.2.1 Ward's Method 77
3.5.2.1.2.2 K-means Method 82
3.5.2.2 Self-Organizing Map 85
3.5.2.2.1 Biological Origin 86
3.5.2.2.2 Theoretical Model 89
3.5.2.2.3 Visualization of Results 99
3.5.2.2.4 Assessment of Topology-Preserving Map 102
3.5.3 Validation of Cluster Solution 104
3.5.3.1 Assessment of Cluster Solution's Stability Using Results of Several Clustering Methods 104
3.5.3.2 Assessment of Homogeneity within Clusters Using F-Values 104
3.5.3.3 Assessment of Heterogeneity between Clusters Using t-Values 105
3.5.3.4 Assessment of Heterogeneity between Clusters and of Cluster Solution Reliability Using Discriminant Analysis 106
3.5.3.4.1 Derivation of Discriminant Functions 106
3.5.3.4.2 Testing Performance of Discriminant Functions 110
3.5.4 Description and Interpretation of Cluster Solution 114
4 International Market Segmentation Study 116
4.1 Study Purpose and Design 116
4.2 Defining Relevant Market 116
4.2.1 Essence of Study Initiator's Business 117
4.2.1.1 Portrayal of Beiersdorf 117
4.2.1.2 Portrayal of Umbrella Brand NIVEA 119

4.2.2 Skin and Body Care Product Categories 120
4.2.3 Geographical and Temporal Market Boundaries 121
4.3 Deciding on Segmentation Approach and Methodology 123
4.4 Procuring Data 123
4.4.1 Fieldwork Dates 124
4.4.2 Fieldwork Locations 125
4.4.3 Fieldwork Methodology, Sample Definition, and Questionnaire Contents 127
4.5 Selecting Basis and Descriptor Variables 130
4.6 Conducting Analysis 135
4.6.1 Additive Intranational Market Segmentation 135
4.6.1.1 Data Preparation Using Factor Analysis 135
4.6.1.2 Finding Cluster Solutions 138
4.6.1.2.1 Segmentation Approach Based on Ward's Method 138
4.6.1.2.2 Segmentation Approach Based on K-means Method 140
4.6.1.2.3 Segmentation Approach Based on Self-Organizing Map 142
4.6.1.3 Validation of Cluster Solutions 145
4.6.1.4 Description and Interpretation of Cluster Solutions 148
4.6.1.5 Finding Transnational Segments 149
4.6.1.5.1 Identification of Common Features 149
4.6.1.5.2 Examples of Regional/Country-Specific Peculiarities 173
4.6.1.5.2.1 Differences in Demographic Characteristics, Brand Assessments, and Behavioral Characteristics 173
4.6.1.5.2.2 Differences in Character/Structure of Cluster Solution 174
4.6.1.6 Assessment of Segmentation Approaches 176
4.6.1.6.1 Application Convenience 176
4.6.1.6.2 Structure, Meaningfulness and Coherency of Cluster Solution 177
4.6.1.6.3 Basis for International Market Segmentation Strategies 178
4.6.2 Integral Market Segmentation 180
4.6.2.1 Data Preparation 180
4.6.2.1.1 Defining Sample Size 180
4.6.2.1.2 Factor Analysis 184

4.6.2.1.3 Data Unification 186
4.6.2.2 Finding Cluster Solutions 187
4.6.2.2.1 Segmentation Approach Based on Ward's Method 187
4.6.2.2.2 Segmentation Approach Based on K-means Method 188
4.6.2.2.3 Segmentation Approach Based on Self-Organizing Map . 189
4.6.2.3 Validation of Cluster Solutions 192
4.6.2.4 Description and Interpretation of Cluster Solutions 193
4.6.2.5 Results of Cluster Interpretation 194
4.6.2.6 Assessment of Segmentation Approaches 198
4.6.2.6.1 Application Convenience 198
4.6.2.6.2 Structure, Meaningfulness and Coherency of Cluster Solution 198
4.6.2.6.3 Basis for International Market Segmentation Strategies .. 199
4.6.3 Contrasting Additive Intranational Market Segmentation and Integral Market Segmentation 200
4.6.3.1 Preparation of Data for Analysis 200
4.6.3.2 Effort- and Time-Costs of Analysis 202
4.6.3.3 Description and Interpretation of Segments 203
4.6.3.4 Conduction of International Market Segmentation Strategies 203
5 Conclusions and Outlook 205
5.1 Additive Intranational Market Segmentation vs. Integral Market Segmentation: Conclusions 205
5.2 Statistical-Mathematical Segmentation Methods: Conclusions 206
5.3 Recommendations for Future Research 207
References 208
Appendix A-1: Statement Compositions of Factors 221
Appendix A-2: Increases in Values of Error Sum of Squares (the Last Ten Fusion Steps) 232
Appendix A-3: Values of Within-Groups Sum of Squares Plotted against Corresponding Quantities of Clusters 239
Appendix A-4: Cluster Names and Sizes 250

List of Figures

Figure 1-1 Structure of the thesis 7
Figure 2-1 Schematic presentation of internal and external interaction partners of a company operating internationally 9
Figure 2-2 Market segmentation analysis 22
Figure 2-3 Market segmentation strategy 27
Figure 2-4 Exclusively country-related market segmentation 28
Figure 2-5 International market segmentation at the macro-level 31
Figure 2-6 International market segmentation at the micro-level 34
Figure 2-7 Exclusively consumer-related market segmentation 38
Figure 3-1 Choice dimensions considered while deciding on the segmentation approach and methodology 41
Figure 3-2 Forms of written surveys 44
Figure 3-3 Forms of verbal surveys 45
Figure 3-4 Forms of computer surveys 46
Figure 3-5 Matrix of factor loadings 63
Figure 3-6 Illustration of a scree-test 64
Figure 3-7 Two-dimensional factor space 66
Figure 3-8 Similarity and distance matrices 70
Figure 3-9 Euclidean distance in a two-dimensional space 73
Figure 3-10 Profiles of individuals j and i 76
Figure 3-11 Example of a dendrogram (the Ward's method) 80
Figure 3-12 Scree-diagram and elbow-criterion (the Ward's method) 81
Figure 3-13 Components of a biological nerve cell (neuron) 87
Figure 3-14 Schematic illustration of an artificial neuron 88
Figure 3-15 "Mexican-hat function" of a lateral interaction 89
Figure 3-16 Feedforward and feedback ANN 90
Figure 3-17 Schematic illustration of SOM 91
Figure 3-18 Neighborhood function of a Gaussian form 98
Figure 3-19 Example of the U-matrix 100
Figure 3-20 Example of the hit histogram of input vectors 101
Figure 3-21 Example of the component plane 102

Figure 3-22 Graphical representation of a discriminant function..... 108
Figure 3-23 Classification matrix for a two-group case..... 113
Figure 3-24 Profiles of cluster A and cluster B..... 114
Figure 4-1 Establishment of the Beiersdorf company..... 117
Figure 4-2 Core brands of the Beiersdorf company..... 118
Figure 4-3 World of NIVEA..... 120
Figure 4-4 Assessment scales..... 131
Figure 4-5 Cluster regions (example of the U-matrix)..... 145
Figure 4-6 Number of countries, where a transnational segment was found (the Ward's method)..... 169
Figure 4-7 Number of countries, where a transnational segment was found (the K-means method)..... 170
Figure 4-8 Number of countries, where a transnational segment was found (SOM)..... 171
Figure 4-9 Percentages of black and white females in a social class..... 174
Figure 4-10 Percentages for a point on a rating scale..... 176
Figure 4-11 Values of the within-groups sum of squares plotted against corresponding quantities of clusters..... 189
Figure 4-12 Cluster regions (the U-matrix)..... 191
Figure 4-13 Preparation of data for analysis..... 201
Figure 4-14 Process of obtaining transnational samples..... 202

List of Tables

Table 2-1 Objects of standardization 11
Table 2-2 Interrelations between orientation systems of the EPRG-framework and standardization/differentiation of marketing programs 15
Table 2-3 Cost saving and sales revenue rising potentials of standardization/differentiation of a product 17
Table 2-4 Classification of segmentation methods 25
Table 2-5 Country characteristics as segmentation criteria classified 29
Table 2-6 Country characteristics as segmentation criteria classified (an alternative approach) 30
Table 2-7 Consumer characteristics as segmentation criteria classified 37
Table 3-1 Examples of secondary data sources 42
Table 3-2 Correspondence between study goals and segmentation bases 50
Table 3-3 Examples of proximity measures 71
Table 4-1 Investigated countries 122
Table 4-2 Fieldwork dates 125
Table 4-3 Fieldwork locations 126
Table 4-4 Fieldwork methodologies, age ranks and sizes of samples 130
Table 4-5 Descriptor variables 134
Table 4-6 Measures of sampling adequacy (MSA) 136
Table 4-7 Final factor solutions 138
Table 4-8 Clustering steps with a relatively significant increase in the error sum of squares 140
Table 4-9 Quantities of clusters, at which a sharp decrease in the within-groups sum of squares was found 141
Table 4-10 SOM parameters 144
Table 4-11 Quantities of completely homogeneous and highly homogeneous clusters 146
Table 4-12 Percentages of respondents classified by discriminant analysis correctly 147
Table 4-13 Structure of “Highly demanding” transnational segment 149
Table 4-14 “Highly demanding” segments found 151

Table 4-15 Structure of "Rational demanding" transnational segment 152
Table 4-16 "Rational demanding" segments found 153
Table 4-17 Structure of "Rationalists" transnational segment 154
Table 4-18 "Rationalists" segments found 155
Table 4-19 Structure of "Good quality at a fair price" transnational segment 156
Table 4-20 "Good quality at a fair price" segments found 157
Table 4-21 Structure of "Quality and good value for money from a strong brand" transnational segment 158
Table 4-22 "Quality and good value for money from a strong brand" segments found 159
Table 4-23 Structure of "Brand glamor driven mainstream" transnational segment 159
Table 4-24 "Brand glamor driven mainstream" segments found 161
Table 4-25 Structure of "Only brand attractiveness driven (very little skin care involved)" transnational segment 162
Table 4-26 "Only brand attractiveness driven (very little skin care involved)" segments found 163
Table 4-27 Structure of "Sensitivity and mildness driven" transnational segment 164
Table 4-28 "Sensitivity and mildness driven" segments found 165
Table 4-29 Structure of "Moderate level of mildness from a popular and modern brand" transnational segment 166
Table 4-30 "Moderate level of mildness from a popular and modern brand" segments found 167
Table 4-31 Structure of "Uninvolved" transnational segment 167
Table 4-32 "Uninvolved" segments found 168
Table 4-33 Presence of transnational segments in twenty one countries 172
Table 4-34 Cluster quantities 178
Table 4-35 Standardized product features 179
Table 4-36 Finding female population sizes 181
Table 4-37 Finding sizes of samples to be extracted 182
Table 4-38 Four-group system 183
Table 4-39 Finding sizes of samples to be extracted according to the four-group system 184

Table 4-40 Chosen factor solution 185
Table 4-41 Increases in the error sum of squares (the last ten fusion steps) 188
Table 4-42 Cluster names and sizes 194
Table 4-43 Percentages of respondents from twenty one countries included into each transnational segment 196
Table 4-44 Cluster sizes (percentages of a corresponding country sample) in the case of each country 197
Table 4-45 Standardized product features (integral market segmentation) 200

List of Abbreviations

AID	Automatic Interaction Detection
ANN	Artificial Neural Networks
CAPI	Computer Assisted Personal Interview
CART	Classification and Regression Trees
CATI	Computer Assisted Telephone Interview
CATS	Completely Automated Telephone Surveys
CSAQ	Computerized Self-Administered Questionnaire
EPRG	Ethnocentric/Polycentric/Regiocentric/Geocentric Orientation System
EU	European Union
FTW	Fine-Tuning of Weights
GATT	General Agreement on Tariffs and Trade
KMO	Kaiser-Meyer-Olkin Criterion
NENET	Neural Networks Tool
MSA	Measure of Sampling Adequacy
PCA	Principal Component Analysis
POW	Proper Ordering of Weights
R&D	Research and Development
SOM	Self-Organizing Map
SPSS	Superior Performing Software System
WTO	World Trade Organization

1 Introduction

1.1 Problematic Issues

"No one can be everything to everybody"[1]. This fact was realized already about fifty years ago, as existence of diversity in consumer needs was acknowledged by manufacturers, and the necessity to develop market-oriented thought within companies became clear and acute. As a result, breaking down markets into internally homogeneous and externally heterogeneous sub-markets and tailoring marketing programs to their specific needs have started to be pursued by an ever bigger number of firms. In this way, the era of **market segmentation** has begun.[2]

The last decades were marked with an increasing involvement of multi-product manufacturers into cross-border business activities.[3] Dealing with heterogeneous needs of consumers in different countries is one of the biggest challenges in the modern business. Correspondingly, special importance is being attached to **international market segmentation**.[4]

The so-called classical approach to conducting international market segmentation lies in dividing markets and satisfying needs of obtained sub-markets on a country-to-country basis, i.e., without any strategic coordination between different countries. In this case, applying domestic market segmentation techniques is more than sufficient.[5]

The relevance of this approach to international market segmentation decreases nowadays, due to the factors that not only encourage conducting international business activities, but also point at decreasing importance of country borders in organizing these activities and therewith at the necessity in and advantages of their standardization. Among these factors are:[6] national markets becoming more saturated together with international competitors becoming more numerous and price aggressive; shorter product life cycles combined with higher research and development costs; global economic and political conditions becoming more

[1] Thorelli, 1980, p. 133.
[2] See Smith, 1956, pp. 3-8, Engel/Fiorillo/Cayley, 1972, pp. 22-23, and Struhl, 1992, pp. 5-6.
[3] See Meffert/Althans, 1982, p. 15 and Wedel/Kamakura, 2000, p. 4.
[4] See Steenkamp/Ter Hofstede, 2002, p. 185.
[5] See Kreutzer, 1991, pp. 4-5 and Steenkamp/Ter Hofstede, 2002, pp. 185-186.
[6] For more detailed information see part 2.1 of the present thesis.

favorable to international business; improved communication and transportation technologies enabling faster and less expensive exchange of information, products, services, and capital; and convergence of demand behavior and attitudes of consumers from different countries. Correspondingly, an alternative approach to international market segmentation, the one aimed at finding the so-called **transnational segments** and developing standardized marketing programs to direct to them, gains on popularity.

A **transnational segment** is a segment that, despite its affiliation in several countries, can be characterized through a set of features common to all its parts in these countries and addressed in a standardized way through one marketing program.[7]

There are several alternative ways of finding transnational segments. International market segmentation can be related to countries and lead to identification of transnational segments in the form of country groups. Moreover, this type of segmentation can be complemented or substituted by international market segmentation related to consumers and result in transnational segments presented through combinations of segments in different countries.

Current empirical evidence shows that demand behavior and attitudes of consumers transcend across national borders, and there are often more similarities between consumer groups in different countries than between consumers in one and the same country.[8] This fact definitely speaks in favor of the latter type of transnational segments and points at such clear shortcomings[9] of international market segmentation related only to countries as disregarding country-specific heterogeneity of consumers and excluding the possibility to find transnational segments in countries belonging to different country groups.

However, not all problematic issues with regard to finding transnational segments are clarified therewith. International market segmentation related to consumers (conducted either in combination with country-related market segmentation or exclusively) can have a form of either **additive intranational market segmentation** or **integral market segmentation.** In the case of **additive intranational market**

[7] See Kreutzer, 1991, p. 5, Steffenhagen, 1992, p. 27, and Stegmüller, 1995, p. 77.
[8] See Ter Hofstede/Steenkamp/Wedel, 1999, pp. 1-2 and Steenkamp/Ter Hofstede, 2002, p. 186.
[9] See Bauer, 2000, p. 2807.

segmentation, intranational segmentations are conducted first. Then, segments having common features, but belonging to different countries are combined into transnational segments. In the case of **integral market segmentation**, transnational segments are identified on the base of segmenting all countries jointly.[10]

There is no clear and commonly accepted position among both academicians and practitioners with regard to the role, which these two methodologies are supposed to play in the area of modern international market segmentation. On the one hand, it is stated that, in view of the increasing country equalization taking place nowadays, the role of integral market segmentation becomes more and more significant.[11] On the other hand, integral market segmentation is strongly criticized because of its following weaknesses, which are expected to be overcome by additive intranational market segmentation:[12]

- providing with information neither on regional/national segments, which may exist and be addressed with regional/national marketing programs, nor on national specifics of media usage and point of purchase choice behavior of members of transnational segments;
- estimating national sizes of transnational segments in a biased way.

Moreover, there is a limitless number of statistical-mathematical segmentation methods, which can be used for finding transnational segments. The question concerning their effectiveness still remains open.

The present thesis seeks to contribute to clarification of the problematic issues mentioned above.

1.2 Research Objectives

Despite increasing importance of international market segmentation for marketing as a discipline (in particular, for international marketing), the level of attention given to it in the literature remains relatively low. Of course, some publications devoted to international market segmentation have been appearing during the last three

[10] See Bauer, 2000, p. 2808.
[11] See Hünerberg, 1994, p. 109.
[12] See Kale/Sudharshan, 1987, p. 63 and Bauer, 2000, p. 2808.

decades.[13] Nevertheless, their number and scope are still astonishingly small in comparison to publications devoted to issues in domestic market segmentation.[14]

Moreover, the following conclusions can be made about empirical international market segmentation studies published so far:

- a significant proportion of them is based on characteristics of countries and not on responses of individuals;[15]
- studies based on responses of individuals are normally limited to a small number of countries and/or consider mainly Europe;[16] they thus can be hardly viewed as truly international;
- there are numerous studies, which were able to identify transnational segments (for instance, Douglas and Urban (1977) have identified two transnational life-style groups of women – "Traditionalists" and "Liberated";[17] Thorelli (1980) has identified one transnational segment "Information Seekers";[18] Crawford, Garland, and Ganesh (1988) have identified one transnational segment of pro-trade oriented consumers;[19] Hassan and Katsanis (1991) have identified two transnational life-style segments – "Global Elite" and "Global Teenager";[20] Yavas, Verhage, and Green (1992) have identified four transnational segments of bath soap and tooth paste buyers with homogenous purchase risk perception and brand loyalty;[21] Hermanns and Wißmeier (1993) have identified five transnational segments of students with homogeneous fashion attitude and garment behavior – "Fashion Enthusiastic", "Fashion Interested", "Fashion

[13] See, for instance, Wind/Douglas, 1972, pp. 17-25, Thorelli, 1980, pp. 133-142, Huszagh/Fox/Day, 1986, pp. 31-43, Sheth, 1986, pp. 9-11, Domzal/Unger, 1987, pp. 23-40, Kale/Sudharsan, 1987, pp. 60-70, Crawford/Garland/Ganesh, 1988, pp. 25-33, Day/Fox/Huszagh, 1988, pp. 14-27, Hassan/Katsanis, 1991, pp. 11-28, Yavas/Verhage/Green, 1992, pp. 265-272, and Ter Hofstede/Steenkamp/Wedel, 1999, pp. 1-17.
[14] See Bauer, 2000, p. 2795 and Steenkamp/Ter Hofstede, 2002, p. 186.
[15] See, for instance, Sethi, 1971, pp. 348-354, Huszagh/Fox/Day, 1986, pp. 31-43, Day/Fox/Huszagh, 1988, pp. 14-27, Lee, 1990, pp. 39-49, Helsen/Jedidi/DeSarbo, 1993, pp. 60-71, Dawar/Parker, 1994, pp. 81-95, Kumar/Stam/Joachimsthaler, 1994, pp. 29-52, Kale, 1995, pp. 35-48, Kumar/Ganesh/Echambadi, 1998, pp. 255-268, and Steenkamp, 2001, pp. 30-44.
[16] See, for instance, Ronen/Kraut, 1977, pp. 89-96, Boote, 1983, pp. 19-25, Yavas/Verhage/Green, 1992, pp. 265-272, Moskowitz/Rabino, 1994, pp. 73-93, Askegaard/Madsen, 1998, pp. 549-568, Ter Hofstede/Steenkamp/Wedel, 1999, pp. 1-17, and Ter Hofstede/Wedel/Steenkamp, 2002, pp. 160-177.
[17] See Douglas/Urban, 1977, pp. 46-54.
[18] See Thorelli, 1980, pp. 133-142.
[19] See Crawford/Garland/Ganesh, 1988, pp. 25-33.
[20] See Hassan/Katsanis, 1991, pp. 11-28.
[21] See Yavas/Verhage/Green, 1992, pp. 265-272.

Ignorant", "Fashion Discerning", and "Fashion Rejecters";[22] Stegmüller (1995) has identified three transnational segments of airline passengers with homogeneous needs – "Demanding", "Mainstream", and "Spartans";[23] Ter Hofstede, Steenkamp, and Wedel (1999) have identified four transnational segments in the European yogurt market[24]); nevertheless, neither of them is devoted to comparison of additive intranational market segmentation and integral market segmentation or testing effectiveness of alternative statistical-mathematical segmentation methods.

The doctoral research presented in this thesis contributes to overcoming the deficits mentioned above. Firstly, it is based on responses of individuals. Secondly, these individuals come from twenty one countries presenting five regions of the world (Africa, Asia, Australia, Europe, and South America). Thirdly, two different forms of international market segmentation (additive intranational market segmentation and integral market segmentation) as well as three different statistical-mathematical segmentation methods (the Ward's method, K-means method, and SOM) are tested and compared with each other.

In particular, the doctoral research has the following **objectives**:

- to investigate advantages and limitations of conducting additive intranational market segmentation and integral market segmentation;
- to assess effectiveness of segmentation approaches based on the Ward's method, K-means method, and SOM in finding transnational segments.

1.3 Thesis Structure

The present doctor thesis is subdivided into five chapters (see Figure 1-1). Chapter 2 following this introductory chapter deals with issues indispensable for understanding the role, which international market segmentation is playing nowadays. First of all, the current state of business internationalization as well as the concepts of international management and international marketing are presented. Furthermore, the controversy "standardization vs. differentiation", which belongs to the central strategic issues of

[22] See Hermanns/Wißmeier, 1993, pp. 26-33.
[23] See Stegmüller, 1995, pp. 306-318.
[24] See Ter Hofstede/Steenkamp/Wedel, 1999, pp. 1-17.

modern international marketing, is introduced. Both notions are discussed in detail in the context of international marketing, and their advantages (i.e., cost saving and sales revenue rising potentials) are presented. The increasing importance of standardization of international business activities and therewith a special role of transnational segments, which can be found by means of international market segmentation, is emphasized afterwards, and the main theoretical frameworks of market segmentation and of international market segmentation are introduced.

Chapter 3 outlines steps and methodologies of international market segmentation analysis. Diverse theoretical aspects of defining the relevant market, deciding on the segmentation approach and methodology, procuring the data, selecting basis and descriptor variables, and conducting the analysis are described here in detail.

Chapter 4 presents the international market segmentation study. It starts with the description of study purpose and design and then leads the reader through all steps, which were undertaken within the scope of the study (in particular, defining the relevant market, deciding on the segmentation approach and methodology, procuring the data, selecting basis and descriptor variables, conducting additive intranational market segmentation and integral market segmentation using three segmentation approaches (based on the Ward's method, K-means method, and SOM) as well as assessing their effectiveness, and contrasting additive intranational market segmentation and integral market segmentation).

Finally, chapter 5 presents conclusions drawn from the international market segmentation study and recommendations for the future research.

Figure 1-1 Structure of the thesis

2 International Business and Market Segmentation

2.1 Internationalization of Business – International Management – International Marketing

Increasing internationalization of business[25] presents the most profound trend occurring during the last decades. Many big companies in leading industrialized countries of the world start conducting or broaden their cross-border activities today.[26] There is a number of factors encouraging this process:[27]

- companies face two problems simultaneously: on the one hand, their national markets become more saturated, on the other hand, their international competitors become more numerous and price aggressive (for instance, vendors from South Asian countries);
- shorter product life cycles combined with higher research and development costs force companies to merchandise their products abroad, in order to amortize their investments to the highest degree;
- a great number of changes in global economic and political conditions have occurred (for instance, GATT (General Agreement on Tariffs and Trade) monitored by WTO (World Trade Organization) has helped to simplify world trade, introduction of Euro has harmonized the EU-market[28], East European countries have become more open, China has shifted its orientation closer to market economy);
- improved communication and transportation technologies make different nations closer neighbors and allow for faster and less expensive exchange of information, products, services, and capital between them;
- demand behavior and attitudes of consumers from different countries are converging due to easier and therefore more frequent travel, emergence of the internet and global media, equalization of demographic structures and education levels.

[25] Following Dülfer, 2001, p. 126, internalization of business is viewed here as any form of cross-border activities conducted by a company. For more detailed information on internationalization see Dülfer, 2001, pp. 126-147.
[26] See Meffert/Althans, 1982, p. 15, Stegmüller, 1995, p. 1, and Bauer, 2002, p. 1.
[27] See Meffert/Althans, 1982, pp. 15-16, Stegmüller, 1995, pp. 1-2, Douglas/Craig, 1997, p. 380, Meffert/Bolz, 1998, p. 15, Mennicken, 2000, p. 1, and Bauer, 2002, pp. 1-2.
[28] EU stands here for “European Union”.

Any type of cross-border business activities involves goal-oriented communication with foreign interaction partners, i.e., **international management**.[29] These foreign interaction partners can be subdivided into **company-external** and **company-internal** (see Figure 2-1).[30]

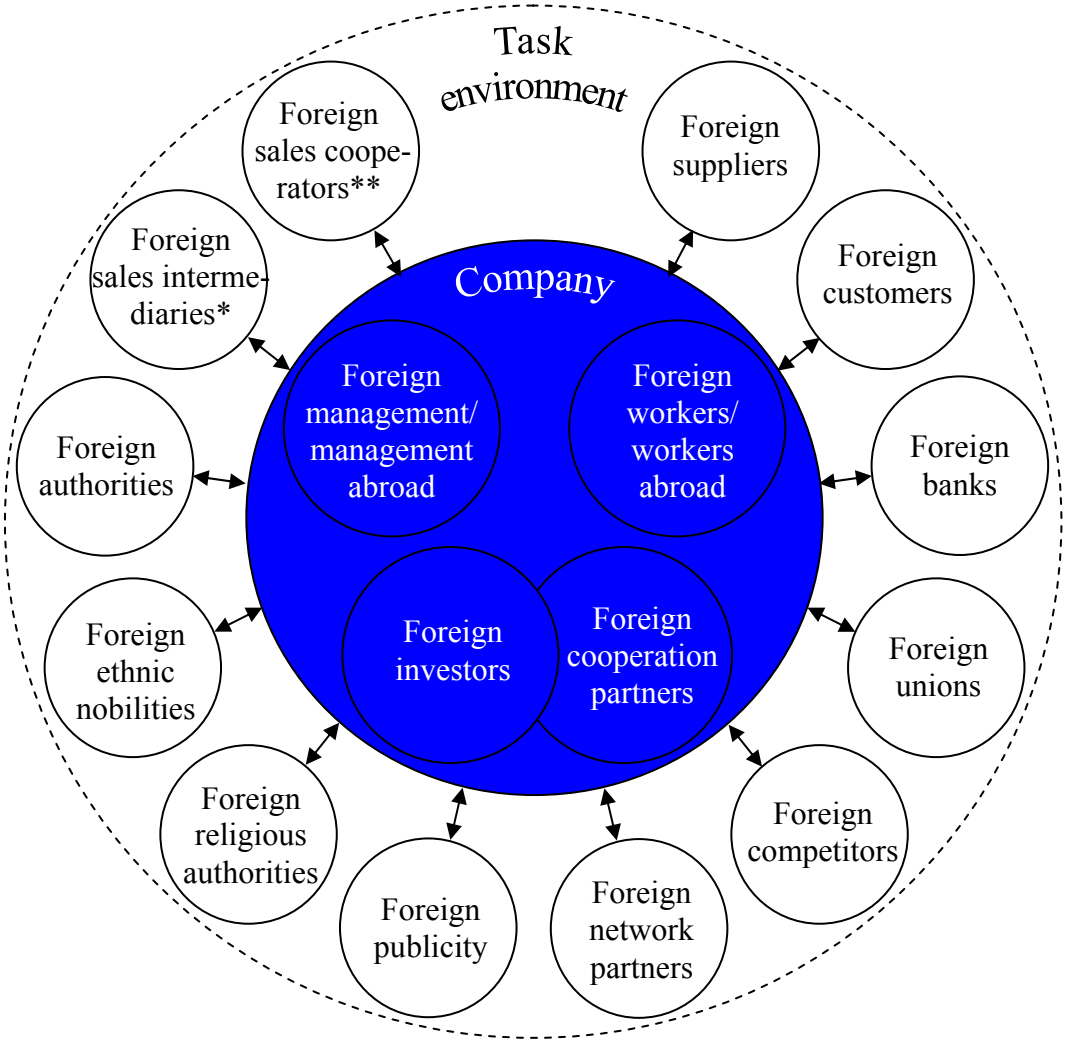


Figure 2-1 Schematic presentation of internal and external interaction partners of a company operating internationally
Source: Dülfer, 2001, p. 253 and Bauer, 2002, pp. 3-4.

[29] See Dülfer, 2001, p. 5.
[30] See Dülfer, 2001, pp. 249-253 and Bauer, 2002, pp. 2-4.

Communication with company-external foreign interaction partners devoted to systematic analysis, initiation, arrangement and control of (possible) transactions between a company providing real and/or nominal goods and foreign inquirers designates the task domain of **international marketing**.[31]

This definition of international marketing is only one of many definitions existing in the literature.[32] It is quite wide and simplified, but it clearly emphasizes the next three highly important aspects characterizing international marketing:[33]

- communication with **foreign** interaction partners takes place in the case of international marketing, thus the uncertainty is higher here than in the case of national marketing;
- this communication is **systematic**; it is not reactive, occasional or accidental;
- the term "international marketing" refers to marketing associated with a **cross-border activity of any form and at any stage of development**, thus it should be viewed as a generic term for such sub-terms as, for instance, "export marketing", "multinational marketing", "global marketing", etc.

Of course, sub-terms of international marketing existing in the literature are not limited to the three forms presented above.[34] Ways of defining them are very diverse. They can be classified according to the number of foreign markets chosen for conducting of business activities, way of dealing with these markets, form of internationalization, orientation of competitors, and form of corporate governance.[35]

[31] See Bauer, 2002, p. 4.
[32] See, for instance, Meffert/Althans, 1982, pp. 21-24, Berekoven, 1985, pp. 19-22, Kulhavy, 1993, p. 10, Hünerberg, 1994, p. 24, Terpstra/Sarathy, 1991, p. 5, Müller/Gelbrich, 2004, pp. 172-174, Backhaus/Büschken/Voeth, 2005, pp. 52-53, Berndt/Fantapié Altobelli/Sander, 2005, p. 6, and Cateora/Graham, 2005, p. 9.
[33] See Bauer, 2002, pp. 4-5.
[34] See, for instance, Keegan, 1980, pp. 4-7, Meffert, 1988, pp. 268-269, Hünerberg, 1994, pp. 25-27, Meffert, 1994, pp. 270-272, Meffert/Bolz, 1998, pp. 25-29, Cateora/Graham, 2005, pp. 19-22, Becker, 2001, pp. 315-324, and Zentes/Swoboda/Morschett, 2004, pp. 609-610.
[35] See Bauer, 2002, p. 5.

2.2 Standardization and Differentiation in the Context of International Marketing

Developments encouraging internationalization of business activities presented above also point at decreasing importance of country borders in organizing international activities and increasing necessity in making international strategic decisions with regard to several markets simultaneously. No wonder that the **controversy "standardization vs. differentiation"** belongs to the central strategic issues of international marketing today.[36]

Standardization should be viewed in the context of international marketing as realization of uniform marketing in different countries.[37] In particular, one can distinguish between two fields of standardization: **standardization of marketing processes** and **standardization of marketing programs**.[38] **Standardization of marketing processes** refers to uniform structuring and procedural-organizational standardization of marketing decision processes, whereas **standardization of marketing programs** concerns standardization of marketing strategies and instruments. The corresponding objects of standardization are presented in Table 2-1.[39]

	Strategy level	Instrument level
Programs	Marketing strategies	Product policy Promotion policy Distribution policy Pricing policy
Processes	Marketing information systems Marketing planning systems Marketing controlling systems Marketing personnel systems	Product planning Publicity planning Operations planning

Table 2-1 Objects of standardization
Source: Bolz, 1992, p. 10.

[36] See Berekoven, 1985, p. 135, Meffert/Bolz, 1998, p. 155, and Berndt/Fantapié Altobelli/Sander, 2005, p. 173.
[37] See Stegmüller, 1995, p. 27.
[38] See Jain, 1989, pp. 70-71.
[39] See Bolz, 1992, pp. 7-10 and Berndt/Fantapié Altobelli/Sander, 2005, p. 173.

Differentiation should be viewed in the context of international marketing as realization of marketing adjusted to peculiarities of each particular foreign market.[40] Again, both marketing programs and marketing processes can be differentiated.

As far as standardization (differentiation) of marketing processes regards mainly corporate-policy issues, only standardization (differentiation) of marketing programs is considered in the following.[41]

A more explicit explanation of standardisation and differentiation notions in the context of international marketing can be provided by means of the **modified EPRG-framework**[42]. Here one talks about an **orientation system** of a company operating internationally, which is defined as attitudes of company's management forming a basis for internationalization of business activities.[43] In particular, one distinguishes between four different orientation systems:[44]

1. **Ethnocentric (= E)**
   - A company is strongly oriented at a domestic country. Marketing strategies and instruments applied to foreign markets do not (barely) differ from domestic ones. (Almost) all specifics of foreign markets are ignored.
   - This kind of an orientation system is typical for a company at the beginning stage of internationalization, when it operates in several markets only. The primarily aim of **ethnocentrically oriented international marketing** in this case is supporting a domestic company in struggling against domestic competitors through utilization of profitable export chances. This utilization is systematic. In other words, ethnocentrically oriented marketing should by no means be mistaken

[40] See Stegmüller, 1995, p. 28.
[41] See ibid. p. 27.
[42] The original framework consisiting of only three orientation systems was proposed by Perlmutter, 1969, pp. 11-14. Heenan/Perlmutter, 1979, pp. 17-21 have later extended it by adding a regiocentric orientation system.
[43] See Heenan/Perlmutter, 1979, p. 17 and Stegmüller, 1995, p. 16.
[44] See Wind/Douglas/Perlmutter, 1973, pp. 14-15, Keegan, 1980, pp. 247-248, Segler, 1986, pp. 152-153, Kreutzer, 1989, pp. 12-16, Stegmüller, 1995, pp. 17-19, Lingenfelder, 1996, pp. 198-199, Bauer, 2002, pp. 7-10, Keegan, 2002, pp. 12-14, Keegan/Schlegelmilch/Stöttinger, 2002, pp. 20-24, and Müller/Kornmeier, 2002, pp. 317-333.

for passively conducted export businesses devoted to satisfying reactively sporadic demands abroad.

- An orientation system of a company may remain ethnocentric and be still successful even after the number of markets chosen for conducting of business activities has increased. This can happen, if, for instance, characteristics of a product are strongly connected to a country of origin. In this case, **ethnocentrically oriented international marketing** appears to be primarily aimed at achieving of success in struggling with regional or global competitors.

2. **Polycentric (= P)**
   - A company is oriented at each particular country it is working with. Marketing strategies and instruments differentiate in this case from country to country. Generally speaking, a polycentric orientation system is opposite to an ethnocentric one. Here every country is viewed as unique.
   - **Polycentrically oriented international marketing** is aimed at fighting local competitors in each particular country and achieving in this way an international success.
   - A company may use this kind of an organization system not only while starting internationalization of its activities, but also manage to remain polycentric even after expanding its business into a bigger number of countries.
3. **Regiocentric (= R)**
   - A company is oriented at homogeneous regions of countries constructed on the base of, for instance, cultural or political country similarities or geographical closeness. Marketing strategies and instruments are standardized for each particular region and differentiated between them. The national borders inside one and the same region are ignored in this case. Not countries, as in the case of a polycentric orientation system, but regions are viewed here as unique entities.
   - The main task of **regiocentrically oriented international marketing** lies in achieving a success in controverting other, particularly, regional

competitors and optimizing in this way company's results in terms of each particular region.

- A regiocentric company may cover its markets step by step working with only a few of them at a time or may consider all of them simultaneously. Moreover, regions chosen for conducting of business activities may be so numerous that in combination they would cover a very big part of the world market. In other words, a company may have a regiocentric orientation system at any stage of internationalization of its activities.

4. **Geocentric (= G)**
   - A company ignores all national borders and orients itself at the entire world as one potential market. Having such a "worldview", it strives to standardize its marketing strategies and instruments at a global level to optimize its total efficiency worldwide. Local interests of single markets can be accepted and satisfied as well, if they serve long-term goals of a company, and the optimal global orientation remains at least at the core of corresponding local businesses.
   - The primary goal of **geocentrically oriented international marketing** is achieving a success in struggling with other, particularly, global competitors and improving a company's global position through systematic global analysis of success and risk potentials and global integration of company's activities.
   - As in the case of a regiocentric company, market coverage can be done by a geocentric company not only for all markets simultaneously, but also step by step. Correspondingly, it can be stated that geocentric companies with any level of internationalization of their business activities may exist.

In practice, companies not always have one of the four orientation systems presented above. Sometimes, several systems are partly combined with each other.[45] Despite this fact, the EPRG-framework is considered to be of high empirical value and relevance.[46]

[45] See Bauer, 2002, p. 10.
[46] See Stegmüller, 1995, p. 20.

Table 2-2 summarizes interrelations between the orientation systems of the EPRG-framework and standardization/differentiation notions. It should be mentioned that, according to Stegmüller (1995), the secondary role of foreign markets in the case of an ethnocentric orientation system can result not in copying of domestic marketing strategies (in other words, not in international standardization of marketing strategies), but in framing some subordinate foreign marketing strategies.[47] As far as this statement is likely to be true only for companies at the very beginning stage of internationalization, it was decided to ignore this assumption in the present thesis and state that international standardization of marketing strategies takes place in the case of an ethnocentric orientation system.

Form of an orientation system	**Standardization of marketing programs**	**Differentiation of marketing programs**
Ethnocentric	High	Low
Polycentric	Low	High
Regiocentric	High inside regions	High between regions
Geocentric	High	Low

Table 2-2 Interrelations between orientation systems of the EPRG-framework and standardization/differentiation of marketing programs

The top objective of international business activities is realization and increase of profits. A profit is determined by **costs** and **sales revenues.** It can be positively influenced through either of these two components.[48]

Strictly speaking, both standardization and differentiation have potentials to save costs and rise sales revenues.[49]

For instance, standardization of a product can lead to the following cost savings:[50]

[47] See ibid. p. 31.
[48] See ibid. pp. 38-39.
[49] See Segler, 1986, p. 211.
[50] See Segler, 1986, p. 212 and Stegmüller, 1995, pp. 48-52.

- **economies of scale in production** resulting from an increase in production volume of standardized products (for instance, decline in per unit fixed costs);
- **R&D (Research and Development) savings** attributed, for instance, to needlessness of conducting R&D for each separate country;
- **economies of scale in marketing** arising, for instance, from using internationally uniform packaging designs.

On the other hand, the sales revenue rising potential of standardization of a product can be reffered to:[51]

- **development of the uniform image of a product** – the image evermore inevitable in the conditions of increasing cross-border transparency of markets caused by a boost in mobility of consumers and highly important for consolidation of brand image;
- **disposal of surplus production** possible due to (at least temporary) expansion of sales areas across borders;
- **rapid parallel coverage of markets** enabled, for instance, by the absence of time-consuming country-specific adaptation of products.

At the same time**,** cost savings attributed to differentiation of a product can be achieved through:[52]

- **"down-adaptation" of a product quality** for countries with lower requirements (in particular, eliminating those product features that generate costs, but are not needed in a corresponding country);
- **reduction of service problems**, which is possible because products are tailored to local market requirements, and consumer incomprehension of their characteristics does not arise;
- **R&D savings** ascribed, for instance, to receiving a big number of suggestions, especially when subsidiaries play a significant role in the process of country-specific adaptation of products.

Finally, the sales revenue rising potential of differentiation of a product can lie in:[53]

[51] See Segler, 1986, p. 212 and Stegmüller, 1995, pp. 42-45.
[52] See Segler, 1986, pp. 212-214 and Stegmüller, 1995, pp. 52-53.

- **increased consumer willingness to buy a product as a result of adjustment to consumer needs** in the way most optimal for each particular country;
- **avoidance of flops in international marketing**, which may appear due to insufficient consideration of country-specific conditions;
- **supply of fringe markets** with products matched to their specific needs.

Examples of cost saving and sales revenue rising potentials of standardization/differentiation of a product described above are summarized in Table 2-3.

Type of the potential	**Standardization of a product**	**Differentiation of a product**
Saving costs	Economies of scale in production	"Down-adaptation" of a product quality
	R&D savings	Reduction of service problems
	Economies of scale in marketing	R&D savings
Rising sales revenues	The uniform image of a product	Increased consumer willingness to buy a product as a result of adjustment to consumer needs
	Disposal of surplus production	
	Rapid parallel coverage of markets	Avoidance of flops in international marketing
		Supply of fringe markets

Table 2-3 Cost saving and sales revenue rising potentials of standardization/differentiation of a product
Source: Segler, 1986, p. 213 and Stegmüller, 1995, p. 40.

It should be emphasized, however, that in practice standardization is considered to be primarily a strategy oriented at saving costs, whereas differentiation – a strategy

[53] See Segler, 1986, p. 214 and Stegmüller, 1995, pp. 45-47.

oriented at rising sales revenues. More and more companies view saving costs by means of standardization as a central aspect of international marketing. Moreover, they start to orient themselves at world regions or even at the whole world as one potential market. A clear trend of switching from ethno- or polycentric to regio- or geocentric orientation systems can be observed. Companies attempt to standardize their international activities as much as possible and differentiate them, only if it is necessary.[54]

In the light of these developments a special attention appears to be given to the topic of **transnational segments**. Addressing them with standardized marketing strategies and instruments is often viewed as a way of mutual compensation of such disadvantages of global standardization and national differentiation as insufficient consideration of consumer needs and loss of potential economies of scale in production and marketing, respectively.[55]

International market segmentation presents an adequate procedure for finding transnational segments. Its peculiarities are discussed below.

2.3 International Market Segmentation

2.3.1 Concept of Market Segmentation

First articles devoted to the concept of market segmentation appeared in the 1950s. The most influential of them was the article "Product Differentiation and Market Segmentation as Alternative Marketing Strategies" written by Wendell R. Smith in 1956. There he contrasted product differentiation with market segmentation stating that the former notion is the strategy, which "is concerned with the bending of demand to the will of supply"[56], whereas the latter one – the strategy, which "is based upon developments on the demand side of the market and represents a rational and more precise adjustment of product and market effort to consumer or user requirements"[57].

[54] See Segler, 1986, p. 211 and Stegmüller, 1995, pp. 53-54.
[55] See, for instance, Yavas/Verhage/Green, 1992, p. 266 and Steenkamp/Ter Hofstede, 2002, p. 186.
[56] Smith, 1956, p. 5.
[57] ibid.

The article of Smith (1956) reflects developments and tensions occurring in his contemporary business environment. In the early and mid fifties, major manufacturers realized that mass production did not allow them to be successful anymore. The competition has increased, and they had often to store unsold output that had not met needs of the market. The manufacturers have acknowledged that needs of consumers differed and decided to pursue a strategy of product differentiation. In other words, although they had accepted the fact that there was diversity in consumer needs, they did not really react to it. Instead of this they treated consumers as similar and attempted to create a satisfactory demand for products with only a few real differences through influencing consumers by promotions, which emphasized these differences and presented product claims appealing to broad consumer needs.[58] In other words, this strategy was "designed to bring about the convergence of individual market demands for a variety of products upon a single or limited offering to the market"[59].

Nevertheless, as technological advances led to smaller product runs, the need in minimization of marketing costs became more acute, prosperity of consumers increased making them choosier, and variety of competing products and services expanded, the interest in market segmentation started to grow.[60] According to Smith (1956), market segmentation "consists of viewing a heterogeneous market (one characterized by divergent demand) as a number of smaller homogeneous markets in response to differing product preferences among important market segments. It is attributable to the desires of consumers or users for more precise satisfaction of their varying wants"[61]. He compared a market segmentation strategy with taking a slice of the market cake (a vertical cut into only one area of the market), whereas product differentiation strategy with taking its layer (a horizontal cut through all areas of the market).[62] He was sure that market segmentation was not only useful in view of the developments listed above, but also that switching attention from a layer of the market cake to its (fringe) slices can create growth potential,[63] and that "exploitation of market segments, which provides for greater

[58] See Engel/Fiorillo/Cayley, 1972, p. 22 and Struhl, 1992, p. 5.
[59] Smith, 1956, p. 4.
[60] See ibid. pp. 6-7.
[61] ibid. p. 6.
[62] See Smith, 1956, p. 5 and Struhl, 1992, p. 6.
[63] See Smith, 1956, p. 7.

maximization of consumer or user satisfactions, tends to build a more secure market position and to lead to greater over-all stability"[64].

Many manufacturers had to agree with the opinion of Smith (1956) and to undergo the second change in dealing with their markets in less than a decade after the first one – they had to switch to market segmentation.[65] Today, market segmentation is an essential element of marketing. It is necessary for most companies in industrialized countries, as far as majority of products and services have to be focused on needs of well-defined sub-markets, in order to be successful.[66]

Since the times of Smith (1956), numerous definitions of market segmentation have been formulated.[67] Although they differ from each other, there is a **common basic idea** behind them: if the total market consists of a vast number of actual and potential consumers, and they have different needs with regard to relevant products, there is a possibility to divide this market into internally homogeneous sub-markets on the base of some particular consumer characteristics and enable therewith satisfying heterogeneous needs of these sub-markets by means of differentiated marketing programs.[68]

In general, the concept of market segmentation should be viewed as an **integrated concept having two aspects**:[69]

- **market-analytical aspect**: here one talks about market segmentation analysis splitting "heterogeneous markets into internally homogeneous and externally heterogeneous sub-markets (market segments)"[70];
- **marketing-strategical aspect**: here one talks about a market segmentation strategy "aimed at tailoring the product or service and, as far as possible, also the other elements of the marketing mix to the specific needs and wants of these particular homogenous buyer/consumer groups (market segments)"[71].

[64] ibid.
[65] See Engel/Fiorillo/Cayley, 1972, pp. 22-23.
[66] See Struhl, 1992, p. 1 and Wedel/Kamakura, 2000, p. 3.
[67] See, for instance, Böhler, 1977, p. 12, Freter, 1983, p. 18, Neidell, 1983, pp. 356-357, McDonald/Dunbar, 1995, p. 10, Böcker/Helm, 2003, p. 23, and Palmer, 2004, p. 166.
[68] See Meffert, 2000, p. 181.
[69] See ibid.
[70] Bauer, 2000, p. 2806.
[71] ibid. pp. 2796-2797.

Peculiarities of both aspects of market segmentation are described below. It should be mentioned that, in the context of the international market segmentation study presented later in this thesis, market segmentation is viewed in the market-analytical sense only.

2.3.1.1 Market Segmentation Analysis

Market segmentation analysis presents an instrumental perception of the concept of market segmentation. In this case, the emphasis is put on identification of consumer segments, which are internally (externally) as homogeneous (heterogeneous) as possible with regard to their demand-relevant characteristics.[72] Market segmentation analysis constitutes the **information side** of market segmentation.[73] It can serve two different purposes:[74]

- on the one hand, it can be focused on "the identification and documentation of generalizable differences among consumer groups because these differences can lead to insights about basic processes of consumer behavior"[75] (**behaviorally oriented approach to market segmentation**);
- on the other hand, it can be focused "not so much on **why** such differences occur as on **how** they can be used to improve the efficiency of the firm's marketing program"[76] (**decision-oriented approach to market segmentation**).

As far as market segmentation analyses conducted within the scope of the international market segmentation study presented later in this thesis are of a decision-oriented character, only the latter approach to market segmentation is considered in the following.

Market segmentation analysis in the decision-oriented sense is aimed at informing a company whether members of the market it is interested in exhibit group-specific differences in demand-relevant characteristics and, if yes, whether it is possible to make use of these differences in increasing achievement rates of a company (for

[72] See Bauer, 1976, p. 63.
[73] See Meffert, 2000, p. 184.
[74] See Bauer, 1976, p. 63.
[75] Frank/Massy/Wind, 1972, p. 11.
[76] ibid. p. 13.

instance, its profit, market position, etc.) through developing differentiated marketing programs[77] adequate for target groups and how to do it.[78]

In other words, market segmentation analysis attempts, in the first place, to localize consumer segments, which do or might react to marketing programs in an internally homogeneous and externally heterogeneous way (see Figure 2-2). These segments "need not be physical entities that naturally occur in the marketplace"[79], but are normally "artificial groupings of consumers constructed to help managers to design and target their strategies"[80].

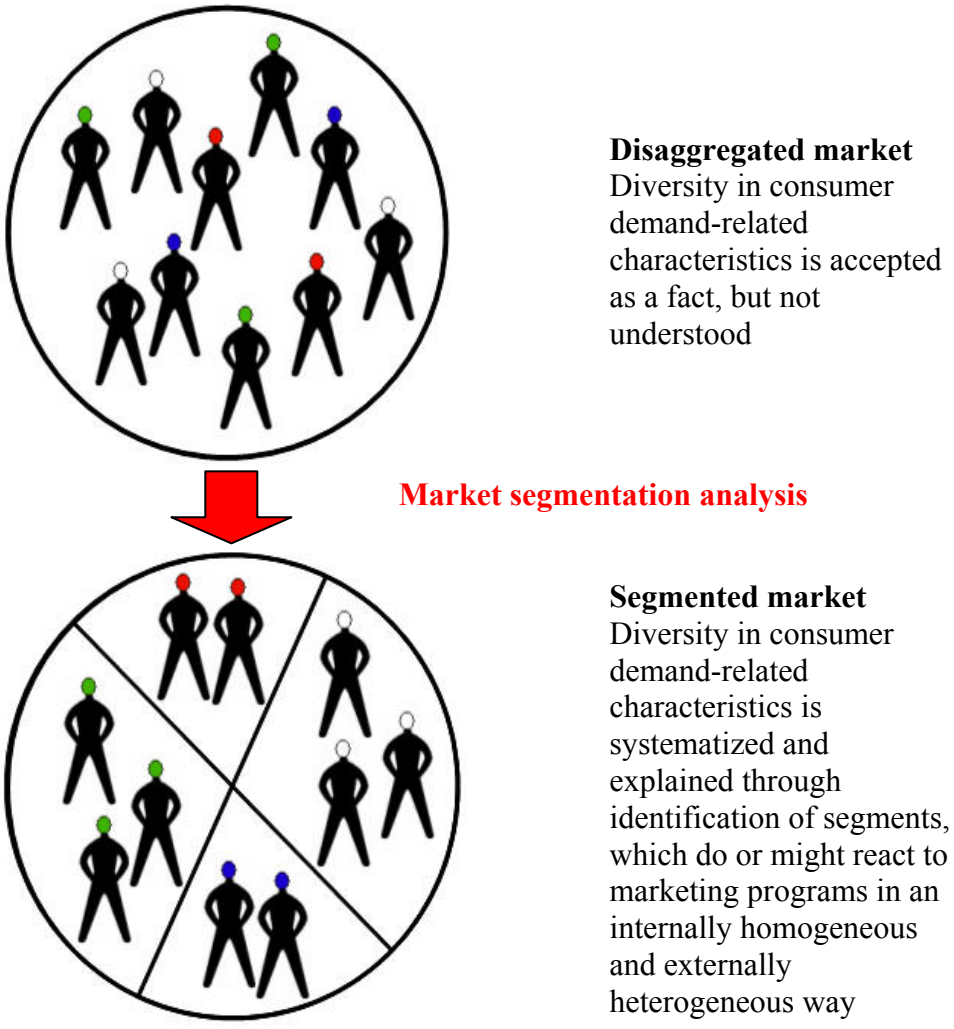


Figure 2-2 Market segmentation analysis

[77] As it was already mentioned above, according to Bauer, 2000, pp. 2796-2797, such marketing mix element as a product should be considered and adjusted primarily in this case, whereas all others (promotion, distribution, pricing) – as far as possible.
[78] See Bauer, 1976, p. 69.
[79] Wedel/Kamakura, 2000, p. 5.
[80] ibid.

Correspondingly, the next two questions appear to be crucial for market segmentation analysis:[81]

- Which statistical-mathematical methods are appropriate for decomposing the total market into sub-markets and determining relevant differences between them?
- Which criteria should be used to subdivide the total market into sub-markets?

Usage of different segmentation methods and criteria[82] normally results in finding consumer segments of different type, number, and usefulness.[83]

Existing segmentation methods are very numerous. In general, they can be classified in two ways.

Firstly, these methods can be of either **descriptive** or **predictive nature**. **Descriptive methods** analyze interconnections within one set of variables and do not distinguish between dependent and independent variables. On the contrary, **predictive methods** analyze interconnections between two sets of variables viewing one set as a group of dependent variables, which have to be explained/predicted by the other set – a group of independent variables.[84]

Secondly, the type of a segmentation method used depends on a segmentation model chosen.[85] In particular, one can distinguish between **a-priori** and **a-posteriori segmentation models**.[86]

Within the scope of **a-priori segmentation**, some particular cluster-defining criterion is chosen in advance. On the base of this criterion consumers are classified into groups and afterwards described by means of characteristics not used for cluster building (the so-called **descriptor variables**[87]). The number of clusters in this case is determined by characteristics of a cluster-defining criterion (for instance, by the number of points on a corresponding measurement scale). A-

[81] See Kaiser, 1977, p. 12.
[82] According to Struhl, 1992, p. 10, segmentation criteria can also be called **basis variables** because they serve as a base for segmentation.
[83] See Wedel/Kamakura, 2000, p. 5.
[84] See ibid. p. 17.
[85] See ibid.
[86] See Green, 1977, p. 64.
[87] See Struhl, 1992, p. 10.

priori segmentation makes sense, if a researcher assumes or knows that some particular groups of consumers exist in the marketplace and attempts to obtain information on them. Classification of consumers into groups according to their favorite brand can be considered as a typical example of a-priori segmentation. Here the variable "My favorite brand is …" serves as a cluster-defining criterion, and the number of clusters corresponds to the number of brands considered.[88]

In the case of **a-posteriori segmentation**, a researcher does not have any information about the number or type of segments in advance and tries to determine them on the base of grouping consumers according to their similarities on some set of variables. Segments obtained in this way can then be additionally described by descriptor variables.[89] As an example of a-posteriori segmentation one can consider segmentation of consumers on the base of their similarities on requirements towards a product/brand (i.e., needs) as in the case of the international market segmentation study presented later in the thesis.

A-priori and a-posteriori segmentation can also be used in combination with each other. In such case, one talks about **hybrid segmentation**. Here a-priori segmentation precedes a-posteriori segmentation.[90] For instance, consumers can first be roughly classified into groups according to their favorite brand, and then each of the obtained groups can be segmented on the base of consumers' requirements towards a product/brand.

Examples of methods classified on the base of the two types of criteria described above are presented in Table 2-4.

The number of characteristics which may serve as segmentation criteria is also huge. In the case of conducting national market segmentation analysis, these characteristics are chosen on the base of

- the goal of the market segmentation study;[91]
- their quality.[92]

[88] See Green/Tull/Albaum, 1988, pp. 687-688 and Stegmüller, 1995, pp. 120-121.
[89] See Wind, 1978, pp. 321-322, Green/Tull/Albaum, 1988, p. 688, and Stegmüller, 1995, p. 121.
[90] See Wind, 1978, p. 322, Green/Tull/Albaum, 1988, pp. 688-689, and Stegmüller, 1995, pp. 121-122.
[91] For more detailed information see part 3.4.1.1 of the present thesis.
[92] For more detailed information see part 3.4.1.2 of the present thesis.

If international markets are being segmented, the choice of segmentation criteria is additionally influenced by the type of international market segmentation analysis.[93]

	A-priori	A-posteriori	Hybrid
Descriptive	Contingency tables Log-linear models	Clustering methods ANN (Artificial Neural Networks) Mixture models	Combination of a-priori and a-posteriori methods
Predictive	Cross-tabulation Regression Multinomial logit model Discriminant analysis	AID (Automatic Interaction Detection) CART (Classification and Regression Trees) Clusterwise regression ANN (Artificial Neural Networks) Mixture models	

Table 2-4 Classification of segmentation methods
Source: Wedel/Kamakura, 2000, p. 17 and Liu, 2005, p. 25.

2.3.1.2 Market Segmentation Strategy

A market segmentation strategy is based on the cognition that markets are heterogeneous, in other words, that consumers have different characteristics, needs, wants, and preferences. Market heterogeneity is interpreted by a market segmentation strategy not as a disturbing evil, but as a beneficial opportunity, an advantage for both a company and consumers: viewing consumers with alike demand-relevant characteristics as homogenous segments and addressing them with marketing programs constructed specifically for these segments are expected to lead to higher satisfaction of consumer needs and therewith to stabilization of or increase in achievement rates of a company (for instance, its profit, market position, etc).[94]

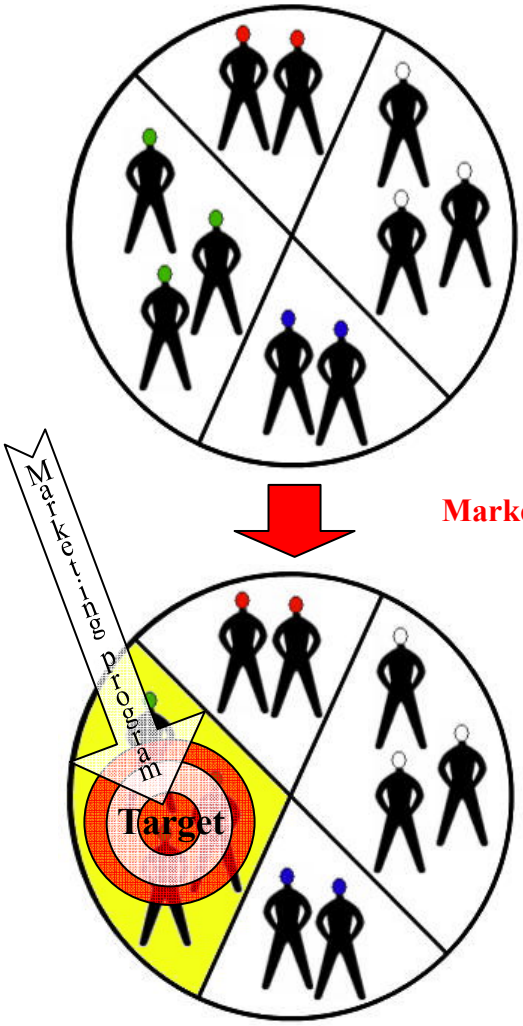
[93] For more detailed information see part 2.3.2 of the present thesis.
[94] See Bauer, 1976, pp. 59-60.

Correspondingly, conducting a market segmentation strategy means producing heterogeneous products for homogeneous sub-markets of the heterogeneous total market and selling them with the help of marketing programs oriented at target sub-markets. It also means the increase in achievement of company's objectives though the increase in satisfaction of individual needs.[95]

A market segmentation strategy constitutes the **action side** of market segmentation. It incorporates identifying a target segment (target segments) and developing segment-specific marketing programs (**management-oriented approach to market segmentation**) (see Figure 2-3).[96] No wonder that in the Anglo-American literature the term "market segmentation" refers to the market-analytical aspect of market segmentation only, whereas market segmentation in the marketing-strategical conceptualization is presented through "targeting" and "brand (product) positioning" terms.[97] For instance, Green, Tull, and Albaum (1988) state:

"From a marketing management viewpoint, market segmentation is the act of dividing a market into distinct groups of buyers who might require separate products and/or marketing programs directed to them. In contrast, brand (product) positioning is the act of developing a product and its associated marketing program to fit a place in the consumer's mind. The basis of product (or brand) positioning is segmentation "working" through market targeting which involves evaluating and selecting one or more of the market segments to serve"[98].

[95] See ibid. p. 60.
[96] See Meffert, 2000, pp. 184-185.
[97] See, for instance, Green/Tull/Albaum, 1988, pp. 672-673, Douglas/Craig, 1995, pp. 188-189, Kotabe/Helsen, 1998, p. 206-207, and Keegan, 2002, pp. 191-202.
[98] Green/Tull/Albaum, 1988, pp. 672-673.



Segmented market
Diversity in consumer demand-related charachteristics is systematized and explained through identification of segments, which do or might react to marketing programs in an internally homogeneous and externally heterogeneous way

Market segmentation strategy

Target sub-market
A target consumer segment is identified, and marketing program specific for this segment is developed

Figure 2-3 Market segmentation strategy

2.3.2 Segmenting International Markets

In the context of international market segmentation one deals not only with consumers constituting a total market of one country, but with consumers constituting total markets of several countries. In other words, "a further dimension has to be considered, namely that of country characteristics"[99].

As it was already mentioned above, market segmentation is viewed only in the market-analytical sense within the scope of the international market segmentation study presented later in this thesis. Therefore, the description of international market segmentation presented below is concentrated on its market-analytical

[99] Wind/Douglas, 1972, p. 18.

aspect only. In particular, the next three general types of international market segmentation analysis will be discussed: **exclusively country-related market segmentation**, **country- and consumer-related market segmentation**, and **exclusively consumer-related market segmentation**.

2.3.2.1 Exclusively Country-Related Market Segmentation

Exclusively country-related market segmentation is international market segmentation aimed at forming a country typology. In other words, not consumers, but countries are being segmented here (see Figure 2-4).[100]

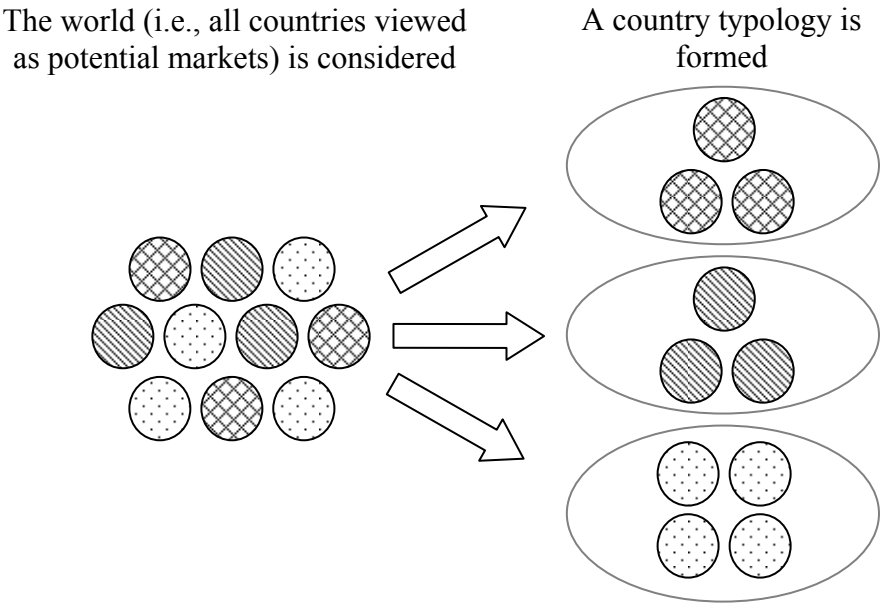


Figure 2-4 Exclusively country-related market segmentation

Correspondingly, only country characteristics are considered as segmentation criteria in this case. According to Meffert and Althans (1982), they can be subdivided into four general groups: **socioeconomic**, **political-legal**, **natural-technical**, and **sociocultural** (see Table 2-5).[101]

[100] See, for instance, Liander/Terpstra/Yoshino/Sherbini, 1967, pp. 59-62, Sethi, 1971, pp. 348-354, Huszagh/Fox/Day, 1986, pp. 31-43, Day/Fox/Huszagh, 1988, pp. 14-27, Lee, 1990, pp. 39-49, Helsen/Jedidi/DeSarbo, 1993, pp. 60-71, Dawar/Parker, 1994, pp. 81-95, Kumar/Stam/ Joachimsthaler, 1994, pp. 29-52, Kale, 1995, pp. 35-48, Kumar/Ganesh/Echambadi, 1998, pp. 255-268, Kotabe/Helsen, 1998, pp. 188-189, Bauer, 2000, p. 2807, and Steenkamp, 2001, pp. 30-44.
[101] See Meffert/Althans, 1982, p. 59.

Group	Country characteristics
Socioeconomic	Market volume Competition
Natural-technical	Typography Climate State of development Infrastructure Urbanization level
Political-legal	Entrepreneurial activity of the state Social order Political stability Economic policy Foreign trade laws Foreign jurisdiction International agreements
Sociocultural	Language Educational system Values and attitudes Religion Social structure

Table 2-5 Country characteristics as segmentation criteria classified
Source: Meffert/Althans, 1982, p. 59.

An alternative approach to classifying country characteristics as segmentation criteria is proposed by Frank, Massy, and Wind (1972).[102] They distinguish between four different groups presented in Table 2-6. This classification approach provides with much more detailed information about the segmentation criteria because it points at differences in the nature of these criteria (general or situation specific) and of their measurement process (objective or inferred)[103].

[102] See Frank/Massy/Wind, 1972, p. 103.
[103] See ibid. pp. 26-27.

	General	Situation specific
Objective	Geographic location Population characteristics Level of socioeconomic development	Economic and legal constraints Market conditions
Inferred	Cultural characteristics Political factors	Product bound culture and life-style characteristics

Table 2-6 Country characteristics as segmentation criteria classified (an alternative approach)
Source: Frank/Massy/Wind, 1972, p. 103.

While conducting exclusively country-related market segmentation, countries can be segmented either by means of segmentation methods presented in Table 2-4 or by means of portfolio analysis[104].

A country typology obtained in the case of exclusively country-related market segmentation can serve as an information support in making country selection decisions in international marketing. Nevertheless, its usefulness in finding meaningful and realistic transnational segments as well as in providing a base for constructing efficient marketing programs is quite questionable. First of all, exclusively country-related market segmentation disregards country-specific heterogeneity of consumers. Moreover, it excludes the possibility of finding transnational segments in countries belonging to different country groups. To address these shortcomings, exclusively country-related market segmentation should be complemented or substituted by consumer-related market segmentation.[105]

2.3.2.2 Country- and Consumer-Related Market Segmentation

In the case of **country- and consumer-related market segmentation**, one talks about international market segmentation at the **macro-level** (i.e., country-related

[104] See Bauer 2000, p. 2807. According to Stegmüller, 1995, p. 107, portfolio analysis presents a facility for evaluation and selection of countries on the base of a country portfolio – a two-dimensional coordinate space structured through evaluation/selection criteria as axes of coordinates. For more detailed information on portfolio analysis see Stegmüller, 1995, pp. 107-109, Backhaus/Büschken/Voeth, 2005, pp. 81-97, and Berndt/Fantapié Altobelli/Sander, 2005, pp. 115-117.
[105] See Bauer, 2000, p. 2807.

market segmentation) followed by international market segmentation at the **micro-level** (i.e., consumer-related market segmentation).[106]

The aim of country-related segmentation in this case is not only to form a country typology, but also to identify a country group (country groups) worth being considered at a micro-level (see Figure 2-5).[107]

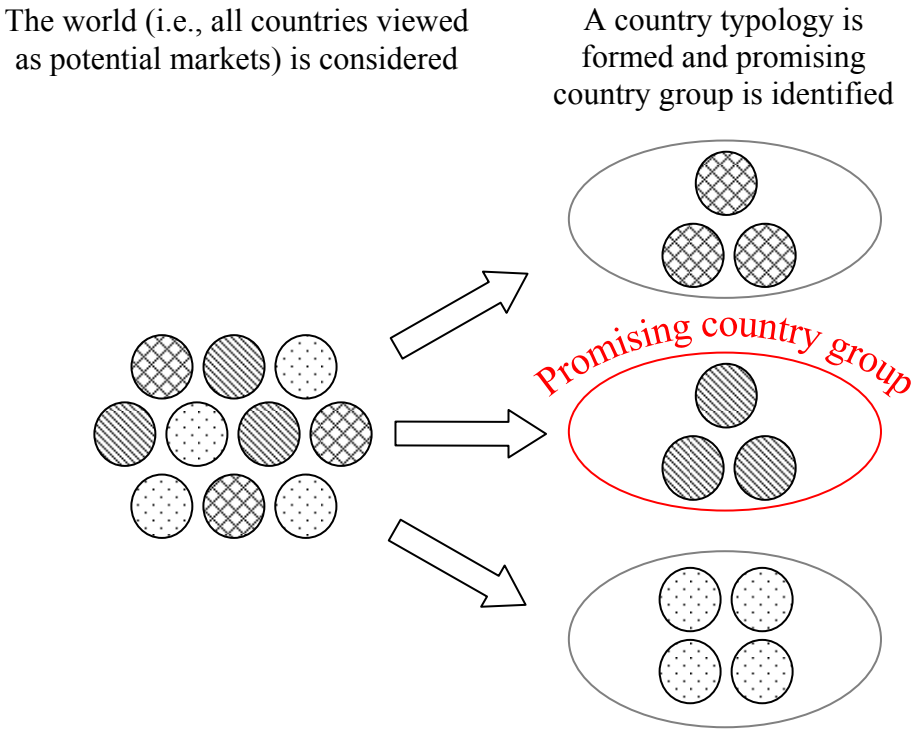


Figure 2-5 International market segmentation at the macro-level

Again, international market segmentation at the macro-level can be based either on segmentation methods presented in Table 2-4 or on portfolio analysis. In the latter case, subsequent assessment of countries is not required – it is already expressed in corresponding portfolio positioning. In the former case, on the contrary, it is necessary.[108] Assessment criteria used here depend on the goal- and preference-

[106] See, for instance, Wind/Douglas, 1972, pp. 17-25, Segler, 1986, p. 192, Althans, 1989, pp. 1469-1477, Hünerberg, 1994, pp. 108-110, Bauer, 2000, p. 2808, Mennicken, 2000, pp. 191-196, and Zentes/Swoboda/Morschett, 2004, p. 617.
[107] See Bauer, 2000, p. 2808.
[108] See ibid.

system of a company.[109] The next two groups of them are considered to be especially important:[110]

- **indicators of business risk:**
  - political factors (for instance, internal political stability, expropriation risks, attitudes of the host-government to foreign investment),
  - legal factors (for instance, import-export restrictions, legal systems, restrictions on private ownership),
  - financial factors (for instance, rate of inflation, capital-flow restrictions, foreign-exchange risks);
- **indicators of market potential:**
  - demographic characteristics (for instance, population size, rate of population growth, degree of urbanization, population density, age structure and composition of population),
  - geographic characteristics (for instance, physical size of the country, topographical characteristics, climate conditions),
  - economic factors (for instance, GNP per capita, income distribution, rate of growth of GNP, rate of investment to GNP),
  - technological factors (for instance, level of technological skills, existing production and consumption technology, education levels),
  - sociocultural factors (for instance, dominant values, life-style patterns, ethnic and linguistic groups).

In general, it can be stated that criteria used for choosing a promising country group are normally quite similar to those used for forming a country typology.[111]

The country group choice procedure can be conducted with the help of either **analytical** or **heuristic methods**.[112]

Analytical methods assume that relevant alternatives, business environment conditions, and activity consequences can be quantified, and thus the optimal alternative can be calculated. These methods require a big amount of information

[109] See Mennicken, 2000, p. 192.
[110] See Douglas/Craig, 1982, pp. 29.8-29.10, Köhler/Hüttemann, 1989, pp. 1433-1434, and Mennicken, 2000, pp. 193-194.
[111] See Mennicken, 2000, p. 194.
[112] See Meffert/Bolz, 1998, p. 116.

to be available. To analytical methods belongs, for instance, the **capital value method** – a traditional method of investment analysis. It views a country group as most advantageous and promising, if the capital value (i.e., the difference between cash values of in- and outpayment) of product sales in it is the highest, and helps to identify it.[113]

Heuristic methods are of a qualitative nature. Their requirements towards an information supply are much lower than those of analytical methods. Among heuristic methods is, for instance, the **checklist method**. The checklist method verifies an ability of a country group to fulfill some basic requirements presented in the form of a list. These requirements normally correspond to indicators of business risk and market potential already presented above (for instance, internal political stability, legal security of agreements, GNP per capita, personal attitude to a job).[114]

After a promising country group (country groups) is (are) identified, a researcher "switches" to the micro-level of international market segmentation and segments consumers in these countries. Consumer-related market segmentation in this case can be done in the form of either **additive intranational market segmentation** or **integral market segmentation** (see Figure 2-6).[115]

[113] See ibid. pp. 116-121.
[114] See Meffert/Bolz, 1998, pp. 116-118 and Kutschker/Schmid, 2005, pp. 936-937.
[115] See Segler, 1986, p. 192 and Bauer, 2000, p. 2808.

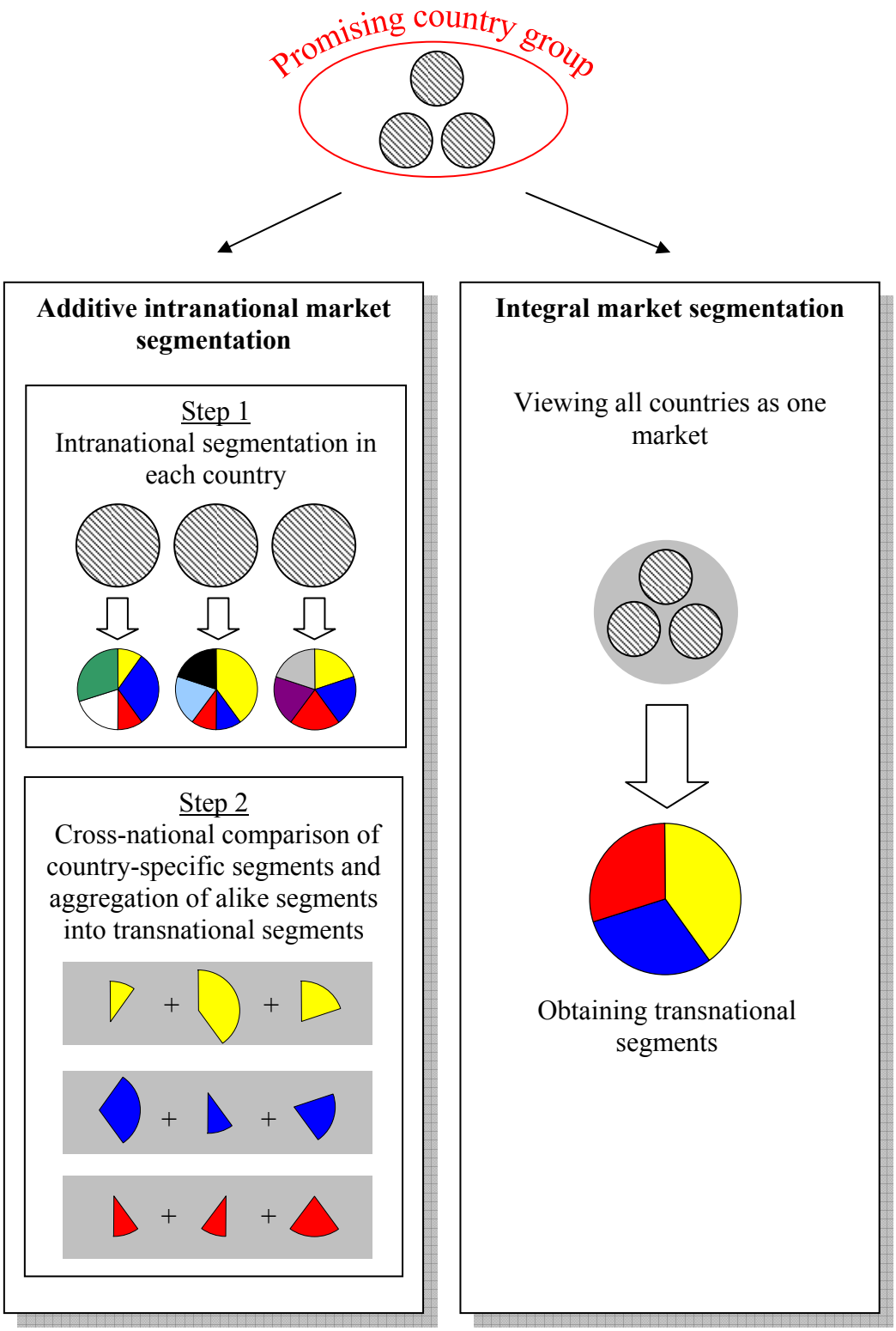


Figure 2-6 International market segmentation at the micro-level

Conduction of **additive intranational market segmentation** can be subdivided into the next two steps:[116]

- **Segmenting countries intranationally**

  Consumers within each particular country are subdivided into internally homogeneous and externally heterogeneous groups.[117] It should be emphasized that intranational segmentations conducted in this case are not identical to corresponding national segmentations. They have to be conducted in the way guaranteeing cross-national comparability of country-specific segments.

- **Comparing and aggregating of country-specific segments cross-nationally**

  Segments identified in each particular country are compared with segments from other countries. If alike segments in different countries are identified, they are combined into corresponding transnational segments.

Within the scope of **integral market segmentation**, all countries are considered jointly, as one market.[118] Here segmenting consumers results in straight identification of transnational segments.[119]

It should be mentioned that in the literature integral market segmentation is sometimes defined not as an option for conducting country- and consumer-related market segmentation at the micro level, but as an alternative to the whole two-step procedure.[120] In particular, it is stated that, in the case of integral market segmentation, conduction of country-related market segmentation is abandoned, and consumers are segmented worldwide. Within the scope of the present thesis, integral market segmentation in this sense is considered only as an option for conducting exclusively consumer-related market segmentation presented below.

Segmentation criteria used at the macro-level of country- and consumer-related market segmentation are normally the same country characteristics as in the case of exclusively country-related market segmentation. The role of segmentation criteria used at the micro-level of country- and consumer-related market segmentation is

[116] See Stegmüller, 1995, p. 79, Kotabe/Helsen, 1998, p. 190, and Bauer, 2000, p. 2808.
[117] In other words, the number of consumer samples segmented in this case corresponds to the number of countries considered.
[118] Here one consumer sample is segmented.
[119] See Kotabe/Helsen, 1998, p. 190 and Bauer, 2000, p. 2808.
[120] See, for instance, Hünerberg, 1994, pp. 109-110, Stegmüller, 1995, pp. 80-81, and Zentes/Swoboda/Morschett, 2004, p. 617.

normally played by different kinds of consumer characteristics. Usually, they are identical to consumer characteristics used in the case of national market segmentation.[121]

In the literature there is a big variety of both consumer characteristics, which can be considered as segmentation criteria, and ways of their systematization[122].
For instance, according to Wind (1978) they can be classified into the next two groups:[123]

- **general customer characteristics:** "demographic and socioeconomic characteristics, personality and life style characteristics, and attitudes and behavior toward mass media and distribution outlets"[124];
- **situation specific customer characteristics:** "product usage and purchase patterns, attitudes toward the product and its consumption, benefits sought in a product category, and any responses to specific marketing variables such as new product concepts, advertisements, and the like"[125].

Stegmüller (1995) criticizes such classification as not selective enough and proposes to subdivide consumer characteristics as segmentation criteria into the next three groups:[126]

- **demographic variables:** geographic characteristics (in particular, city size, city/village, and region), demographic characteristics (in particular, gender, age, marital status, and number of children), and socioeconomic characteristics (in particular, occupation, education, and income);
- **psychographic variables:** attitudes (in particular, general, product type specific and brand specific attitudes), motives, perceptions, and interests;
- **behavioral variables:** activities, product choice, purchase quantity and frequency, brand loyalty, price behavior, choice of place of purchase, and media usage.

[121] See Bauer, 2000, p. 2808.
[122] See, for instance, Frank/Massy/Wind, 1972, p. 27, Böhler, 1977, p. 63, Meffert, 1977, p. 438, Wind, 1978, p. 319, Freter, 1983, p. 46, Green/Tull/Albaum, 1988, p. 691, Kramer, 1991, p. 24, Struhl, 1992, p. 14, Stegmüller, 1995, p. 164, Palmer, 2004, pp. 172-185, and Berndt/Fantapié Altobelli/Sander, 2005, p. 122.
[123] See Wind, 1978, p. 319.
[124] ibid.
[125] ibid.
[126] See Stegmüller, 1995, pp. 163-164.

Again, Frank, Massy, and Wind (1972) provide with the most informative subdivision of consumer characteristics as segmentation criteria. As in the case of country characteristics, they consider four groups of segmentation criteria differing with respect to the nature of these criteria and of their measurement process (see Table 2-7).[127]

	General	Situation specific
Objective	Demographic factors Socioeconomic factors	Consumption patterns Brand loyalty patterns Buying situations
Inferred	Personality traits Life-style	Attitudes Perceptions and preferences

Table 2-7 Consumer characteristics as segmentation criteria classified
Source: Frank/Massy/Wind, 1972, p. 27.

Segmentation methods used for conducting international market segmentation at the micro-level can be normally found among methods presented in Table 2-4.

2.3.2.3 Exclusively Consumer-Related Market Segmentation

Exclusively consumer-related market segmentation is international market segmentation aimed at forming a consumer typology only.[128] From a purely theoretical point of view, a researcher segments consumers from all countries viewed as potential markets in this case. Again, segmenting consumers can be done by means of either additive intranational market segmentation or integral market segmentation (see Figure 2-7).[129]

In practice, however, the number of countries considered is normally reduced to some manageable size, before consumer-related segmentation takes place.[130] Approaches to selecting countries range from analytical and heuristic methods

[127] See Frank/Massy/Wind, 1972, pp. 26-27.
[128] See, for instance, Kale/Sudharshan, 1987, pp. 60-70, Stegmüller, 1995, pp. 79-81, and Bauer, 2000, p. 2809.
[129] See Bauer, 2000, p. 2809.
[130] See ibid.

already described above (they are used in this case not for country group selection, but for country selection) to simple filtering based on some specific management objectives and considerations.

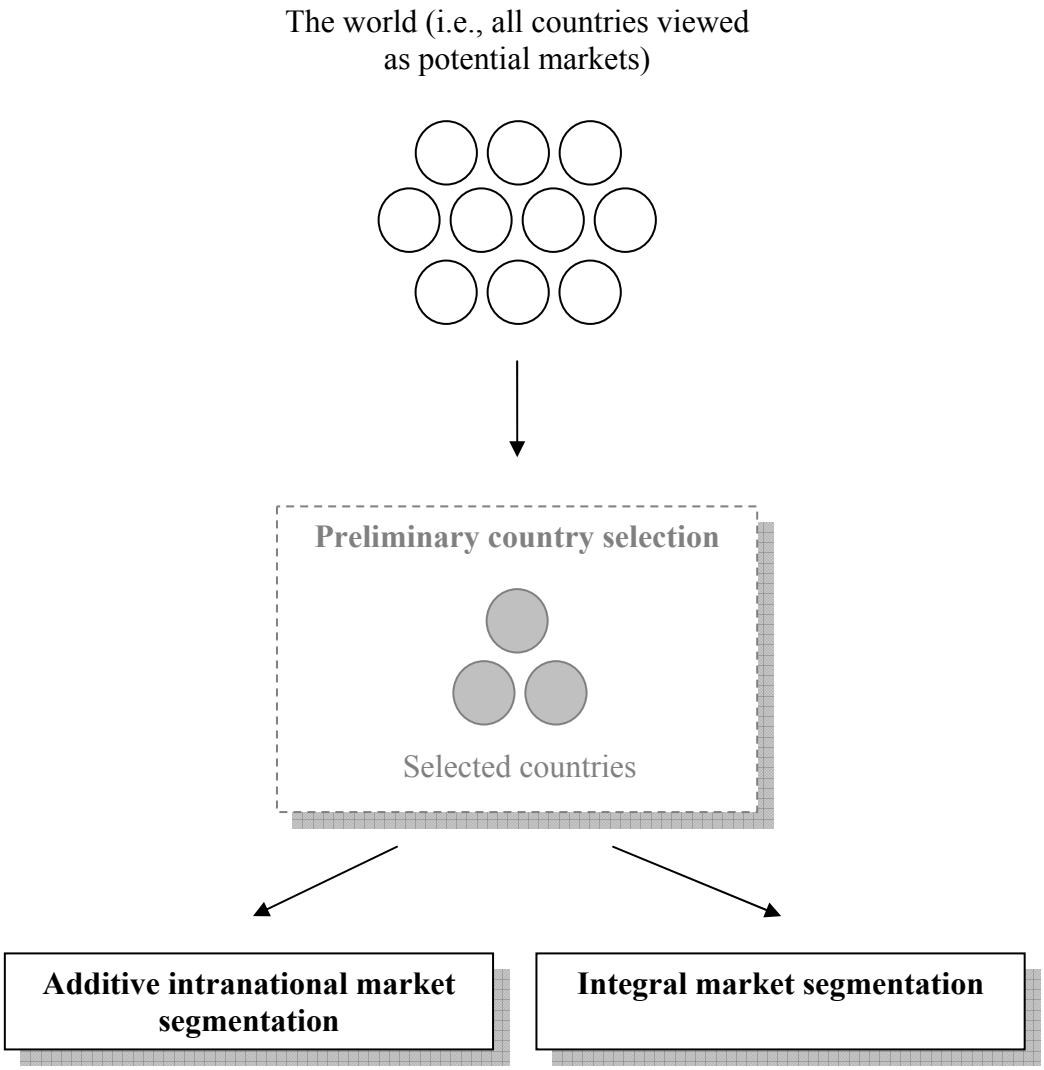


Figure 2-7 Exclusively consumer-related market segmentation

3 Steps and Methodologies of International Market Segmentation Analysis

There is a great variety of approaches to designing conduction of market segmentation analysis. Bauer and Liu (2006) propose to summarize them in the form of **a common framework** consisting of the next eight general research steps:[131]

1. Defining the relevant market.
2. Deciding on the segmentation approach.
3. Deciding on basis and descriptor variables.
4. Designing the survey.
5. Deciding on the data analysis methodology.
6. Collecting the data.
7. Applying the methodology to identify market segments.
8. Profiling/describing segments by means of basis and descriptor variables.

Of course, these steps are quite idealized. The framework of market segmentation analysis may vary from study to study: the number, contents and order of the steps may be slightly changed. In the case of the international market segmentation study presented later in this thesis, it was decided to adjust the common framework presented above to the conditions of the study (i.e., study purpose, data availability, and international environment) and to do the following general research steps:

1. Defining the relevant market.
2. Deciding on the segmentation approach and methodology.
3. Procuring the data.[132]
4. Selecting basis and descriptor variables.
5. Conducting the analysis.

[131] See Bauer/Liu, 2006, p. 4.

[132] As far as it was impossible to influence the data procurement process, basis and descriptor variables used in the international market segmentation study presented later in this thesis were chosen from the contents of already collected data. Therefore, it was decided to consider the research step "Procuring the data" before the research step "Selecting basis and descriptor variables" here.

Theoretical aspects referring to each of these steps are presented in this part of the thesis.

3.1 Defining Relevant Market

In order to conduct international market segmentation analysis, one has first to define the relevant market. In particular, the following questions have to be answered:[133]

- What business are we in?
- What are the relevant products?
- What are the geographical market boundaries?
- What are the temporal market boundaries?

The relevant market definition should be neither too broad nor too narrow. A too broad definition can complicate international market segmentation analysis and overwhelm a researcher, whereas a too narrow definition can limit useful new opportunities opened up by international market segmentation analysis to a very small number.[134]

3.2 Deciding on Segmentation Approach and Methodology

If national market segmentation analysis is to be conducted, a researcher has to choose between three segmentation models already mentioned in part 2.3.1.1 of this thesis: **a-priori**, **a-posteriori**, and **hybrid**. Moreover, the nature of segmentation methods has to be determined: a researcher can choose between two groups of methods, which were also presented in part 2.3.1.1 – between **descriptive** and **predictive methods**. Afterwards, a particular segmentation method (methods) can be selected out of the chosen group.

If international market segmentation analysis is to be conducted, the third choice dimension is added to the decision process described above (see Figure 3-1): the type of international market segmentation analysis has to be selected. As it was already demonstrated in part 2.3.2 of this thesis, there are three alternatives here: **exclusively country-related market segmentation**, **country- and consumer-market segmentation**, and **exclusively consumer-related segmentation**.

[133] See Liu, 2005, p. 18 and Bauer/Liu, 2006, p. 4.
[134] See McDonald/Dunbar, 1995, p. 4.

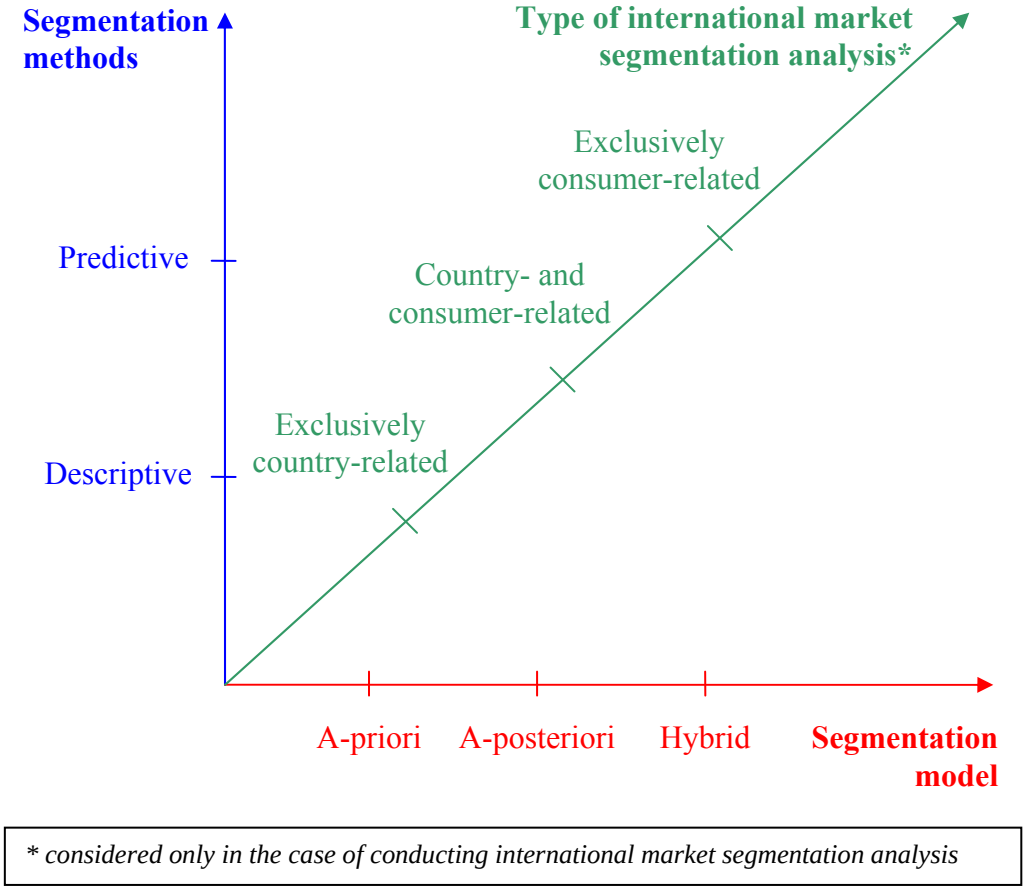


Figure 3-1 Choice dimensions considered while deciding on the segmentation approach and methodology

All types of choice presented above depend on the objectives of a researcher conducting a segmentation study.

3.3 Procuring Data

Data used as basis or descriptor variables can be subdivided into the next two groups: **secondary data** and **primary data**.

Secondary data refers to readily available information collected for some other purposes at an earlier date, which can also be useful for the current study.[135] They can be generally classified as follows:[136]

- **statistical data** (for instance, official, semi-official or operational statistics);

[135] See Kotabe/Helsen, 1998, p. 154 and Hammann/Erichson, 2000, p. 77.
[136] See Bauer, 2002, p. 73.

- **empirical analyses** (for instance, consumer, competitor or media analyses);
- **reports** and **notifications** (for instance, annual reports, catalogs, reference books, internet announcements).

There are two types of secondary data sources: **company-internal** and **company-external** (see Table 3-1). Company-internal information enables conducting faster and organizationally smoother research at a lower cost. Nevertheless, such information is quite limited in both size and content. On the contrary, company-external information is so vast and diverse that a well-planned selection of indeed useful information is required.[137]

Company-Internal Sources	Company-External Sources
Sales figures	Ministries, public authorities
Purchase order statistics	Statistical agencies
Information about clients and suppliers	Chambers of commerce
General employee surveys	Trade associations
Field reports	Economic research institutes
Buyer reports	Embassies and consulates
Management reports	National banks and banks
Conference papers	Consulting firms
	Advertising agencies
	Market research institutes
	Representatives of international organizations
	Electronic databases
	International exhibitions

Table 3-1 Examples of secondary data sources
Source: Berndt/Fantapié Altobelli/Sander, 2005, pp. 54-55.

Primary data are collected specifically for objectives of the current study. Their acquisition is usually more expensive and time-consuming than acquisition of secondary data.[138] Therefore, research based on primary data is conducted only in

[137] See Bauer, 2002, pp. 74-75 and Berndt/Fantapié Altobelli/Sander, 2005, p. 54.
[138] See Kotabe/Helsen, 1998, p. 154.

the case, when information required for a particular study cannot be (or can be only partially) found in readily available data material.[139]

Methods of primary data collection can be either **quantitative** or **qualitative**. **Quantitative methods** are aimed at generating statistically representative quantitative data. On the contrary, **qualitative methods** do not produce such type of data, but are concentrated on providing a researcher with information on respondents' thoughts, subconscious feelings and need states. Such information is often used to prepare, deepen or interpret the quantitative research. Besides, the qualitative research can also be conducted independently from the quantitative research (for instance, for the purpose of idea generation for new products). [140]

As far as the scope of all existing primary data collection methods is very wide, and the input data considered in the context of the international market segmentation study presented later in the thesis are of quantitative nature, description of methods is limited here to quantitative ones only.

In general, it can be distinguished between three quantitative approaches to primary data collection: **not-experimental surveys**, **not-experimental observations**, and **experimental surveys and observation**.[141]

Not-experimental surveys present the most important and widely used primary data collection approach. Here a representative group of respondents is prompted by means of stimuli (for instance, questions or illustrations) to make comments with regard to an issue of investigation, which is presented by a researcher without influencing it systematically.[142] There are three basic types of non-experimental surveys:[143]

1. **Written surveys**

   Within the scope of a written survey, printed questionnaires are delivered to respondents, filled in by them, and delivered back to researches. No personal contact between researchers and respondents

[139] See Berndt/Fantapié Altobelli/Sander, 2005, p. 64.
[140] See Bauer, 2002, pp. 257-258 and Craig/Douglas, 2005, pp. 205-206.
[141] See Meffert/Bolz, 1998, p. 88.
[142] See Bauer, 2002, p. 184 and Berndt/Fantapié Altobelli/Sander, 2005, pp. 70-71.
[143] See Bauer, 2002, pp. 185-190 and Berndt/Fantapié Altobelli/Sander, 2005, pp. 71-72.

takes place here. Alternative forms of written surveys are presented in Figure 3-2.

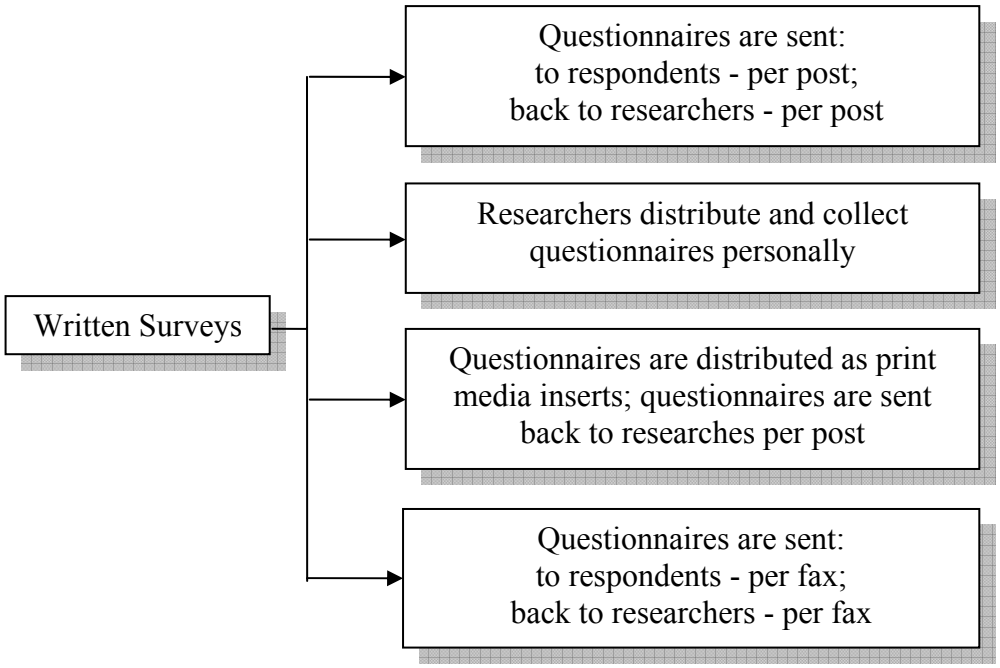


Figure 3-2 Forms of written surveys
Source: Bauer, 2002, p. 186.

2. Verbal surveys

In the case of a verbal survey, direct communication takes place between an interviewer and interviewee. Such surveys can be administered **face-to-face** or **by telephone** (see Figure 3-3). Face-to-face surveys can take place in respondent's home or some location outside it (for instance, street, mall or central-location). Moreover, both face-to-face and telephone surveys can be conducted in the form of a **conventional survey** or **computer assisted survey** (**Computer Assisted Personal Interview (CAPI)** in the case of face-to-face surveys and **Computer Assisted Telephone Interview (CATI)** in the case of telephone surveys). In the former case, an interviewer works (in particular, reads questions and enters answers of an interviewee) with a printed questionnaire, whereas in the latter case – with a questionnaire in an electronic form. Besides, there is one more type of a telephone interview, a relatively new and rarely deployed one: **Completely Automated Telephone Surveys (CATS)**. Here an interviewer is

substituted by an iterative "voice response technology" playing audiotape with questions and recording answers of an interviewee.

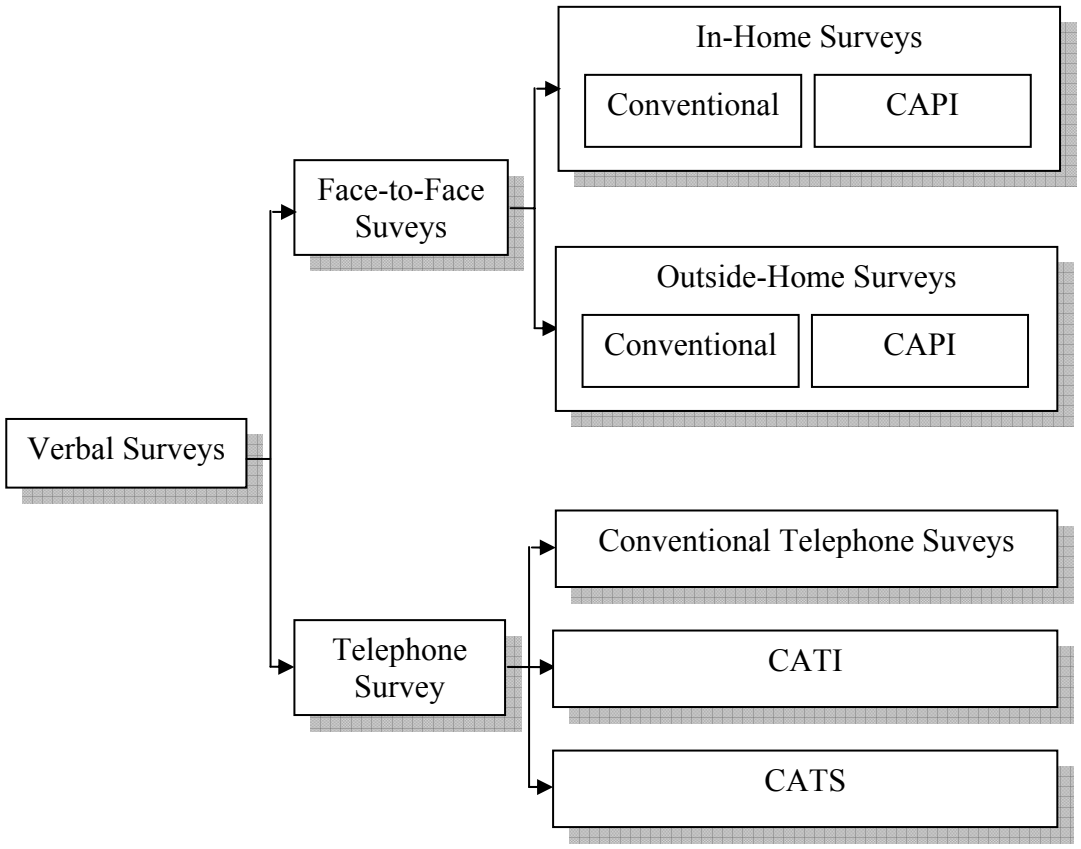


Figure 3-3 Forms of verbal surveys
Source: Bauer, 2002, p. 187.

3. Computer surveys

This type of surveys can also be defined as **Computerized Self-Administered Questionnaire Surveys (CSAQ-Surveys)**, due to the fact that, in this case, a respondent fills in an electronic questionnaire by herself (himself), and there is no personal communication between her (him) and a researcher. Computer surveys can be done either **offline** or **online**. Within the scope of an offline survey, a respondent receives a questionnaire and sends its filled-in version back to a researcher using a floppy disk, CD-ROM, fax-modem or e-mail (a detailed description of corresponding alternatives is presented in Figure 3-4). In this case, a respondent fills in a questionnaire at her (his) computer in the offline mode. If an online survey is conducted, a respondent's computer is

permanently connected to a central computer managing this survey. Possible forms of online surveys can also be found in Figure 3-4.

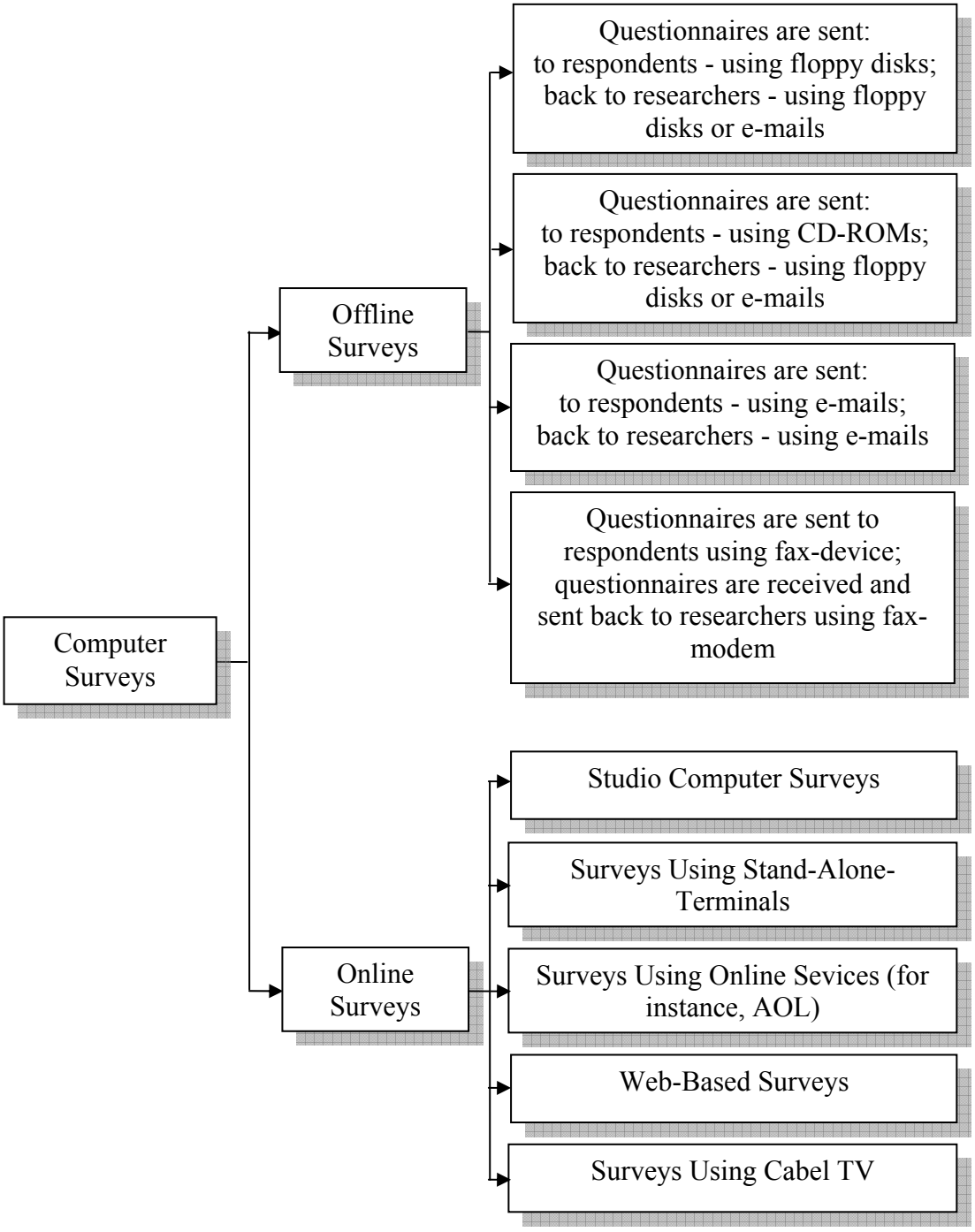


Figure 3-4 Forms of computer surveys
Source: Bauer, 2002, p. 189.

Not-experimental observations take place, when a representative group of observation objects is considered, and certain perceivable issues of investigation, which are not systematically influenced by a researcher, are recorded in an orderly fashion. Such data recordal can be done by a person or technical device.[144] Correspondingly, one distinguishes between two groups of observations: [145]

1. **Personal observations (data are recorded by a person)**
    - **Conventional trade panel observations** present a typical example of personal observations. Here employees of a panel institute periodically (normally, once per two months) contact companies belonging to a trade panel and ascertain sales done in a corresponding intervening period on the base of inventories and purchase documents. Additionally, they register information about prices, product placements and promotions undertaken during this period.
    - **In-store observations** can be considered as a further example of personal observations. With the help of such observations researchers gather information on in-store distribution of products, prices, displays, etc. for big samples of nationally representative retail stores.
2. **Automated observations (data are recorded by a technical device)**
    - This group includes, for instance, **observations of in-home-scanning panels**. Purchases of some particular products done by members of a corresponding household panel and recorded by them at home by means of a **hand scanner** are analyzed in this case.
    - **Observations of TV-viewer panels** are another example of automated observations. Within their scope researchers analyze TV-usage behavior of persons or households, which is recorded with the help of a **set or people meter**[146] – an accessory device attached to a TV-set for registration of TV-usage duration and channel choice of observation objects.

[144] See Bauer, 2002, p. 237.
[145] See ibid. pp. 237-240.
[146] See Hammann/Erichson, 2000, p. 119.

One talks about **experimental surveys and observation**, if issues of investigation are systematically influenced by a researcher. Experimental surveys, observations or combinations of them take place in the form of diverse **test procedures**. For instance, c**oncept tests** and **product tests** can be found among them. Within the scope of a **concept test**, a specific product idea or concept presented in verbal, written or visual form is being assessed by test persons. During a **product test**, a product itself serves as a test object, and its subjective quality is being examined. Concept tests are normally used for identification of promising ideas or concepts for new not yet existing products, whereas product tests normally help to obtain information on market chances and improvement possibilities (in particular, on ways to advance a product design and marketing concept) in the case of finished (ready for selling) products. Correspondingly, concept tests usually precede product tests.[147]

It should be mentioned while concluding this part of the thesis that although secondary data have such advantages over primary data as easier accessibility, relative inexpensiveness, quicker procurement, high reliability attributed to dealing with better samples and better quality control of data collection procedures, and providing with longitudinal data indispensable for dynamic segmentation analysis, most market segmentation studies use primary data. This fact can be explained by such disadvantages of secondary data as a mismatch of measurement units and data classification definitions with those required for the current study, lack of the data timeliness, and limited possibility to assess the data credibility.[148]

3.4 Selecting Basis and Descriptor Variables

3.4.1 Choice of Basis Variables

In order to decide which data should be used for cluster building or, in other words, to define basis variables, the next two criteria should be considered: the study goal and quality of basis variables. Aspects connected with these criteria are discussed below.

[147] See Hammann/Erichson, 2000, pp. 205-206 and Bauer, 2002, pp. 248-250.
[148] See Bauer/Liu, 2006, p. 11.

3.4.1.1 Study Goals

The choice of a particular segmentation base out of the limitless number of existing alternatives should be made in accordance with goals of each particular market segmentation study.[149] Examples of such goals together with bases most appropriate in the case of each of them are listed in Table 3-2.[150]

Goals of A Market Segmentation Study	Segmentation Bases
Providing a general understanding of a market	Benefits sought Needs products will fill Product purchase and usage patterns Brand loyalty and switching patterns
Positioning studies (developing market segmentation strategies)	Product usage Product preference Benefits sought Needs products will fill Product-, user-, and self-perceptions
Studies of new product concepts (and new product introduction)	Reaction to new concepts (intention to buy, preference over current brand, etc.) Benefits sought Product usage patterns Price sensitivity
Studies of pricing decisions	Price sensitivity, by purchase and usage patterns Product, user, and self-images associated with products at different prices Product usage patterns Sensitivity to "deals"

[149] See Struhl, 1992, p. 14.

[150] As far as international market segmentation conducted within the scope of international market segmentation study presented later in this thesis has the form of exclusively consumer-related market segmentation, only consumer characteristics are considered as segmentation criteria from this point on.

Studies of advertising decisions	Benefits sought Needs Psychographics/"life-styles" Product-, user-, and self-perceptions Media usage
Studies of distribution decisions	Store loyalty and patronage Benefits sought in store selection Sensitivity to "deals"

Table 3-2 Correspondence between study goals and segmentation bases
Source: Wind, 1978, p. 320 and Struhl, 1992, pp. 14-15.

3.4.1.2 Quality of Basis Variables

The choice of basis variables also depends on their quality. In order to guarantee effectiveness of international market segmentation, basis variables have to fulfill certain requirements.

First of all, the next six criteria, which are commonly used for assessment of basis variables in the case of national market segmentation,[151] should also be considered in the case of international market segmentation:[152]

- **identifiably**: the possibility to identify distinct segments;
- **substantiality**: the possibility to obtain segments of a substantial size;
- **accessibility**: the possibility to reach obtained segments with promotional and distributional efforts;
- **stability**: the possibility to obtain segments with low temporal dynamic;
- **actionability**: the possibility to obtain segments useful for construction of effective marketing strategies;
- **responsiveness**: the possibility to obtain segments, which respond to a marketing effort uniquely.

Moreover, basis variables used in international market segmentation should exhibit **construct equivalence**, or, in other words, they should present concepts equivalent

[151] See Wedel/Kamakura, 2000, p. 7.
[152] See Steenkamp/Ter Hofstede, 2002, p. 196.

across countries. If this condition is not fulfilled, obtained transnational segments will be biased by cross-national differences in the meaning of these variables.[153]

There are three types of construct equivalence:[154]

1. **Functional equivalence**

   It is often the case that the same (different) objects or behaviors perform different (the same) functions in different countries. For instance, in some countries bicycles are viewed as means of conveyance, whereas in other countries they are predominantly used for recreation purposes. Of course, differences of this type are likely to influence the structure and character of segments, and therefore it is important to examine if basis variables present concepts having the same role or function across countries (i.e., functionally equivalent concepts).

2. **Conceptual equivalence**

   Interpretation or application ways of the same concepts may differ from country to country. In particular, concepts may be strongly culture-bound or simply inexistent in some countries. For instance, in the USA the concept of "a masculine life-style" is associated with frequent reading of "Playboy" or big interest in sport news, whereas in Mexico – with taking part in bullfights prevalently; such concept as "philotimo" ("behaving in the way members of one's in-group expect"[155]) exists only in Greece. To be protected from appearance of corresponding biases while conducting international market segmentation, the ability of basis variables to present concepts existing and having the same interpretation or application in different countries (i.e., conceptually equivalent concepts) should be assessed.

3. **Category equivalence**

   There can be differences in categorization of objects or behaviors across countries too. The same (different) objects or behaviors may

[153] See ibid. p. 198.
[154] See Green/White, 1976, pp. 81-82, Kramer, 1991, pp. 121-125, Meffert/Bolz, 1998, pp. 90-92, Bauer, 2002, pp. 56-58, Steenkamp/Ter Hofstede, 2002, p. 198, and Craig/Douglas, 2005, pp. 188-190.
[155] Craig/Douglas, 2005, p. 190.

belong to different (the same) categories. For instance, in Netherlands milk falls into the category "soft drinks". At the same time, in many other countries it is viewed as an additive for other drinks only. Again, such differences in categorization should be avoided while segmenting international markets. In other words, basis variables should present concepts, which belong to the same category in different countries (i.e., categorically equivalent concepts).

However, fulfillment of the construct equivalence condition alone does not guarantee that the quality of basis variables and thus reliability of corresponding transnational segments is high. The quality of segmentation bases can be affected by the process of input data collection and processing. Correspondingly, the following equivalence conditions have to be fulfilled as well:[156]

1. **Equivalence of research methods**
   - **Methodical equivalence of data collection:** data collection methods, which normally differ from country to country, must lead to equivalent representation of national samples and equivalent internal validity of survey results.
   - **Tactical equivalence of data collection:** partly nation-specific formats and formulations of questions, which help to eliminate or minimize biases typical for corresponding countries (for instance, item non-response, politeness biases, socially desired answers), must be developed.
   - **Stimuli translation equivalence:** translation of verbal and non-verbal stimuli must be meaning-invariant.
   - **Measurement method equivalence:** measurement methods, which are adjusted to a particular culture (culture fair) or independent of any culture (culture free), must be used.
2. **Equivalence of research objects**
   - **Definition equivalence:** empirical definition of research objects must be equivalent.
   - **Choice equivalence:** choice principles, methods, and techniques, which lead to equivalent representation of national samples, must be used.

[156] See Bauer, 2002, pp. 59-63.

3. **Equivalence of research situations**
    - **Temporal equivalence:** national fieldworks must be conducted in such way that the next two types of influencing factors can be controlled:
        - **factors relating to the passage of time:** social factors (for instance, alteration of values), political factors (for instance, legislation amendments), and economic factors (for instance, economic cycle changes);
        - **factors relating to the point in time**: natural factors (for instance, season, weather), political factors (for instance, elections), religious factors (for instance, public holidays), and economic factors (for instance, seasonal impacts).
    - **Interaction equivalence:** during all national data collection processes, influence of an interviewer/researcher and any third party must be controlled in an equivalent way.
4. **Equivalence of research data processing**
    - **Response translation equivalence:** there must be a semantic equivalence between original and translated variants of responses.
    - **Response categorization equivalence:** categorization schemes of responses must be equivalent.

3.4.2 Choice of Descriptor Variables

Descriptor variables are expected not only to make description and interpretation of clusters more precise,[157] but also to "facilitate the development and implementation of strategies aimed at allocating marketing resources to take advantage of heterogeneity in consumer behavior"[158].

Correspondingly, the role of descriptor variables should be played by such variables, which can be linked to both a segmentation base and performance characteristics of marketing instruments. Typical examples of descriptor variables are demographic characteristics, attitudes, and media usage.[159]

[157] See Steinhausen/Langer, 1977, p. 21.
[158] Frank/Massy/Wind, 1972, p. 19.
[159] See Frank/Massy/Wind, 1972, pp. 17-18 and Struhl, 1992, p. 10.

3.5 Conducting Analysis

3.5.1 Data Preparation

Before conducting segmentation analysis itself some preliminary transformation of input data may be required. In this part of the thesis, such ways of data preparation as preliminary data standardization as well as data preprocessing by means of factor analysis are explicitly described.

3.5.1.1 Preliminary Data Standardization

The need for preliminary data standardization normally arises, if input data are measured on rating scales of different length. In such case, input variables are standardized to the zero mean and unit variance.[160]

As far as in the scope of the international market segmentation analyses presented later in the thesis one deals with N input variables presenting N characteristics of J individuals, input data are to be viewed as a data matrix $X = [x_{jn}]$ (j = 1,…, J; n = 1,…, N), where x_{jn} are values of N variables (characteristics) for each of J individuals. Standardization of an input data matrix X according to the way mentioned above can then be described mathematically as follows: [161]

$$z_{jn} = \frac{x_{jn} - \bar{x}_n}{s_n}, \qquad (3\text{-}1)$$

where

x_{jn} is a value of a variable n for an individual j

$\bar{x}_n$ is the mean of a variable n over all individuals

$s_n = \sqrt{\frac{1}{J-1}\sum_{j=1}^{J}(x_{jn} - \bar{x}_n)^2}$ is a standard deviation of a variable n values

z_{jn} is a standardized value of a variable n for an individual j

[160] See Aldenderfer/Blashfield, 1985, p. 20.
[161] See Backhaus/Erichson/Plinke/Weiber, 2003, p. 271.

3.5.1.2 Data Preprocessing Using Factor Analysis

Factor analysis is often used for preprocessing of input data in the case, when presence of high correlation is noticed in them.[162] It enables transformation of input variables into new independent variables (the so-called **factors**), which leads to exclusion of correlations from the data and thus to preventing appearance of overemphasis distortions caused by highly correlated variables while conducting segmentation analysis.[163]

Factor analysis interprets correlation between two variables as a result of existence of a third hypothetical and unobservable magnitude called **factor** behind the variables finding its expression in both of them.[164]

Factors not always contribute to correlation between variables. In particular, there can be **common** and **unique factors**. If variation of a factor causes variation of at least two variables, it is called a **common factor**. If one variable at most varies with a factor, it is called a **unique factor**.[165]

Factor analysis can be used for an **exploratory** or **confirmatory purpose** depending on the objectives of a researcher. **Exploratory factor analysis** is aimed at data reduction and summarization by means of representing a set of observed variables in terms of a smaller number of underlying factors. **Confirmatory factor analysis** is aimed at testing specific hypothesis about the structure of the data.[166] Of course, factor analysis used for preprocessing of input data is of an exploratory type.

Conducting of factor analysis can be subdivided into the following general steps:[167]

- constructing the correlation matrix;
- extracting factors;
- rotating and interpreting factors;
- calculating factor values.

[162] See Aldenderfer/Blashfield, 1985, p. 21.
[163] See Backhaus/Erichson/Plinke/Weiber, 2003, pp. 537-538.
[164] See Überla, 1977, p. 2 and Backhaus/Erichson/Plinke/Weiber, 2003, p. 264.
[165] See Lauwerth, 1980, p. 10.
[166] See Green/Tull/Albaum, 1988, p. 554.
[167] See Hammann/Erichson, 2000, p. 258.

Main aspects of each step are presented below.

3.5.1.2.1 Constructing Correlation Matrix

A correlation matrix showing relationship between input variables (in the case of the international market segmentation study presented later in the thesis – between characteristics of individuals) is a necessary base for factor extraction. A correlation matrix can be obtained from an input data matrix $X = [\,x_{jn}\,]$ (j = 1,…, J; n = 1,…, N), where x_{jn} are values of N variables for each of J individuals. Values x_{jn} have to be measured on a metric scale.[168]

An input data matrix X should be first transformed into a standardized data matrix $Z = [\,z_{jn}\,]$ according to the way described in part 3.5.1.1 of the present thesis because such transformation enables simplifying the standard formula of the Pearson's product-moment correlation coefficient between two variables n and k as follows:[169]

$$r_{nk} = \frac{\sum_{j=1}^{J}(z_{jn} - \bar{z}_n)\cdot(z_{jk} - \bar{z}_k)}{\sqrt{\sum_{j=1}^{J}(z_{jn} - \bar{z}_n)^2 \cdot \sum_{j=1}^{J}(z_{jk} - \bar{z}_k)^2}} = \frac{\sum_{j=1}^{J} z_{jn}\cdot z_{jk}}{J-1}, \qquad (3\text{-}2)$$

where

z_{jn} is a standardized value of a variable n (correspondingly, k) for an individual j

$\bar{z}_n$ is the mean of standardized values of a variable n (correspondingly, k) over all individuals

[168] According to Gorsuch, 1974, pp. 127-128, data measured on the scales with metric (interval or ratio) characteristics is normally required for constructing a Pearson's product-moment correlation coefficient presented below in equation (3-2).

[169] According to Überla, 1977, pp. 50-51, in the standard form $r_{nk} = \frac{s_{nk}}{s_n \cdot s_k}$, where $s_{nk} = \frac{1}{J-1}\sum_{J=1}^{J}(z_{jn}-\bar{z}_n)\cdot(z_{jk}-\bar{z}_k)$ is covariance between variables n and k; under the condition of data standardization, r_{nk} is equal to s_{nk}, or in other words, a correlation matrix is equal to a covariance matrix.

Values of a correlation coefficient range from -1 to +1, where the value of 0 indicates absence of relationship between variables. The closer its values to +1 (-1) are, the stronger positive (negative) relationship between variables is.[170]

A symmetric correlation matrix $R = [\, r_{nk} \,]$ can then be presented in the following way:[171]

$$R = [\, r_{nk} \,] = \frac{1}{J-1} \, Z \cdot Z' , \qquad (3\text{-}3)$$

where

Z' is a transpose of a matrix Z

A correlation matrix is a good indicator of input data appropriateness for factor analysis. A big number of low correlation coefficients casts doubt upon the possibility to combine variables and extract a smaller number of factors, thus upon the reasonability of conducting factor analysis.[172]

If it is difficult to make a conclusion about input data appropriateness for factor analysis on the base of a correlation matrix itself, the following additional criteria can be considered:[173]

- **level of significance of correlations**: shows the error probability of a correlation coefficient being significantly different from zero. Correspondingly, 1 minus the level of significance of a correlation coefficient is equal to the probability that this correlation coefficient is different from zero.
- **inverse correlation matrix**: it is assumed that a correlation matrix is appropriate for factor analysis, if an inverse correlation matrix presents a diagonal matrix, or, in other words, if its non-diagonal elements are close to zero.
- **Bartlett's test**: shows the probability that variables in a data set are correlated and allows to indicate if a correlation matrix is different from a unit matrix – a matrix showing that there is no correlation in the data – only accidentally.

[170] See Überla, 1977, p. 3.
[171] See ibid. p. 51.
[172] See Backhaus/Erichson/Plinke/Weiber, 2003, pp. 272-273.
[173] See ibid. pp. 272-276.

- **anti-image covariance matrix**: image is the part of variance of a variable, which can be explained through other variables by means of multiple regression analysis; anti-image is the part of variance of a variable, which is independent from other variables. A correlation matrix is assumed to be inappropriate for factor analysis, if non-diagonal elements of an anti-image covariance matrix, which are not equal to zero (> 0.09), account for at least 25% of all non-diagonal elements.
- **Kaiser-Meyer-Olkin (KMO) criterion**: presents the measure of sampling adequacy (MSA) calculated on the base of an anti-image correlation matrix. It demonstrates to what degree variables belong together. Values of MSA range between 0 and 1. If MSA $\geq$ 0.8, it is assumed that factor analysis is appropriate.

3.5.1.2.2 Extracting Factors

Among a big number of existing factor-extraction techniques **principal component analysis (PCA)** is considered to be especially efficient one.[174] PCA produces unique, reproducible results.[175] It is a formal method directed at reduction of complex relationships in the data to a more simple form, not at constructing some specific hypotheses.[176] PCA is a major factor-analytic technique used in market research.[177]

The prime characteristic of PCA is that factors, here called "components", are extracted in such way that the first extracted factor accounts for the maximum amount of the total variance in the data, the next extracted factor – for the maximum amount of the rest variance, and so on. Moreover, the extracted factors have to be mutually independent (in geometric representation – orthogonal).[178]

To start with factor extraction one should consider the **basic assumption of factor analysis** that observed variables are linear combinations of several hypothetical factors. Mathematically this assumption can be presented as follows:[179]

[174] See Hammann/Erichson, 2000, p. 261.
[175] See Green/Tull/Albaum, 1988, p. 566.
[176] See Weber, 1974, p. 94.
[177] See Wyss, 1991, p. 563.
[178] See Überla, 1977, p. 99.
[179] See Backhaus/Erichson/Plinke/Weiber, 2003, p. 278.

$$z_{jn} = a_{n1} \cdot p_{j1} + a_{n2} \cdot p_{j2} + \ldots + a_{nq} \cdot p_{jq} + \ldots + a_{nQ} \cdot p_{jQ} \quad (q = 1,\ldots, Q), \tag{3-4}$$

where

a_{nq} is a loading of a factor q by a variable n

p_{jq} is a factor value of a factor q for an individual j

Due to the fact that both variables and factors are standardized and factors are uncorrelated, equation (3-4) can be viewed as an analog of a regression function with factor loadings a_{nq} as regression coefficients equal to simple correlations between a variable and each factor.[180]

A matrix form of the basic assumption presents the **basic equation of factor analysis**:[181]

$$Z = A \cdot P \tag{3-5}$$

This equation serves as a base for mathematical procedures leading to determination of factor values discussed in the thesis later.[182]

Combining equation (3-5) with equation (3-3) leads to the following result:[183]

$$R = \frac{1}{J-1} (A \cdot P)(A \cdot P)' = A \frac{1}{J-1} P \cdot P' \cdot A', \tag{3-6}$$

As far as factor values p_{jq} are standardized, $\frac{1}{J-1} P \cdot P'$ presents a correlation matrix of factors C.[184] In other words, one can rewrite equation (3-6) as follows:[185]

$$R = A \cdot C \cdot A' \tag{3-7}$$

Due to independence of factors in PCA, C = I (a unit matrix). Consequently, one obtains the next equation:[186]

$$R = A \cdot A' \tag{3-8}$$

[180] See Green/Tull/Albaum, 1988, p. 563.
[181] See Überla, 1977, p. 52 and Backhaus/Erichson/Plinke/Weiber, 2003, p. 278.
[182] See Backhaus/Erichson/Plinke/Weiber, 2003, p. 278.
[183] See Überla, 1977, p. 52.
[184] See Überla, 1977, p. 52 and Backhaus/Erichson/Plinke/Weiber, 2003, p. 279.
[185] See Überla, 1977, p. 52 and Backhaus/Erichson/Plinke/Weiber, 2003, p. 279.
[186] See Überla, 1977, p. 52 and Backhaus/Erichson/Plinke/Weiber, 2003, p. 279.

Equations (3-7) and (3-8) present the **fundamental theorem of factor analysis**. They demonstrate the relationship between a correlation matrix R and matrix of factor loadings A. The fundamental theorem points at the possibility to reproduce a correlation matrix from a matrix of factor loadings A and correlation matrix of factors C. Equation (3-8) is true only under condition of model's linearity and independence of factors.[187]

The more factors are extracted, the bigger part of variance in the data can be explained. In PCA, variance of a variable is measured through squared correlations between a variable and factors.[188] In order to prove this, one should consider variance of a variable under condition of data standardization:[189]

$$s_n^2 = 1 = \frac{1}{J-1}\sum_{j=1}^{J} z_{jn}^2 \qquad (3\text{-}9)$$

Putting equation (3-4) into equation (3-9) leads to the next result:

$$s_n^2 = a_{n1}^2 \frac{\sum p_{j1}^2}{J-1} + a_{n2}^2 \frac{\sum p_{j2}^2}{J-1} + \ldots + a_{nQ}^2 \frac{\sum p_{jQ}^2}{J-1} +$$

$$+ 2(a_{n1}\, a_{n2} \frac{\sum p_{j1} p_{j2}}{J-1} + \ldots) \qquad (3\text{-}10)$$

As far as PCA assumes that factors are independent and standardized, $\frac{\sum p_{jq}^2}{J-1} = 1$ and $\frac{\sum p_{j1} p_{j2}}{J-1} = 0$. Correspondingly, equation (3-10) can be transformed into the next one:

$$s_n^2 = a_{n1}^2 + a_{n2}^2 + \ldots + a_{nQ}^2 = 1 \qquad (3\text{-}11)$$

Thus, the sum of all squared factor loadings (squared correlations) of one variable is equal to variance of this variable, correspondingly, to 1.[190]

[187] See Backhaus/Erichson/Plinke/Weiber, 2003, p. 279.
[188] See Gorsuch, 1974, p. 86.
[189] See Überla, 1977, pp. 56-57.
[190] See ibid. p. 57.

As it was already mentioned above, variance of variables can be explained by common and unique factors. The part of variable's variance which can be accounted for by common factors is called **communality** $\mathbf{h_n^2}$.[191]

Picking R common factors out of all Q factors, one can present communality of a variable n mathematically as follows:[192]

$$h_n^2 = a_{n1}^2 + a_{n2}^2 + \ldots + a_{nR}^2 \qquad (3\text{-}12)$$

The part of variable's variance not attributed to common factors is called variable's **uniqueness** $\mathbf{u_n^2}$.[193] Correspondingly, one can modify equation (3-11) as follows:[194]

$$s_n^2 = h_n^2 + u_n^2 = 1 \qquad (3\text{-}13)$$

Uniqueness can be additionally subdivided into variance explained by unique factors b_n^2 indeed and variance caused by measurement errors e_n^2:[195]

$$u_n^2 = b_n^2 + e_n^2 \qquad (3\text{-}14)$$

Such additional subdivision seldom takes place in practice. It is normally assumed that the whole uniqueness corresponds to the sum of squared unique factor loadings.[196]

In order to connect the notion of communality and uniqueness with a correlation matrix, one should modify equation (3-8) in the following way:[197]

$$R = (A + U) \cdot (A + U)', \qquad (3\text{-}15)$$

where

R is a correlation matrix with unities in a diagonal

A is a matrix of common factor loadings

U is a diagonal matrix with unique factor loadings in a diagonal

As far as $U \cdot A' = A \cdot U' = 0$, opening the brackets leads to the next equation:[198]

[191] See Gorsuch, 1974, p. 26.
[192] See Überla, 1977, p. 57.
[193] See Gorsuch, 1974, p. 26.
[194] See Überla, 1977, p. 57.
[195] See ibid. p. 57-58.
[196] See ibid.
[197] See ibid. p. 60.

$$R = A \cdot A' + U \cdot U', \quad (3\text{-}16)$$

where

$A \cdot A' = R_h$ is a reduced correlation matrix with values of communality h_n^2 in a diagonal

$U \cdot U' = U^2$ is a diagonal matrix with values of uniqueness u_n^2 in a diagonal

PCA is aimed at comprehensive reproduction of a data structure through possibly small number of factors. Distinction between communality and uniqueness is not taken into consideration in PCA. There is no causal interpretation of factors here either.[199] In particular, PCA assumes that all variance of a variable can be explained by common factors ("components"), and there is no uniqueness. Thus, values of communality h_n^2 are always considered to be equal to 1, and values of uniqueness u_n^2 are always substituted with zeros. Correspondingly, PCA always extracts factors from a correlation matrix with unities in a diagonal, and, if all feasible factors are extracted, or, in other words, if the number of extracted factors is equal to the number of variables, a reproduced communality value should be equal to 1. It becomes smaller than 1, only if a smaller number of factors than that of variables is extracted, which is normally the case in PCA.[200]

In general, the notion of communality h_n^2 refers to variance of a variable explained by all (extracted) common factors. If one considers the part of variance over all variables explained by one particular factor, one talks about the notion of an **eigenvalue λ_q**.[201]

Correspondingly, it can be shown schematically that an eigenvalue λ_q of each factor is equal to a column sum of squared factor loadings in a matrix of factor loadings A (see Figure 3-5). At the same time, communality h_n^2 of each variable presents a row sum of squared factor loadings in a matrix of factor loadings A. Factor loadings as elements of a column present correlations between a

[198] See ibid.
[199] According to Backhaus/Erichson/Plinke/Weiber, 2003, p. 292, due to this feature PCA is often separated from factor analysis and viewed as an independent procedure. Nevertheless, according to Basilevsky, 1994, p. 351, in established practice of the applied statistical literature, the term "factor analysis" refers to a group of methods used to explore or establish correlational structures between observed random variables, and PCA is included into this group.
[200] See Backhaus/Erichson/Plinke/Weiber, 2003, pp. 291-292.
[201] See ibid. p. 295.

corresponding factor and variables, and as elements of a row – regression coefficients between a corresponding variable and factors.[202]

An eigenvalue shows importance of a corresponding factor. In PCA, due to maximization of the (residual) variance accounted by successive factors, importance of factors decreases with every next factor extracted. The total variance, which is equal to the sum of unit variances of standardized variables and thus to the number of variables, appears to be redistributed between factors in a decreasing manner. Usually, only several first factors accounting for the major part of the total variance are considered to be important for analysis. After their extraction, analysis is considered to be completed, and further factors are not extracted.[203]

Factors / Variables	1	...	q	...	Q	$\sum_q a_{nq}^2$
1	a_{11}	...	a_{1q}	...	a_{1Q}	h_1^2
⋮	⋮		⋮		⋮	⋮
n	a_{n1}	...	a_{nq}	...	a_{nQ}	h_n^2
⋮	⋮		⋮		⋮	⋮
N	a_{N1}	...	a_{Nq}	...	a_{NQ}	h_N^2
$\sum_n a_{nq}^2$	λ_1	...	λ_q	...	λ_Q	

Figure 3-5 Matrix of factor loadings
Source: Hammann/Erichson, 2000, p. 264.

There is no clear rule for determining the number of factors to be extracted. An approach of every researcher is quite individual. Of course, there are several criteria, which may help in solving a number-of-factors question.[204]

[202] See Hammann/Erichson, 2000, pp. 263-264.
[203] See Gorsuch, 1974, p. 130.
[204] See Backhaus/Erichson/Plinke/Weiber, 2003, p. 295.

The criterion most widely used in practice is the **Kaiser criterion**. According to it, only factors with corresponding eigenvalues higher than 1 are to be extracted. In other words, an extracted factor should account for the part of the total variance that is bigger than unit variance of a standardized variable.[205]

Another important criterion is the **scree-test**. Here the scree-plot of eigenvalues of the successively extracted factors has to be examined. Factor extraction has to be stopped at the point, where eigenvalues begin to smooth out forming a strait line with an almost horizontal slope.[206] For instance, according to the scree-test criterion, the last left point on a symbolic strait line at the right part of a graph presented in Figure 3-6 points at a four-factor solution.[207]

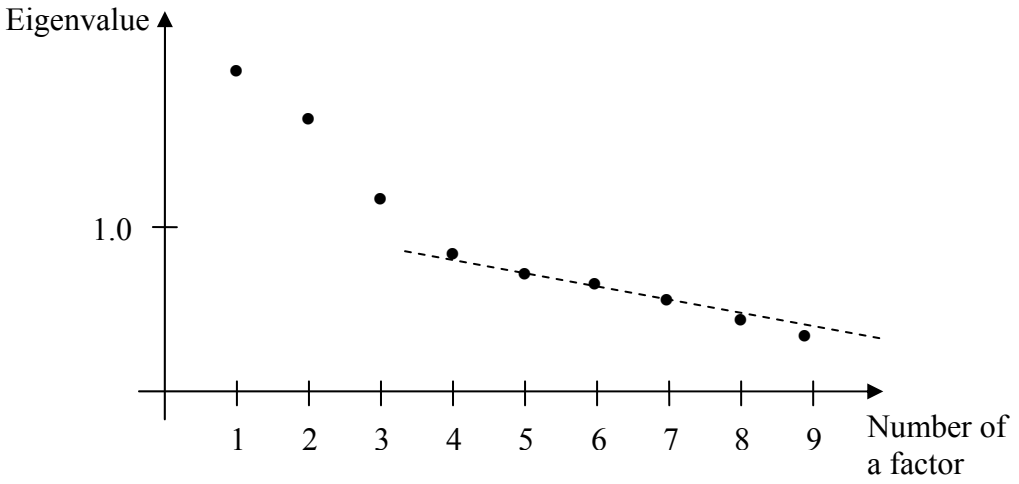


Figure 3-6 Illustration of a scree-test
Source: Überla, 1977, p. 128.

Other criteria proposed in the literature are: extracting factors until x% of the total variance are explained; extracting n (some certain number of) factors; extracting factors until their number is twice smaller than the number of variables, etc.[208]

In order to be protected from accepting dubious results, one may try to combine various criteria and accept the outcome supported by several of them while considering all other outcomes as experimental hypotheses. Of course, the outcome

[205] See ibid.
[206] See Kim/Mueller, 1978, p. 44.
[207] See Überla, 1977, p. 127.
[208] See Backhaus/Erichson/Plinke/Weiber, 2003, p. 314.

chosen according to this so-called **general rule-of-thumb** should be additionally checked on the reasonableness on the base of the current standards in the research field[209].

3.5.1.2.3 Rotating and Interpreting Factors

After factors are extracted, they have to be interpreted and named. In PCA, factor interpretation is aimed at finding a collective term for variables highly loaded on a corresponding factor. In practice, a factor loading is considered to be high, if it is ≥ 0.5. If a variable is highly loaded on several factors, it should be taken into consideration while naming each of them.[210]

It is quite easy to interpret factors, if every variable is highly loaded on only one of them. This is often not the case, when a big amount of fieldworks is conducted, as it is usually done in market research. Here interpretation of factors can become highly complicated, and a factor loading pattern can even remain open for a subjective judgment of a researcher.[211]

In order to improve the interpretation of factors, it is advisable to rotate them beforehand.[212]

The easiest way to explain the notion of **rotation** is to consider a two-factor solution. In such case, factors can be depicted as mutually perpendicular axes of coordinates in a two-dimensional coordinate space. Standardized variables presented as unit vectors in a multidimensional coordinate space of all existing factors can be projected onto this two-dimensional coordinate space in the form of arrows starting at the zero point. The length of each arrow is equal to $\sqrt{a_{n1}^2 + a_{n2}^2}$. In other words, it corresponds to the part of variance of a variable explained by factor 1 and factor 2 (see Figure 3-7).[213] Pulling the axes around the zero point and changing in this way their position with regard to the arrows presenting variables is nothing else but rotation in a factor analytic sense.[214]

[209] See Kim/Mueller, 1978, p. 45.
[210] See Backhaus/Erichson/Plinke/Weiber, 2003, pp. 298-299.
[211] See ibid. p. 299.
[212] See Hammann/Erichson, 2000, p. 265.
[213] See ibid. pp. 264-266.
[214] See Holm, 1976, p. 18.

Factor rotations can be subdivided into two groups – **orthogonal** and **oblique** rotations. **Orthogonal rotations** preserve the right angle between factors or, in other words, their mutual independence. **Oblique rotations** lead to a loss of a mutual perpendicularity between factors.[215]

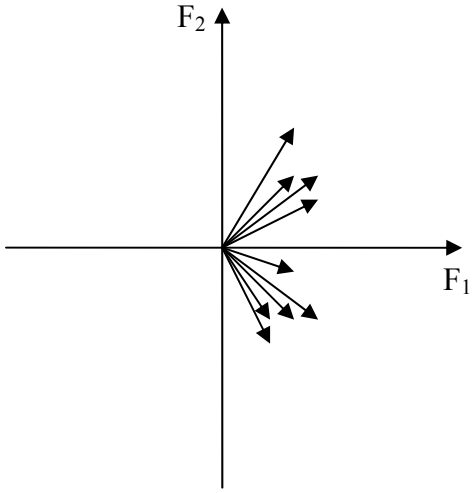


Figure 3-7 Two-dimensional factor space
Source: Backhaus/Erichson/Plinke/Weiber, 2003, p. 299.

In market research applications, PCA is almost always followed by the **Varimax rotation** – a specific type of orthogonal rotations. The reason for this is that such option allows for easier factor interpretation than any other option involving oblique rotation.[216]

The Varimax rotation is aimed at producing some high loadings and some near-to-zero loadings on each of the factors.[217] In other words, by redistributing variance between factors it simplifies columns of the matrix of factor loadings shown in Figure 3-5.[218]

After the Varimax rotation is conducted, the successive factors do not account for the maximum amount of the (residual) variance anymore. At the same time, the

[215] See Green/Tull/Albaum, 1988, pp. 569-570.
[216] See ibid. p. 572.
[217] See ibid. p. 570.
[218] See Hammann/Erichson, 2000, pp. 265-266.

common variance accounted by factors as a group as well as communalities remain unchanged.[219]

3.5.1.2.4 Calculating Factor Values

If the only interest of a researcher lies in transforming variables into a smaller number of independent factors, factor analysis reaches its final point after extracting, rotating and interpreting factors. Nevertheless, there is quite often the need to describe individuals previously characterized through variables by means of extracted, rotated and interpreted factors. In such case, one additional step has to be made: finding factor values for each individual.[220]

A matrix of factor values P can be obtained from the basic equation of factor analysis

$$Z = A \cdot P \tag{3-17}$$

by means of the following transformation

$$P = S \cdot Z, \tag{3-18}$$

where

S is a matrix of factor scores.[221]

The way of transformation from equation (3-17) to equation (3-18) has to be chosen out of the following conditioned alternatives:

a) If all variance of a variable is explained by common factors, and if all factors are extracted, a matrix of factor loadings A appears to be a square matrix and can be inverted.[222] In such case, both sides of equation (3-17) can be multiplied by an inverse matrix A^{-1}:

$$A^{-1} \cdot Z = A^{-1} \cdot A \cdot P \tag{3-19}$$

As far as $A^{-1} \cdot A$ is equal to a unit matrix I and $I \cdot P$ is equal to P, the following transformation result can be obtained:[223]

$$P = A^{-1} \cdot Z \tag{3-20}$$

b) If all variance of a variable is explained by common factors, but not all of them are extracted, a matrix of factor loadings A is not a square matrix

[219] See Green/Tull/Albaum, 1988, p. 570.
[220] See Hammann/Erichson, 2000, p. 267.
[221] See ibid. p. 268.
[222] See Überla, 1977, p. 237.
[223] See Backhaus/Erichson/Plinke/Weiber, 2003, p. 302.

anymore, and it is impossible to invert it.[224] Here both sides of equation (3-17) must be multiplied by a transposed matrix A':

$$A' \cdot Z = A' \cdot A \cdot P \quad (3\text{-}21)$$

A matrix $(A' \cdot A)$ is a square matrix and can be inverted. Thus, it is possible to multiply both sides of equation (3-21) by an inverted matrix $(A' \cdot A)^{-1}$:[225]

$$(A' \cdot A)^{-1} \cdot A' \cdot Z = (A' \cdot A)^{-1} \cdot (A' \cdot A) \cdot P \quad (3\text{-}22)$$

As far as $(A' \cdot A)^{-1} \cdot (A' \cdot A)$ is equal to a unit matrix I, and $I \cdot P$ is equal to P, the next transformation result can be obtained:[226]

$$P = (A' \cdot A)^{-1} \cdot A' \cdot Z \quad (3\text{-}23)$$

c) If variance of a variable can be explained by common factors only partly, a matrix of common and unique factor loadings F= (A|U) = A+U includes a bigger number of factors than that of variables.[227] It is not a square matrix and thus cannot be inverted. A matrix of factor scores S can be found in such case only with the help of multiple regression.[228]

After a matrix of factor scores S is determined, it should be multiplied by a standardized data matrix Z in order to obtain a factor value matrix P. Due to the fact that a matrix of factor scores S is a $(N \times Q)$ matrix, and a matrix Z is a $(J \times N)$ matrix, such multiplication is possible.

3.5.2 Finding Cluster Solution

In this part of the thesis, a-posteriori descriptive segmentation methods are considered. In particular, peculiarities of only those methods, which are used within the scope of international market segmentation study presented later in this thesis – cluster analysis and self-organizing map (a specific type of artificial neural networks), are covered here.

[224] See Überla, 1977, p. 237.
[225] See Backhaus/Erichson/Plinke/Weiber, 2003, p. 303.
[226] See ibid.
[227] According to Überla, 1977, p. 59, a matrix F is a $(N \times R+N)$ matrix, where R is the number of common factors.
[228] See Überla, 1977, pp. 241-246.

3.5.2.1 Cluster Analysis

Cluster analysis is the most commonly used generic term for techniques aimed at data separation into component groups.[229] Cluster analysis helps to solve a complicated task of grouping classification objects (in the case of the international market segmentation study presented later in the thesis – of grouping individuals) on the base of all their characteristics simultaneously.[230]

Any type of cluster building is based on the notion of **homogeneity** or, in other words, on the notion of **homogeneous groups**, which can be expressed through the next two conditions:[231]

1. **Homogeneity within a cluster**: classification objects belonging to one homogeneous group must be similar to each other.
2. **Heterogeneity between clusters**: classification objects belonging to different homogeneous groups must be different from each other.

In general, techniques of cluster analysis are used for achieving the following principal goals:

"a) development of a typology or classification,
b) investigation of useful conceptual schemes for grouping entities,
c) hypothesis generation through data exploration,
d) hypothesis testing, or the attempt to determine if types defined through other procedures are in fact present in a data set"[232].

Development of a classification is considered to be the most frequent use of cluster analysis. Nevertheless, in applied data analysis several goals of cluster analysis are usually combined to form a basis of a study.[233]

Two general problems are addressed in cluster analysis:[234]

1. Choosing a proximity measure.
2. Choosing a grouping method.

[229] According to Everitt, 1974, p. 1, these techniques can also be referred to as techniques of classification, typology, Q-analysis, grouping, clumping, numerical taxonomy, and unsupervised pattern recognition. Such name variety can be explained by importance of the techniques in diverse research fields.
[230] See Hammann/Erichson, 2000, pp. 270-271 and Backhaus/Erichson/Plinke/Weiber, 2003, p. 480.
[231] See Bacher, 1996, p. 2.
[232] Aldenderfer/Blashfield, 1985, p. 9.
[233] See Aldenderfer/Blashfield, 1985, p. 9.
[234] See Green/Tull/Albaum, 1988, p. 579 and Hammann/Erichson, 2000, pp. 271-272.

Various proximity measures and grouping methods including those used in the international market segmentation study presented later in the thesis (the Euclidean distance and the Ward's and K-means methods respectively) are described below.

3.5.2.1.1 Proximity Measures

Before conducting grouping of individuals itself a **similarity** or **distance matrix** must be constructed. It is normally calculated from a raw data matrix $X = [x_{jn}]$ (j = 1,…, J; n = 1,…, N) presenting a set of J individuals characterized by a set of N variables. A similarity (distance) matrix includes similarity values s_{ji} (distance values d_{ji}) between two individuals j and i.[235] Similarity values s_{ji} or distance values d_{ji} are quantified by **pairwise proximity measures.**[236]

Correspondingly, there are two classes of pairwise proximity measures:[237]

1. **Similarity measures** reflecting the similarity between two individuals: the higher the similarity measure is, the more similar the individuals are.
2. **Distance measures** reflecting the dissimilarity between two individuals: the higher the distance measure is, the more different the individuals are.

As far as a similarity (distance) between two individuals is assumed not to be influenced by the order of their comparison, or, in other words, it is assumed that $s_{ji} = s_{ij}$ ($d_{ji} = d_{ij}$), a similarity matrix $S = [s_{ji}]$ (a distance matrix $D = [d_{ji}]$) is a symmetric $J \times J$ matrix (see Figure 3-8).[238]

$$S = \begin{vmatrix} 1 & s_{12} & \dots & s_{1J} \\ s_{21} & 1 & \dots & s_{2J} \\ s_{J1} & s_{J2} & \dots & 1 \end{vmatrix} \qquad D = \begin{vmatrix} 0 & d_{12} & \dots & d_{1J} \\ d_{21} & 0 & \dots & d_{2J} \\ d_{J1} & d_{J2} & \dots & 0 \end{vmatrix}$$

Similarity Matrix Distance Matrix

Figure 3-8 Similarity and distance matrices
Source: Duran/Odell, 1939, pp. 5-6.

[235] See Backhaus/Erichson/Plinke/Weiber, 2003, pp. 482-483.
[236] According to Green/Tull/Albaum, 1988, p. 581, pairwise proximity measures are used by majority of cluster analysis techniques.
[237] See Backhaus/Erichson/Plinke/Weiber, 2003, p. 483.
[238] See Bock, 1974, p. 25.

Values of a similarity measure have to range from 0 to 1, where the value of 0 means complete dissimilarity between the individuals, and the value of 1 – their complete similarity.[239] Correspondingly, diagonal elements of a similarity matrix S are equal to unities.[240]

At the same time, values of a distance measure have to be ≥ 0.[241] The value of a distance measure is equal to 0, if two corresponding individuals are completely similar. The more different the two individuals are, the high the value of a distance between them is.[242] In that effect, diagonal elements of a distance matrix D are equal to zeros.[243]

Existing proximity measures can be subdivided according to a scale type of raw data used. Examples of proximity measures that can be derived from nominal or metric data are presented in Table 3-3. The latter group deserves a closer consideration, due to the fact that the input data used in the international market segmentation study presented later in the thesis are measured on a metric scale.

Type of Raw Data	Proximity Measure
Nominal	Tanimoto-Coefficient
	RR-Coefficient
	M-Coeficient
	Dice-Coeficient
	Kulczynski-Coefficient
Metric	Minkowski Metrics
	Mahalanobis Squared Distance
	Q-Correlation Coefficient

Table 3-3 Examples of proximity measures
Source: Backhaus/Erichson/Plinke/Weiber, 2003, p. 483.

[239] See Backhaus/Erichson/Plinke/Weiber, 2003, p. 487.
[240] See Duran/Odell, 1939, p. 6.
[241] See Bock, 1974, p. 25.
[242] See Deichsel/Trampisch, 1985, p. 12.
[243] See Duran/Odell, 1939, p. 5.

The class of metric distance functions called **Minkowski metrics** or **L-norms** presents proximity measures for metric variables widely used in practical applications.[244] **Minkowski metrics** are defined in a general form as follows:[245]

$$d_{ji} = \left(\sum_{n=1}^{N} \left| x_{jn} - x_{in} \right|^{r} \right)^{\frac{1}{r}} \qquad \text{with } r \geq 1, \qquad (3\text{-}24)$$

where

x_{jn} is a value of a variable (characteristic) n for an individual j (correspondingly, i)

r is the Minkowski constant

If r = 2, one obtains the equation of the classical quadratic distance (**Euclidean distance** or **L_2-norm**); if r = 1, one obtains the equation, which depends on the absolute value of differences between classification objects (**Manhattan distance** or **L_1-norm**); if $r \to +\infty$, one obtains the equation of the maximum absolute difference between classification objects (**dominance metric**).[246]

The **Euclidean distance** is the most often used proximity measure for metric variables. It can be easily explained in a two-dimensional coordinate space structured through variables as axes of coordinates (see Figure 3-9). x_{j1}, x_{j2} and x_{i1}, x_{i2} are projections of points J and I on axis 1 and axis 2. These projections correspond to values of the two variables (characteristics) for individuals j and i. The Euclidean distance is presented by the shortest line between these two points, in other words, by the hypotenuse of the triangle JOI.[247]

According to the Pythagorean Theorem, the square of the hypotenuse is equal to the sum of squares of the sides of the right angle.[248] Correspondingly, the Euclidean distance for a multidimensional coordinate space of N variables can be defined as follows:[249]

[244] See Backhaus/Erichson/Plinke/Weiber, 2003, p. 491.
[245] See Eckes, 1980, p. 45 and Backhaus/Erichson/Plinke/Weiber, 2003, pp. 491-492.
[246] See Eckes, 1980, pp. 45-46, Jambu/Lebeaux, 1983, p. 93, and Backhaus/Erichson/ Plinke/Weiber, 2003, p. 492.
[247] See Matiaske, 1994, p. 3.
[248] See ibid. pp. 3-4.
[249] See Aldenderfer/Blashfield, 1985, p. 25.

$$d_{ji} = \sqrt{\sum_{n=1}^{N} (x_{jn} - x_{in})^2} \tag{3-25}$$

In practice, it is usually preferred to square a value of a distance d_{ji} avoiding in this way the use of a square root. The obtained d_{ji}^2 is called the **squared Euclidean distance**.[250]

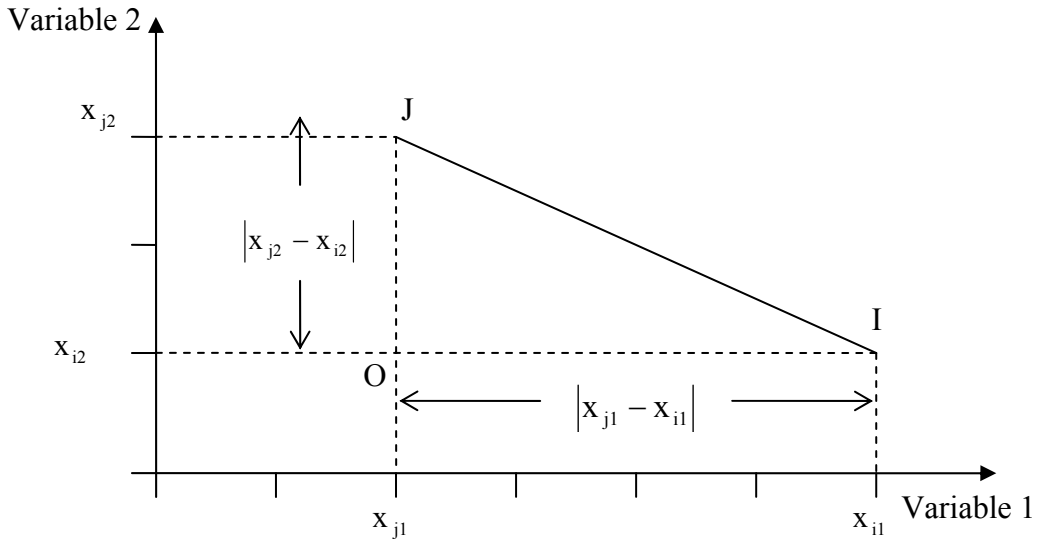


Figure 3-9 Euclidean distance in a two-dimensional space
Source: Matiaske, 1994, p. 4.

The **Manhattan distance** or **city-block metric** is another popular proximity measure for metric variables. It is defined as follows:[251]

$$d_{ji(1)} = \sum_{n=1}^{N} |x_{jn} - x_{in}| \tag{3-26}$$

In the two-dimensional coordinate space presented in Figure 3-9, the Manhattan distance is equal to the sum of the sides of the right angle in the triangle JOI.[252]

The **dominance metric** or **supremum metric** is rather of theoretical importance. It is defined as follows:[253]

[250] See ibid.
[251] See ibid.
[252] See Matiaske, 1994, p. 6.

$$d_{ji(+\infty)} = \max_{n} \left| x_{jn} - x_{in} \right| \qquad (3\text{-}27)$$

In the two-dimensional coordinate space presented in Figure 3-9, the dominance metric is equal to the longest side of the right angle in the triangle JOI (side OI).[254]

In general, it should be mentioned that the level of contribution of distances measured on separate variables to calculation of the Minkowski metrics depends on the size of the Minkowski constant r. With its increase, contribution of big distances increases, whereas contribution of small ones decreases.[255]

Minkowski metrics are not scale-invariant. Therefore, if raw variables are measured on rating scales of different length, one has first to standardize them to unit variances and zero means.[256]

Moreover, neither of measures allows for correlations between variables.[257] Therefore, if highly correlated variables are present in raw data, preliminary factor analysis should be conducted.[258]

One more important proximity measure for metric variables is the **Mahalanobis squared distance** defined as follows:[259]

$$d_{ji(mah)} = (X_j - X_i)' \Sigma^{-1} (X_j - X_i), \qquad (3\text{-}28)$$

where

Σ is a within-groups variance-covariance matrix,

X_j is a vector of values of all variables (characteristics) for an individual j (correspondingly, i)

The advantage of this proximity measure over Minkowski metrics is that it allows for correlation between variables. If all variables are uncorrelated, the Mahalanobis squared distance is equivalent to the Euclidean distance derived from standardized variables.[260]

[253] See Eckes, 1980, p. 46.
[254] See ibid.
[255] See ibid.
[256] See Aldenderfer/Blashfield, 1985, p. 26.
[257] See Everitt, 1974, p. 57 and Aldenderfer/Blashfield, 1985, pp. 25-26.
[258] See Green/Tull/Albaum, 1988, p. 581.
[259] See Gordon, 1981, p. 25 and Aldenderfer/Blashfield, 1985, p. 25.
[260] See Everitt, 1974, p. 57 and Aldenderfer/Blashfield, 1985, pp. 25-26.

Finally, a different type of a proximity measure for metric variables – a similarity measure – is presented by the **Q-correlation coefficient** defined in the next way:[261]

$$r_{ji} = \frac{\sum_{n=1}^{N}(x_{jn} - \bar{x}_j) \cdot (x_{in} - \bar{x}_i)}{\sqrt{\sum_{n=1}^{N}(x_{jn} - \bar{x}_j)^2 \cdot \sum_{n=1}^{N}(x_{in} - \bar{x}_i)^2}}, \qquad (3\text{-}29)$$

where

$\bar{x}_j$ is the mean of the values of all variables (characteristics) for an individual j (correspondingly, i)

In other words, the Q-correlation coefficient measures a similarity between two classification objects j and i under consideration of all their characteristics. It is the Pearson's product-moment correlation coefficient adapted for measurement of correlation between individuals.[262]

As a similarity measure the Q-correlation coefficient possesses completely different features with regard to profiles of individuals (see Figure 3-10) than distance measures. Distance measures consider the distance between the profiles, whereas similarities – the slope of them. The profiles of individual j and i presented in Figure 3-10 are viewed as different, if one uses distance measures. At the same time, they are considered to be absolutely equal, when similarity measures are used.[263]

This important difference between distance and similarity measures points at the necessity to take into consideration the context of analysis while choosing a proximity measure. Distance measures should be used, if the absolute distance between classification objects is of interest, whereas similarity measures are appropriate, when similarities in trend of classification objects' profiles and not differences in their levels must be considered.[264]

[261] See Backhaus/Erichson/Plinke/Weiber, 2003, p. 494.
[262] See Aldenderfer/Blashfield, 1985, p. 22.
[263] See Matiaske, 1994, p. 7.
[264] See Backhaus/Erichson/Plinke/Weiber, 2003, p. 496.

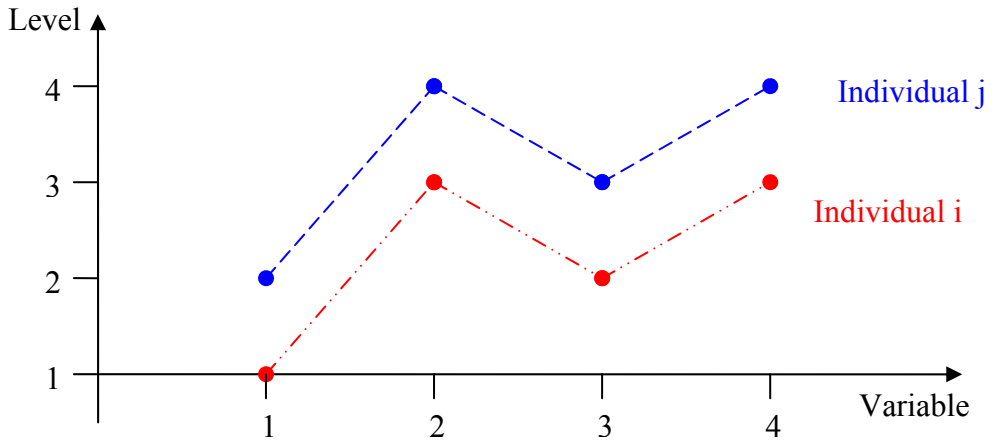


Figure 3-10 Profiles of individuals j and i
Source: Matiaske, 1994, p. 7.

In the case of the international market segmentation study presented later in the thesis, the **Euclidean distances** are chosen as a proximity measure because

- the input data are measured on a metric scale;
- the Euclidean distances are primarily appropriate for grouping methods considered (the Ward's and K-means methods).

3.5.2.1.2 Grouping Methods

A variety of existing grouping methods can be roughly classified into the following types:[265]

- **hierarchical methods**: here already existing groups are classified into new groups, and this process is repeated at successive steps of grouping, in order to form a hierarchy. Hierarchical methods are subdivided into **agglomerative** and **divisive methods**. **Agglomerative methods** start with J groups including one individual each and combine the two most similar individuals. Continuing in this way, all individuals appear to be combined into one group. **Divisive methods** consider all individuals as one group first and then subdivide them into two groups. At the next step, each of these groups is subdivided again. The group subdivision continues till there are J groups with one individual in each of them.[266]

[265] See Everitt, 1974, p. 7.
[266] See Tücke, 1976, p. 21.

- **optimization-partitioning methods**: here groups are formed through optimization of some predefined clustering criteria. The groups do not overlap, thus the partition of individuals is formed.
- **density or mode-seeking methods**: here groups are formed through identification of regions with a relatively high density of individuals. The groups do not overlap here either.
- **clumping methods**: here groups are allowed to overlap.
- **others**: these methods cannot be clearly assigned to any of the mentioned above groups (for instance, Q technique of factor analysis – factor analysis exploring relationship between individuals, not between their characteristics).

In the case of the international market segmentation study presented later in the thesis, the **Ward's** and **K-means grouping methods** are used. A special interest in these two methods is due to their high application frequency and prominence in the area of market segmentation.

3.5.2.1.2.1 Ward's Method

The **Ward's method** belongs to the family of hierarchical agglomerative grouping methods.[267] All hierarchical agglomerative methods start with constructing a $(J \times J)$ similarity or distance matrix including similarities or distances between all $\frac{1}{2}J(J-1)$ possible pairs of individuals.[268] Only distance measures are appropriate for the Ward's method, and the squared Euclidean distances are the primary used ones.[269] Correspondingly, it is allowed for raw data used in the case of the Ward's method neither to be measured on ratings of different length nor to be highly correlated. As it was already mentioned above, if these conditions are not fulfilled, preprocessing of raw data by means of standardization or factor analysis is required.[270]

[267] See Backhaus/Erichson/Plinke/Weiber, 2003, p. 499.
[268] See Lorr, 1983, p. 84.
[269] See Steinhausen/Langer, 1977, p. 81 and Backhaus/Erichson/Plinke/Weiber, 2003, p. 505.
[270] For more details see part 3.5.2.1.1 of the present thesis.

At the first step of clustering, all hierarchical agglomerative methods combine the two least different individuals (groups) into a new group.[271] Therewith, the number of existing groups R = J decreases by 1, and the two rows and two columns presenting combined individuals in the distance matrix have to be substituted with a new row and column presenting a new group. In other words, new distances – the ones between a new group and other individuals (groups) – have to be calculated, in order to construct a corresponding reduced (J-1 × J-1) distance matrix used as a base for the next clustering step. At this point, differences between hierarchical agglomerative grouping methods arise because they define these new distances in different ways.[272] These ways can be summarized by the next general formula:[273]

$$d_{(ji),f} = ad_{jf} + bd_{if} + cd_{ji} + e\,|\,d_{jf} - d_{if}\,|, \qquad (3\text{-}30)$$

where

$d_{(ji),f}$ is a distance between a new group consisting of individuals (groups) j and i and individual (group) f.

d_{jf} is a distance between an individual (group) j and individual (group) f

d_{if} is a distance between an individual (group) i and individual (group) f

d_{ji} is a distance between an individual (group) j and individual (group) i

a, b, c, e are constants changing from method to method

The Ward's method is aimed at the construction of maximally homogeneous clusters in such way that the loss of information at every step of clustering is as small as possible and at the same time quantifiable in a readily interpretable form. The information loss is defined here in the form of the **error sum of squares** (also called the **variance criterion**). The method combines those individuals (groups) at every step of clustering, whose fusion results in the minimum increase in the error sum of squares.[274]

The **error sum of squares** for a group r (r = 1,…, R) is defined as follows:[275]

[271] This holds for all successive clustering steps as well.
[272] See Backhaus/Erichson/Plinke/Weiber, 2003, pp. 503-504.
[273] See Steinhausen/Langer, 1977, p. 76 and Backhaus/Erichson/Plinke/Weiber, 2003, p. 505.
[274] See Bijnen, 1973, p. 41, Steinhausen/Langer, 1977, p. 80, Everitt, 1993, p. 65, and Backhaus/Erichson/Plinke/Weiber, 2003, p. 511.
[275] See Tücke, 1976, p. 23.

$$ESS_r = \sum_{j=1}^{J_r}\sum_{n=1}^{N}(x_{jnr} - \overline{x}_{nr})^2 , \qquad (3\text{-}31)$$

where

x_{jnr} is a value of a variable (characteristic) n (n = 1,…, N) for an individual j (j = 1, …, J) from a group r (r = 1,…, R) including J_r individuals

$\overline{x}_{nr} = \frac{\sum_{j=1}^{J_r} x_{jnr}}{J_r}$ is the mean of values of a variable (characteristic) n (n = 1,…, N) for individuals in a group r (r = 1,…, R)

Before clustering starts, every individual presents an independent group, and the error sum of squares is equal to zero. Each squared Euclidean distance in the distance matrix is equal to a doubled increase in the error sum of squares arising at fusion of a corresponding pair of individuals (groups). Correspondingly, the two individuals (groups) combined at the first clustering step (the ones, whose fusion causes the minimum increase in the error sum of squares) are also the two least different individuals (groups) in terms of the squared Euclidean distances.[276]

Each of the distances between a new group and all other individuals (groups) is calculated by the Ward's method in such way that it is also equal to a doubled increase in the error sum of squares arising at fusion of a corresponding pair of individuals.[277] Here $a = \frac{n_j + n_f}{n_j + n_i + n_f}$, $b = \frac{n_i + n_f}{n_j + n_i + n_f}$, $c = \frac{-n_f}{n_j + n_i + n_f}$ and e = 0, and correspondingly:[278]

$$d_{(ji),f} = \frac{1}{n_j + n_i + n_f}\left[(n_j + n_f)d_{jf} + (n_i + n_f)d_{if} - n_f d_{ji}\right], \qquad (3\text{-}32)$$

where

n_j is the number of individuals in a group j (correspondingly i, f)

In other words, due to such updating of the distance matrix, all distance values in the reduced distance matrix at any following step of clustering are equal to corresponding doubled increases in the error sum of squares, and the clustering

[276] See Backhaus/Erichson/Plinke/Weiber, 2003, pp. 511-512.
[277] See ibid. p. 512.
[278] See Steinhausen/Langer, 1977, pp. 79-80.

process can be continued in an analogous to the first step way. The total error sum of squares existing after completion of each clustering step can also be calculated as the sum of increases in the error sum of squares obtained at each of the fusions of individuals (groups), which have already taken place.[279]

Successive fusions of individuals (groups) conducted according to the Ward's method can be portrayed in the form of a tree diagram called **dendrogram** (see Figure 3-11). All J-1 successive clustering steps (in the form of branches of a tree diagram) together with total error sums of squares obtained after combining individuals (groups) at each corresponding step are depicted here. At the lowest level of a dendrogram each individual presents an independent group, whereas at its highest level all individuals (groups) are combined into one large group.[280]

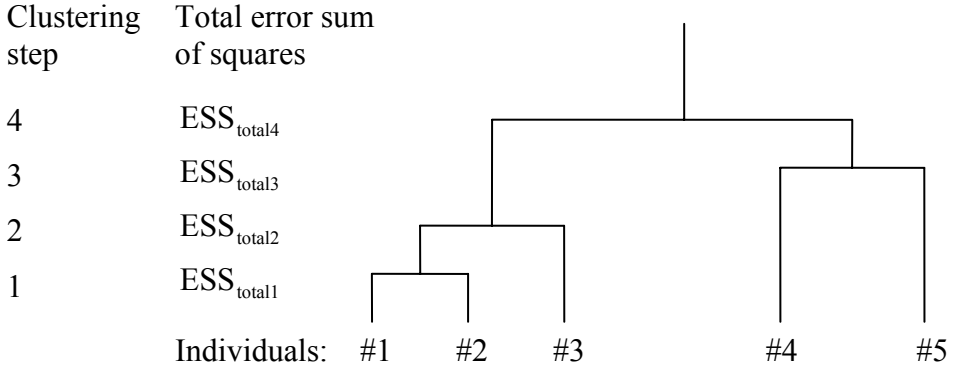


Figure 3-11 Example of a dendrogram (the Ward's method)
Source: Backhaus/Erichson./Plinke/Weiber, 2003, p. 515.

In the case of hierarchical clustering, one has to select the appropriate partition of individuals (groups) (in other words, the appropriate number of clusters) out of alternatives presented through the sequence of fusions and stop combining individuals (groups) at a corresponding clustering step.[281]

One commonly used approach helping to determine the appropriate number of clusters is based on the so-called **scree-diagram** (see Figure 3-12). The abscissa of the scree-diagram presents quantities of clusters at successive clustering steps

[279] See Backhaus/Erichson/Plinke/Weiber, 2003, pp. 513-515.
[280] See Everitt, 1974, p. 8, Eckes, 1980, p. 76, Aldenderfer/Blashfield, 1985, p. 36, and Backhaus/Erichson/Plinke/Weiber, 2003, p. 515.
[281] See Everitt, 2001, p. 138.

(reading from right to left), and the ordinate presents the total error sum of squares obtained after combining individuals at each corresponding clustering step. According to the so-called **elbow criterion**, combining clusters should be stopped, when the (first) clear knick appears in the graph. This knick signals about a relatively significant increase in the error sum of squares at the following clustering step meaning that two relatively dissimilar individuals (groups) are combined at that step.[282]

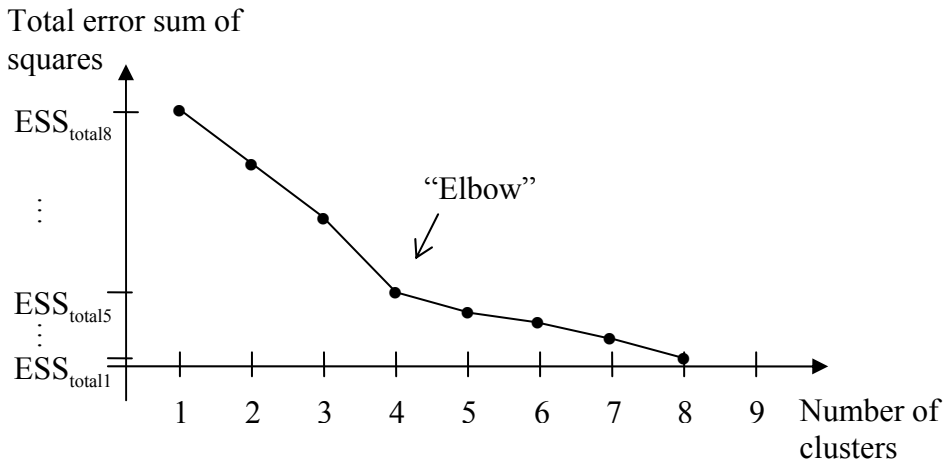


Figure 3-12 Scree-diagram and elbow-criterion (the Ward's method)
Source: Backhaus/Erichson/Plinke/Weiber, 2003, p. 524.

Other popular procedures helping to make a decision about the number of clusters in a cluster solution include "cutting" the dendrogram by subjective visual inspection of its different levels or examining values of the error sum of squares at different fusion steps, in order to discover a relatively significant "jump" in them pointing at the appropriate number of clusters.[283]

Generally speaking, most procedures for determining the number of clusters in a cluster solution are heuristic, and their results should be supported by an appropriate validation procedure.[284] In fact, the final decision about the number of clusters is often determined by subjective judgments of a researcher based on the

[282] See Aldenderfer/Blashfield, 1985, pp. 54-56, Bacher, 1996, p. 247, and Backhaus/Erichson/Plinke/Weiber, 2003, pp. 522-524.
[283] See Aldenderfer/Blashfield, 1985, p. 54-57.
[284] See ibid. p. 58.

knowledge or hypothesis about the data structure or, pragmatically, by interpretation ease.[285]

3.5.2.1.2.2 K-means Method

The **K-means method** is a specific type of optimization-partitioning grouping methods. The central idea of most optimization-partitioning grouping methods lies in improving some specified initial partition of individuals by means of moving individuals between groups. In different optimization-partitioning methods, the notion of **improved partition** is defined in different way.[286] The K-means method attempts to improve the initial partition so that the **within-groups sum of squares**, which can also be interpreted as the total error sum of squares, is minimized.[287]

The **within-groups sum of squares** is defined here as follows:[288]

$$SS_w = \sum_{k=1}^{K} \sum_{j=1}^{J_k} \sum_{n=1}^{N} (x_{jnk} - \overline{x}_{nk})^2 , \qquad (3\text{-}33)$$

where

x_{jnk} is a value of a variable (characteristic) n (n = 1,…, N) for an individual j (j = 1,…, J) from a cluster k (k = 1,…, K) including J_k individuals

$\overline{x}_{nk} = \frac{\sum_{j=1}^{J_k} x_{jnk}}{J_k}$ is the centroid of a cluster k (k = 1,…, K) for a variable n (in other words, it is the mean of values of a variable n in a cluster k)

Due to the fact that $\sum_{n=1}^{N} (x_{jnk} - \overline{x}_{nk})^2$ is equal to the squared Euclidean distance between an individual j (j = 1,…, J) from a cluster k (k = 1,…, K) and centroid of a cluster k in a multidimensional space of N variables, the within-groups sum of squares can be expressed in the next equivalent form:[289]

$$SS_w = \sum_{k=1}^{K} \sum_{j=1}^{J_k} d_{jk}^2 , \qquad (3\text{-}34)$$

[285] See Steinhausen/Langer, 1977, p. 171.
[286] See Anderberg, 1973, p. 158 and Steinhausen/Langer, 1977, p. 100.
[287] See Bacher, 1996, pp. 308-309.
[288] See ibid. p. 308.
[289] See ibid. p. 309.

where

d_{jk}^2 is the squared Euclidean distance between an individual j (j = 1,…, J) from a cluster k (k = 1,…, K) and centroid of a cluster k in a multidimensional space of N variables

The K-means method does not require calculation and storage of a $(J \times J)$ similarity or distance matrix including similarities or distances between $\frac{1}{2}J(J-1)$ possible pairs of individuals. It works with raw data directly.[290] This feature may appear to be quite advantageous while analyzing large data sets.

In the case of the K-means method, clusters are constructed according to the following **optimization-partitioning algorithm**:[291]

a) find initial cluster centroids of predetermined by a researcher number K;
b) allocate each individual to the cluster centroid closest in terms of the squared Euclidean distances and minimize in this way the within-groups sum of squares;[292]
c) after all individuals are assigned to the clusters, compute new cluster centroids;
d) repeat steps b) and c) until no change in cluster membership of individuals occurs.

In practice, there is a great variety of different approaches to identifying initial cluster centroids. For instance, they can be found by means of some other grouping method or assigned at random.[293] Within the scope of the international market segmentation study presented later in the thesis, **initial cluster centroids** are acquired as follows:[294]

- first K individuals are regarded as provisional cluster centroids;

[290] See Aldenderfer/Blashfield, 1985, p. 46.
[291] See Bacher, 1996, pp. 309-310.
[292] It should be mentioned that the SPSS software (version 11) used within the scope of the international market segmentation analyses presented later in the thesis allocates individuals to the cluster centroid closest not in terms of the squared Euclidean distances, but in terms of the Euclidean distances. This, however, does not change the rationale of the algorithm because distances between individuals are non-negative numbers.
[293] See Everitt, 1993, p. 94.
[294] According to Brosius, 2002, pp. 670-671, such procedure is designated in the SPSS software (version 11).

- each of the remaining J - K individuals is examined on her ability to present a better cluster centroid and is substituted with the closest to her already existing provisional centroid, if one of the following conditions is met:
    - the Euclidean distance between a new individual and the closest to her provisional cluster centroid is bigger than the Euclidean distance between the two closest provisional centroids,
    - the Euclidean distance between a new individual and the closest to her provisional cluster centroid is bigger than the Euclidean distance between this provisional cluster centroid and the closest to it provisional cluster centroid;
- the cluster centroids originated after one-time examining of all J - K individuals are considered to be the initial cluster centroids.

In other words, one deals in this case with the Euclidean distances between individuals. Correspondingly, if scales of raw data are different, or if raw data are highly correlated, their preprocessing by means of standardization or factor analysis is required.[295]

It should be mentioned that the optimization-partitioning algorithm described above does not necessary lead to the global minimum of the within-groups sum of squares (the so-called **global optimum**). The global optimum would be found, if one formed all possible partitions of individuals and compared them. However, this task is computationally not feasible already for a moderate amount of data because the number of possible partitions becomes astronomical. The algorithm described above belongs to the procedures, which were developed to approximate the global optimum while sampling only a small part of all possible partitions.[296]

In order to ensure a good approximation to the global optimum, it is advisable to start the procedure using different initial partitions and compare obtained values of the within-groups sum of squares.[297]

As it was already mentioned above, the number of clusters K is determined by a researcher. In order to estimate this number, a researcher has to run the

[295] For more details see part 3.5.2.1.1 of the present thesis.
[296] See Eckes, 1980, p. 57, Lorr, 1983, p. 69, Aldenderfer/Blashfield, 1985, p. 46, Struhl, 1992, p. 41, and Everitt, 2001, p. 143.
[297] See Steinhausen/Langer, 1977, p. 101.

optimization-partitioning algorithm several times for some interval of K values. Then, the following criteria can be used to make a decision about the correct number of clusters:[298]

- plotting values of the within-groups sum of squares against corresponding quantities of clusters at each of the successive runs of the optimization-partitioning algorithm[299] and searching for sharp decreases in values of the within-groups sum of squares, which indicate correct quantities of clusters;
- assessing meaningfulness of cluster interpretation in the case of each particular number of clusters.

3.5.2.2 Self-Organizing Map

The **self-organizing map (SOM)** presents a relatively new approach to discovering market segments.[300] SOM is a specific type of **artificial neural networks (ANN)**, which were originally developed to provide researchers with both more powerful tools for accomplishment of certain optimization tasks and abstract models of parts of a brain for better understanding of its functioning.[301]

SOM was introduced in 1982 by the Finnish scientist Teuvo Kohonen.[302] It simulates the **self-organization** of a brain – the process enabling creation of the projection of external sensory signals (input signals) onto the brain's cortex in such way that topological relations between these signals are preserved.[303]

One can regard SOM as a nonlinear transformation of a high-dimensional input space into a low-dimensional (normally, two-dimensional) output space.[304] In general, SOM is comparable to PCA: both procedures are used for reduction of data dimensionality. The difference between them is that PCA transforms data in a linear way. Correspondingly, the low-dimensional data space created by SOM

[298] See Kaufman/Rousseeuw, 1990, p. 38 and Everitt, 1993, p. 100.
[299] At each successive run of the optimization-partitioning algorithm, the number of clusters K is increased by one.
[300] See Curry/Davies/Evans//Moutinho/Phillips, 2003, p. 191.
[301] See Jockusch, 1995, p. 6.
[302] See Quittek, 1997, p. 31.
[303] See Speckmann, 1995, p. 4 and Sadeghi, 1996, p. 1.
[304] See Rushmeier/Lawrence/Almasi, 1997, p. 2.

presents a more precise approximation of the original data space than the one created by PCA.[305]

The output space (map) originated by SOM is **topology-preserving**. This means that, on the one hand, topological relations between input signals cannot be completely reproduced in the output space (map) because the dimensionality of the input space is normally higher than the dimensionality of the output space (map), and, correspondingly, the loss of information is unavoidable, but, on the other hand, the output space (map) is ought to describe topological relations between input signals in the most precise way possible. In other words, a topology-preserving output space (map) is an approximation of a topological output space (map). It should include essential features of topological relations in input data and have as few irregularities as possible. Such topology-preserving output space (map) can be quite useful in identifying and visualizing clusters of similar input signals.[306]

In this part of the thesis the biological origin of SOM, SOM as a theoretical model as well as the ways of visualization and assessment of results of the SOM learning process are described.

3.5.2.2.1 Biological Origin

Development of ANN was primarily inspired by attempts to model processes taking place in brains of living beings (i.e., in biological neural networks).[307] Biological neural networks consist of a multitude of nerve cells called **neurons**. A human brain, for instance, is composed of more than 10^{11} highly interconnected neurons. They transmit and process sensory signals coming from an external environment.[308] Although a processing speed of a neuron is very low in comparison to that of a transistor, biological neural networks are considerably more efficient than modern microelectronic systems due to their highly parallel data processing structure.[309]

A neuron consists of three general parts: **dendrites**, **cell body**, and **axon** (see Figure 3-13). Through **dendrites** (i.e., fine structures of cell appendices) a neuron

[305] See Eimert, 1997, p. 18.
[306] See Retzko, 1996, p. 30 and Rushmeier/Lawrence/Almasi, 1997, p. 2.
[307] See Pytlik, 1995, p. 145, Kropp, 1999, p. 12, and Schwanenberg, 2001, p. 9.
[308] See Heikkonen, 1994, p. 38 and Backhaus/Erichson/Plinke/Weiber, 2003, p. 738.
[309] See Kropp, 1999, pp. 11-12 and Porrmann, 2002, p. 1.

receives excitatory and inhibitory signals from other neurons. The signals are summed and then transmitted to a **cell body**. If the excitation of a cell nucleus caused by the total input value of all incoming signals exceeds some certain threshold, a cell body sends out a short electrical impulse through an **axon** (i.e., a nerve fiber). An axon brings the impulse to **synapses** (i.e., links between the axon and dendrites of subsequent neurons). Every synapse produces biological messengers called **neurotransmitters**, which enable transmission of the impulse from one neuron to another. There are two general types of synapses: **excitatory** and **inhibitory**. The former type forces the impulse to increase (to a greater or lesser extent) the total input value of all signals coming into the subsequent neuron, whereas the latter one – to reduce it. Synapses are plastic and can change themselves. By adapting synapses and thereby changing the influence of one neuron on another a brain learns.[310]

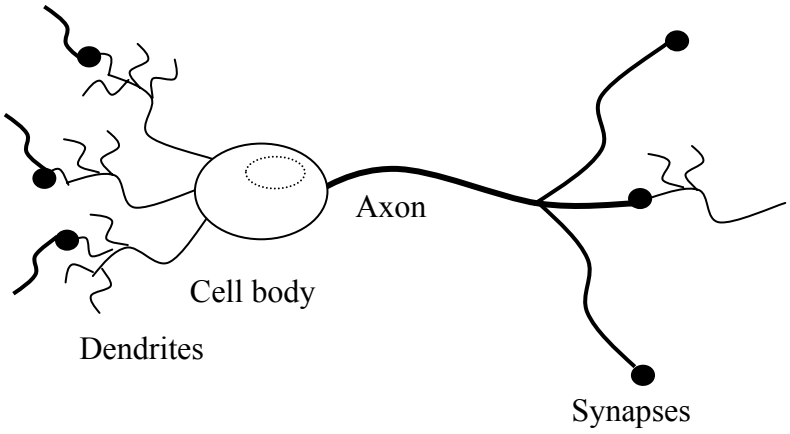


Figure 3-13 Components of a biological nerve cell (neuron)
Source: Backhaus/Erichson/Plinke/Weiber, 2003, p. 739.

An artificial neuron is an abstracted model of a biological neuron (see Figure 3-14).[311] All components and biological processes are represented in this model through mathematical equivalents and arithmetic operations:[312]

- mathematical data (input, output values) correspond to signals in a brain;
- synapses are modeled by means of modifiable weights;

[310] See Ritter, 1988, p. 6, Quittek, 1997, p. 32, Seiffert, 1998, p. 13, Kropp, 1999, p. 12, and Backhaus/Erichson/Plinke/Weiber, 2003, pp. 738-739.
[311] See Kropp, 1999, p. 13.
[312] See Backhaus/Erichson/Plinke/Weiber, 2003, pp. 740-747.

- the total input value of incoming signals is calculated according to the so-called **propagation function**;
- the so-called **activation function** determines whether a neuron is activated.

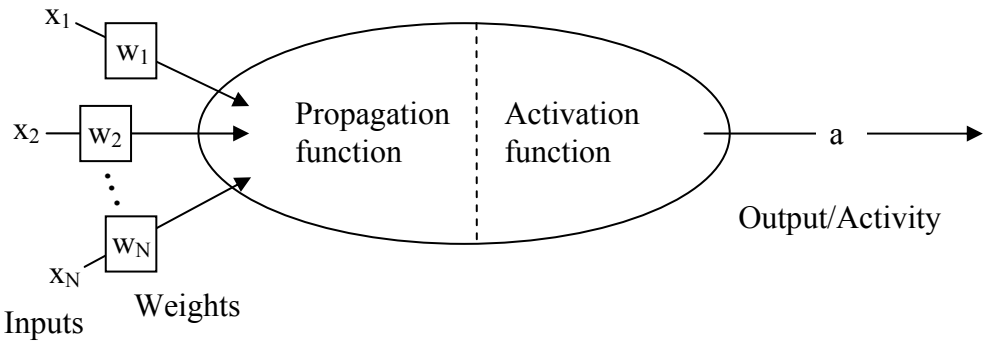


Figure 3-14 Schematic illustration of an artificial neuron
Source: Fanghänel, 2001, p. 28.

In a brain all neurons are arranged in layers, and signals flow between these layers. Additionally, in more than 90% of a cerebral cortex excitatory and inhibitory interactions can be found also between neighboring neurons inside one and the same layer. The type of such interactions (excitatory or inhibitory) is defined by a function of distance between these neurons.[313] According to anatomical and physiological evidence, this function takes a form of the **"Mexican-hat function"** in a human brain (see Figure 3-15).[314]

It was noticed that similar input signals cause activation of neighboring regions of neurons in many areas of a brain.[315] In other words, a brain generates representations of external conditions preserving their neighborhood structure.[316] Such representations can be found, for instance, in "visual, auditive, and somatosensory fields as well as in the motor-cortex"[317].

[313] See Elsen, 2000, p. 45.
[314] See Kohonen, 1989, p. 122.
[315] See Retzko, 1996, p. 24.
[316] See Polani, 1996, p. 14.
[317] Lampinen, 1992, p. 23.

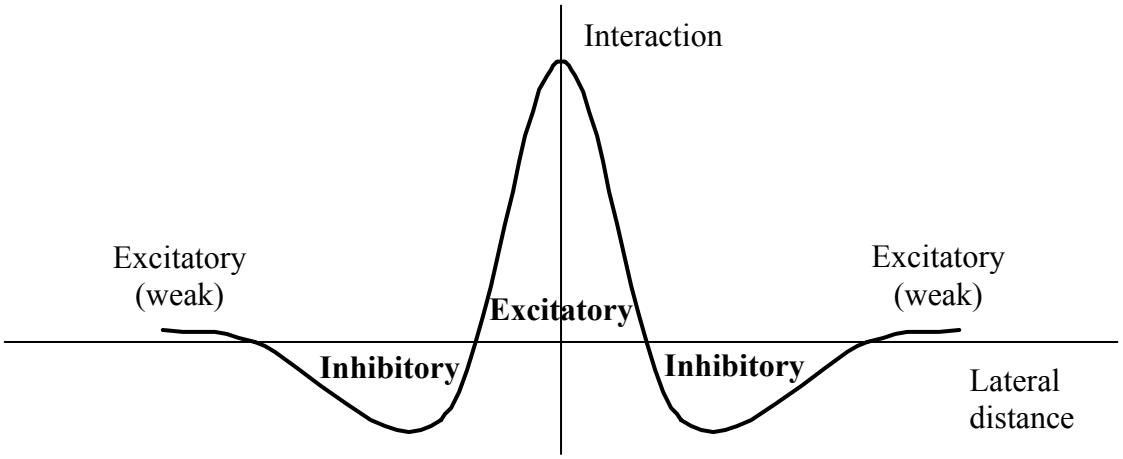


Figure 3-15 "Mexican-hat function" of a lateral interaction
Source: Kohonen, 1989, p. 123.

The feature of a human brain described above is only partly determined genetically. To a bigger part it is set up through the **self-organization of neurons**.[318] The **self-organization of neurons** is the process of adaptation of synapses under the influence of excitatory and inhibitory lateral interactions between neurons that leads to creation of a pattern of activated neurons describing topological relations of input signals.[319]

SOM presents a powerful computational algorithm, which abstracts from many biological details, but, despite its simplicity, enables a good simulation of essential aspects of the self-organization.[320]

3.5.2.2.2 Theoretical Model

SOM belongs to **feedback ANN**, which should be distinguished from **feedforward ANN**. In **feedforward ANN**, data information flows only in one direction. In other words, a layer of neurons can influence only subsequent layers of neurons. On the contrary, in **feedback ANN**, data information can flow in any direction. Here a layer of neurons can influence the preceding layer of neurons, or

[318] See Kohonen, 1989, p. 119 and Hassoun, 1995, p. 113.
[319] See Kohonen, 1989, p. 119 and Elsen, 2000, p. 45.
[320] See Obermayer, 1993, p. 38, Heikkonen, 1994, p. 48, and Polani, 1996, p. 14.

there can be connections between neurons inside one and the same layer.[321] Examples of feedforward and feedback ANN are demonstrated in Figure 3-16.

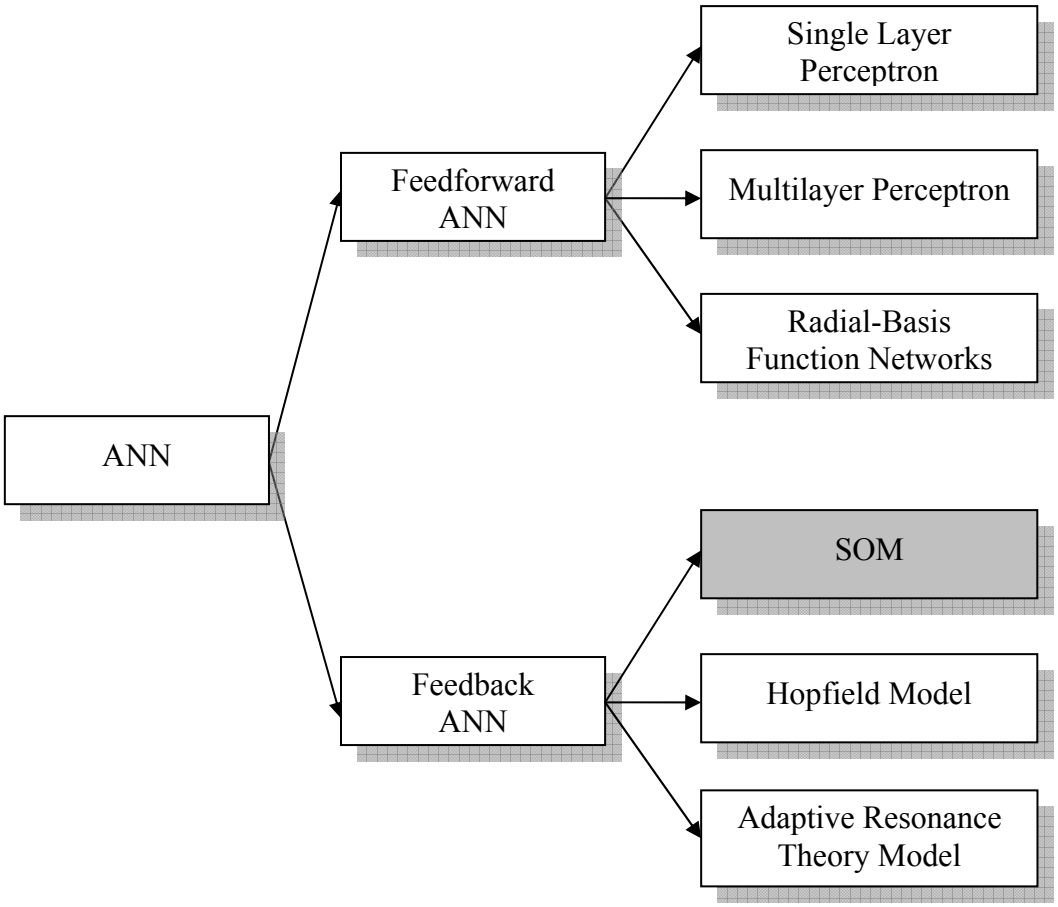


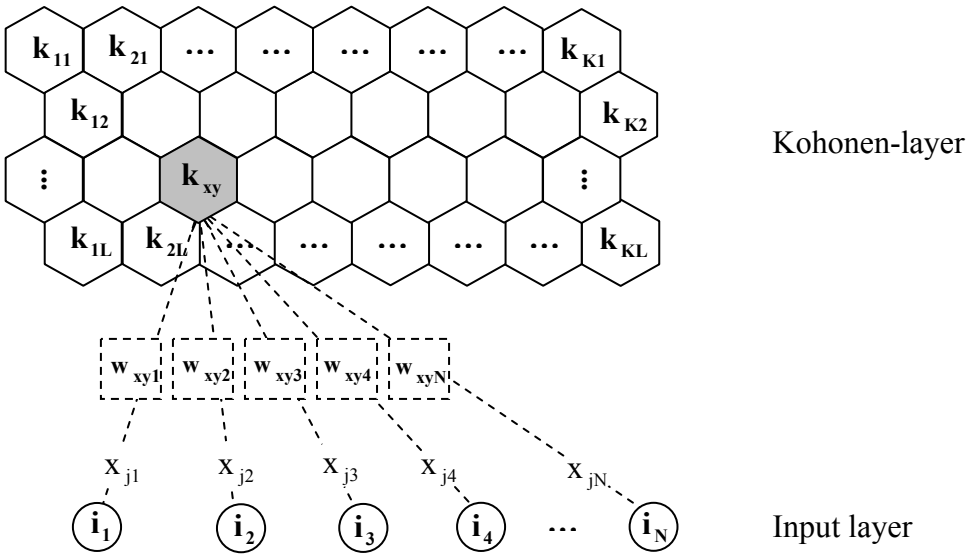
Figure 3-16 Feedforward and feedback ANN
Source: Fanghänel, 2001, p. 24.

SOM consists of two layers of neurons: the **input layer** and **Kohonen-layer** (see Figure 3-17).[322]

The task of neurons of the **input layer** consists of introducing input data into the network and transferring them unchanged to the Kohonen-layer.[323] Input data can be again thought of as a data matrix $X = [x_{jn}]$ $(j = 1,\ldots, J, n = 1,\ldots, N)$, where x_{jn} are values of N variables (characteristics) for each of J individuals. Each input neuron i_n $(n = 1,\ldots, N)$ corresponds to a particular input variable. In other words,

[321] See Scherer, 1997, pp. 54-55, Fanghänel, 2001, p. 24, and Backhaus/Erichson/Plinke/Weiber, 2003, p. 741.
[322] See Schweizer, 1995, p. 83 and Retzko, 1996, p. 25.
[323] See Schweizer, 1995, p. 83.

input data are introduced into the network in the form of input vectors $X_j = (x_{j1}, x_{j2}, \ldots, x_{jN})$ each presenting values of N variables (characteristics) for a corresponding individual j (j = 1,…, J).[324]



where
i_n *is an input neuron n (n = 1…N);*
k_{xy} *is a Kohonen-Neuron with a location vector* L_{xy} *= (x,y) (x = 1…K, y = 1…L);*
x_{jn} *is a value of a variable (characteristic) n (n = 1,…, N) in the case of an input vector* X_j *(j = 1,…, J)*
w_{xyn} *is a modifiable weight indicating strength of a link between an input neuron* i_n *and Kohonen-neuron* k_{xy}

Figure 3-17 Schematic illustration of SOM

Neurons of the **Kohonen-layer** process the data and display a pattern of activated neurons. The Kohonen-layer is normally presented through a two-dimensional lattice of neurons because it provides with a good compromise between a computational effort and graphical presentability.[325] Such arrangement of Kohonen-neurons can be of a hexagonal, rectangular or even irregular type. A

[324] See Obermayer, 1992, p. 40 and Curry/Davies/Evans//Moutinho/Phillips, 2003, p. 193.
[325] See Fanghänel, 2001, p. 30.

hexagonal arrangement type is considered to be especially effective for visual presentation.[326]

Kohonen-neurons are entirely interconnected.[327] A vector $L_{xy} = (x, y)$ presents a location vector of each Kohonen-neuron k_{xy} in a two-dimensional space A^2 of the Kohonen-layer defined as follows:[328]

$$A^2 = \{(x, y) | (x, y) \in N \times N \wedge 1 \leq x \leq K \wedge 1 \leq y \leq L\}.$$

Each Kohonen-neuron k_{xy} is also connected to each input neuron i_n.[329] Strength of every corresponding link is indicated through a modifiable weight w_{xyn}. Generally speaking, a weight vector $W_{xy} = (w_{xy1}, w_{xy2}, \ldots, w_{xyN})$ is assigned to every Kohonen-neuron k_{xy}, and the number of elements in each weight vector W_{xy} is equal to the number of elements in each input vector X_j. As it was already mentioned above, a weight w_{xyn} corresponds to a synapse of a biological neuron, whereas a positive weight stands for an excitatory synapse, and a negative weight – for an inhibitory one. All weights w_{xyn} are normally initialized randomly and then subjected to subsequent adaptations.[330]

With introduction of an input vector X_j into a network, all Kohonen-neuron k_{xy} receive the same **input signal** $\mathbf{I_{xy}}$.[331] It consists of an **external input** $\mathbf{I^e_{xy}}$ and **lateral feedback** $\mathbf{I^f_{xy}}$:[332]

$$I_{xy} = I^e_{xy} + I^f_{xy} \tag{3-35}$$

In other words, equation (3-35) presents the **propagation function** in the case of SOM.

An **external input** $\mathbf{I^e_{xy}}$ is defined as follows:[333]

[326] See Kohonen, 2001, p. 110.
[327] See Martinetz, 1992, p. 19 and Retzko, 1996, p. 25.
[328] See Tryba, 1992, p. 25.
[329] See Bieler, 1994, p. 37.
[330] See Ritter, 1988, p. 16 and Seiffert, 1998, p. 30.
[331] See ibid. p. 31.
[332] See Kohonen, 2001, p. 180.

$$I_{xy}^{e} = \sum_{n} w_{xyn} x_{jn} , \qquad (3\text{-}36)$$

where

w_{xyn} is a modifiable weight indicating strength of a link between an input neuron i_n and Kohonen-neuron k_{xy}

x_{jn} is a value of a variable n in the case of an input vector X_j

$\sum_{n} w_{xyn} x_{jn}$ is a scalar product of an input vector X_j and weight vector W_{xy} associated with a Kohonen-neuron k_{xy}.

A **lateral feedback** $\mathbf{I_{xy}^{f}}$ is defined as follows:[334]

$$I_{xy}^{f} = \sum_{k_{x'y'} \in A_{xy}} g_{xyx'y'} E_{x'y'} \quad k_{xy} \in A^2 , \; A_{xy} \subseteq A^2 , \qquad (3\text{-}37)$$

where

$g_{xyx'y'}$ is a function showing strength of a lateral interaction between two Kohonen-neurons k_{xy} and $k_{x'y'}$. It corresponds to the "Mexican-hat function" of a lateral interaction already mentioned above with its maximum at a Kohonen-neuron k_{xy}.

$E_{x'y'}$ is an excitation of a Kohonen-neuron $k_{x'y'}$

A_{xy} is a local interaction neighborhood of a neuron k_{xy}

To become a topology-preserving map, the network presented above has first to learn. **Learning in ANN** lies in adaptation of strengths of links between neurons (in other words, weights). There are two types of learning in ANN: **supervised** and **unsupervised**. During **supervised learning**, an output pattern of activated neurons produced by a network is compared to some desired output pattern. Here deviations between the two patterns are calculated, and weights are adapted so that the real output pattern approximates the desired one. In contrast, during **unsupervised learning**, no desired output is presented to a network. Here an adaptation of weights must lead to constructing a consistent output pattern of activated neurons on the base of a multitude of input vectors. In this case, a

[333] See ibid. p. 180.
[334] See Tryba, 1992, p. 23 and Kohonen, 2001, p. 180.

network attempts to group different input vectors according to their similarity, or, in other words, so that similar output values comply with similar input values. Correspondingly, SOM learns in an unsupervised way.[335]

The learning process in SOM starts with random initialization of weights.[336] Then, input vectors are introduced into a network randomly, each one at a time t_z (z = 1,…, Z) for a $\Delta t_z = [t_z, t_{z+1}]$ period of time. In order to determine an excitation of a Kohonen-neuron k_{xy} caused by introduction of one input vector, some certain number of iterations should be undertaken during the time period Δt_z according to the following equation:[337]

$$E_{xy}(t+\Delta t) = \sigma\left(\sum_n w_{xyn} x_{jn} + \sum_{k_{x'y'} \in A_{xy}} g_{xyx'y'} E_{x'y'}(t) - \sigma_0\right) \quad k_{xy} \in A^2,\ A_{xy} \subseteq A^2, \quad (3\text{-}38)$$

where

$E_{xy}(t+\Delta t)$ is an excitation of a Kohonen-neuron k_{xy} obtained after one iteration

$\Delta t = \dfrac{\Delta t_z}{\text{Number of iterations}}$ is a length of one iteration

$\sigma(\cdot)$ is a non-linear sigmoid function

$\sigma_0(t)$ is an excitation threshold function chosen so that with an increasing t_z a smaller number of neurons is activated

In other words, equation (3-38) presents the **activation function** in the case of SOM.

It should be also mentioned that such iteration algorithm is very robust to changes of a function $g_{xyx'y'}$. Correspondingly, it does not have to be of an exact form of the "Mexican-hat function" described above, but must only approximate it.[338]

Due to a lateral interaction between Kohonen-neurons, values of E_{xy} concentrate themselves in the course of conducting iterations according to equation (3-38) around the Kohonen-neuron with the maximum scalar product $\sum_n w_{xyn} x_{jn}$. The

[335] See Eimert, 1997, pp. 14-15 and Backhaus/Erichson/Plinke/Weiber, 2003, p. 742.
[336] See Tryba, 1992, p. 16.
[337] See Ritter, 1988, p. 16, Kohonen, 1989, p. 123, and Tryba, 1992, pp. 23-25.
[338] See Tryba, 1992, p. 24.

fact that the scalar product $\sum_n w_{xyn} x_{jn}$ can be defined as a measure of the similarity between a weight vector W_{xy} and input vector X_j has allowed Teuvo Kohonen to carry out some simplifications of the iteration process. To avoid time-consuming computer simulation of iterations according to equation (3-38), he has assumed that after sufficiently many iterations the Kohonen-neuron with the maximum value of E_{xy} corresponded to the Kohonen-neuron with the best match between a weight vector W_{xy} and input vector X_j and substituted conducting iterations according to equation (3-38) with a more trivial process of comparing all weight vectors with an input vector X_j.[339] This comparison takes place on all Kohonen-neurons simultaneously.[340]

Moreover, to allow for a simple mathematical approach, the similarity measure $\sum_n w_{xyn} x_{jn}$ was replaced by the Euclidean distance between a weight vector W_{xy} and input vector X_j.[341] The **Euclidean distance d_{xy}** is defined here in the next form:[342]

$$d_{xy} = \left\| W_{xy} - X_j \right\| = \sqrt{\sum_n (w_{xyn} - x_{jn})^2} \qquad (3\text{-}39)$$

In this case, the Kohonen-neuron with the smallest Euclidean distance d_{xy} between a weight vector W_{xy} and input vector X_j presents the Kohonen-neuron with the best match between these vectors.[343]

It is assumed then that only this Kohonen-neuron is activated, i.e., has an output different from zero. In particular, the output is obtained through the **"winner takes all" activation function**:[344]

$$\text{Output of a Kohonen-neuron} = \begin{cases} 1, & \text{if it is a neuron with } \min_{x,y} d_{xy}. \\ 0, & \text{otherwise.} \end{cases} \qquad (3\text{-}40)$$

[339] See Ritter, 1988, p. 16 and Tryba, 1992, pp. 24-25.
[340] See Speckmann, 1995, p. 16.
[341] See Tryba, 1992, p. 25 and Rüping, 1995, p. 9.
[342] See Tryba, 1992, p. 25.
[343] See Rüping, 1995, p. 9.
[344] See Jockusch, 1995, p. 12 and Retzko, 1996, pp. 61-62.

Correspondingly, the Kohonen-neuron with the smallest Euclidean distance d_{xy} between a weight vector W_{xy} and input vector X_j is called the **winner neuron**.[345]

After the winner neuron is identified, weights assigned to it and its neighboring Kohonen-neurons are made more similar to a corresponding input vector.[346] According to the adaptation rule designated in the model of Kohonen, weights assigned to the winner neuron are adapted to an input vector to the highest degree, whereas a degree of adaptation of weights assigned to all other Kohonen-neurons depends on their position in the neighborhood of the winner neuron.[347] Assuming that the winner neuron has the location vector $L_{x^w y^w} = (x^w, y^w)$ this process can be presented mathematically as follows:[348]

$$w_{xyn}(t_{z+1}) = w_{xyn}(t_z) + h_{x^w y^w xy}(t_z)\,[x_{jn} - w_{xyn}(t_z)] \qquad (3\text{-}41)$$

Here $h_{x^w y^w xy}$ is the so-called **neighborhood function**. It defines to which degree weights of Kohonen-neurons are adapted.[349]

A neighborhood function serves as a substitute for the presented above function of strength of a lateral interaction $g_{xyx'y'}$, through which an adaptation neighborhood would be defined in the case of conducting iterations according to equation (3-38).[350]

A form of a neighborhood function is not strictly determined. There are only following general requirements, which a neighborhood function has to comply with:[351]

a) its maximum value should decrease with the time to guarantee convergence of the adaptation process:

$$\lim_{t_z \to \infty} h_{x^w y^w xy} = 0$$

b) its values should decrease with the distance from the winner neuron to allow for imitation of the biological model:

[345] See Seiffert, 1998, p. 31.
[346] See Porrmann, 2002, p. 7.
[347] See Retzko, 1996, p. 27.
[348] See Kohonen, 2001, pp. 110-111.
[349] See Elsen, 2000, p. 53.
[350] See Tryba, 1992, pp. 24-26.
[351] See Elsen, 2000, p. 54 and Kohonen, 2001, p. 111.

$$\lim_{d_{x^w y^w xy} \to \infty} h_{x^w y^w xy} = 0$$

One of the most widely applied forms of a neighborhood function is the **Gaussian function**:[352]

$$h_{x^w y^w xy} = \alpha(t_z) \exp\left(- \frac{d^2_{x^w y^w xy}}{2\sigma^2(t_z)} \right) \qquad (3\text{-}42)$$

where

$d^2_{x^w y^w xy}$ is the squared Euclidean distance between the winner neuron $k_{x^w y^w}$ and Kohonen-neuron k_{xy}

$\alpha(t_z)$ is the learning-rate factor defining a degree of adaptation of weights during each adaptation step ($0 < \alpha(t_z) < 1$)

$\sigma(t_z)$ is the width parameter defining a width of a neighborhood function $h_{x^w y^w xy}$

The maximum of the neighborhood function $h_{x^w y^w xy}$ is located at the winner neuron $k_{x^w y^w}$ (see Figure 3-18). Its width defined by the width parameter $\sigma(t_z)$ corresponds to the radius of the **neighborhood $A_{x^w y^w} \subseteq A^2$ of the winner neuron $k_{x^w y^w}$**.[353] Weights assigned to Kohonen-neurons belonging to this neighborhood are adapted to a corresponding input vector, whereas weights assigned to Kohonen-neurons outside it remain unchanged.[354]

The **width parameter $\sigma(t_z)$** should be set to a rather big value at the beginning of the adaptation process. Otherwise, the Kohonen-layer accommodates itself to a pattern of input data not as a uniform map, but as many small map areas, between which accommodation is interrupted. The starting value of the width parameter $\sigma(t_z)$ should be equal to approximately 70% of the longer side of the Kohonen-layer. Nevertheless, it should decrease with the time, in order to allow for detailed accommodation of a Kohonen-layer to input vectors. Correspondingly, the width

[352] See Kohonen, 2001, p. 111 and Porrmann, 2002, p. 8.
[353] See Kohonen, 2001, p. 111.
[354] See Fanghänel, 2001, p. 31.

parameter $\sigma(t_z)$ must be presented through a monotonically decreasing function of time.[355]

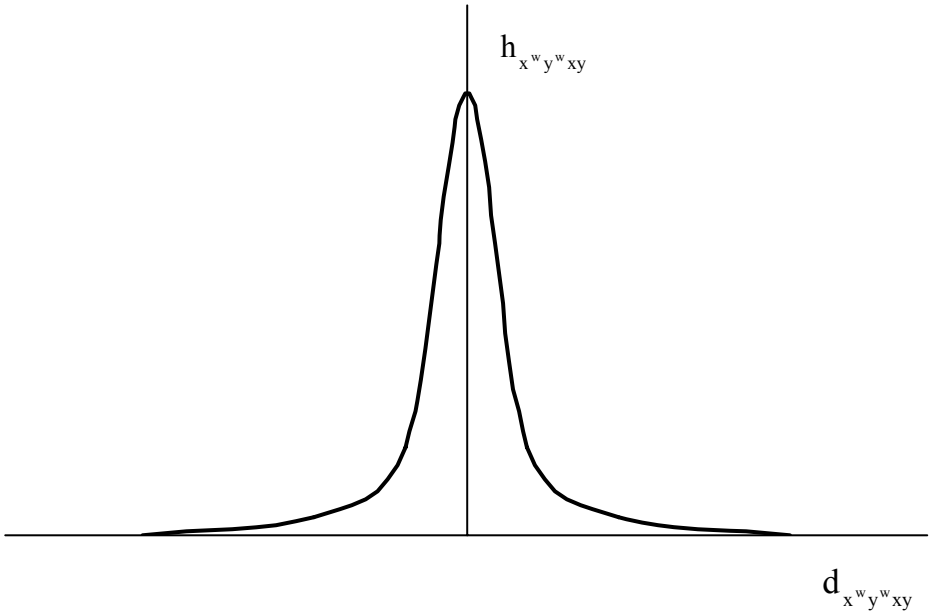


Figure 3-18 Neighborhood function of a Gaussian form
Source: Kohonen, 2001, p. 179.

The value of the **learning-rate factor $\alpha(t_z)$** should be set close to unity at the beginning of the adaptation process and approach 0 with the time, in order to enable convergence of the adaptation process. Correspondingly, it must be presented through a monotonically decreasing function of time too.[356]

The exact form of monotonically decreasing functions of time presenting the width parameter $\sigma(t_z)$ and learning-rate factor $\alpha(t_z)$ is not very critical for SOM including not more than several hundred Kohonen-neurons. Both can be presented as linear functions, for instance.[357]

In general, the adaptation process can be subdivided into two phases: **proper ordering of weights (POW) and fine-tuning of weights (FTW)**. The width parameter $\sigma(t_z)$ should be reduced to some very small value (for instance, one unit) during the first phase, and a topological neighborhood should include only

[355] See Ritter, 1988, p. 18, Schweizer, 1995, p. 84, and Kohonen, 2001, pp. 111-112.
[356] See Ritter, 1988, p. 19, Fanghänel, 2001, pp. 31-32, and Kohonen, 2001, pp. 111-112.
[357] See Kohonen, 2001, p. 111.

the nearest neighbors of the winner neuron in the second phase. The learning-rate factor $\alpha(t_z)$ should also reach a very small value (for instance, 0.02 or smaller) after the POW phase. For a high final statistical accuracy of a pattern of activated neurons, the FTW phase should be ten to hundred times longer than the POW phase. Moreover, the number of iteration steps in the FTW phase should be at least five hundred times bigger than the number of Kohonen-neurons.[358]

During the iterative learning process described above, weights assigned to neighboring Kohonen-neurons become more and more similar to each other. After the learning is completed, similar input vectors cause activation of neighboring Kohonen-neurons. In other words, a topology-preserving map is created.[359]

3.5.2.2.3 Visualization of Results

Results of the SOM learning process can be visualized in the following ways:[360]

- the U-matrix;
- the hit histogram of input vectors;
- the component planes.

The **U-matrix** (see Figure 3-19) shows distribution of the average distance[361] between a Kohonen-neuron and its closest neighbors on the topology-preserving Kohonen-layer defined as follows:[362]

$$U_{xy} = \frac{\sum_{k_{x^c y^c} \in A_{x^c y^c}} \left\| W_{xy} - W_{x^c y^c} \right\|}{C} \qquad k_{x^c y^c} \in A^2,\ A_{x^c y^c} \subseteq A^2, \qquad (3\text{-}43)$$

where

$A_{x^c y^c}$ is the closest neighborhood of a Kohonen-neuron k_{xy}

$k_{x^c y^c}$ is the closest neighbor of a Kohonen-neuron k_{xy}

C is the number of closest neighbors of a Kohonen-neuron k_{xy}

[358] See Kohonen, 1989, p. 133 and Kohonen, 2001, p. 112.
[359] See Eimert, 1997, pp. 16-17.
[360] These possibilities of map visualization are provided by the NENET software used within the scope of the international market segmentation analyses presented later in the thesis.
[361] According to Porrmann, 2002, p. 12, the distance measure used here should be the same as the one used for comparison of input vectors with weight vectors, in other words, the Euclidean distance.
[362] See Rüping, 1995, pp. 17-18, Speckmann, 1995, p. 20, Kropp, 1999, p. 26, and Kohonen, 2001, p. 165.

W_{xy} is a weight vector assigned to a Kohonen-neuron k_{xy}

$W_{x^c y^c}$ is a weight vector assigned to a Kohonen-neuron $k_{x^c y^c}$

Different values of average distances U_{xy} are presented through shades of grey (dark shades denoting high values, light shades – low ones). Dark-grey channels of Kohonen-neurons illustrate borderlines of cluster regions on the Kohonen-layer.[363]

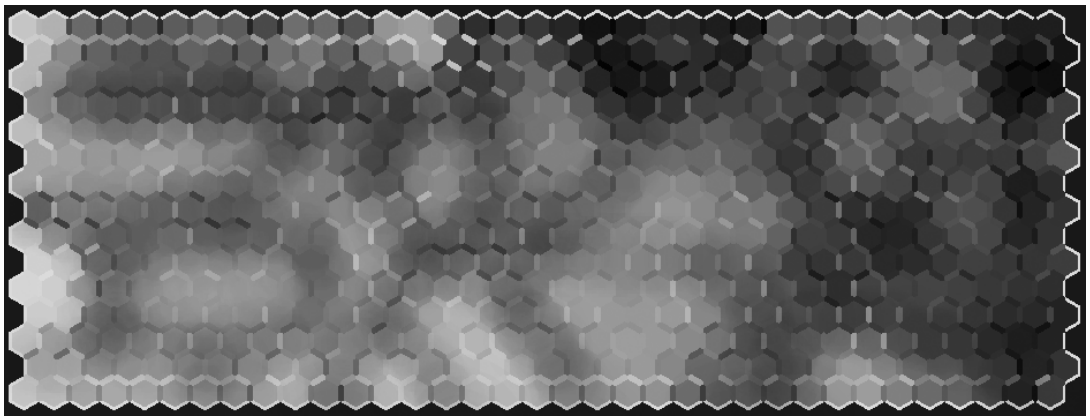
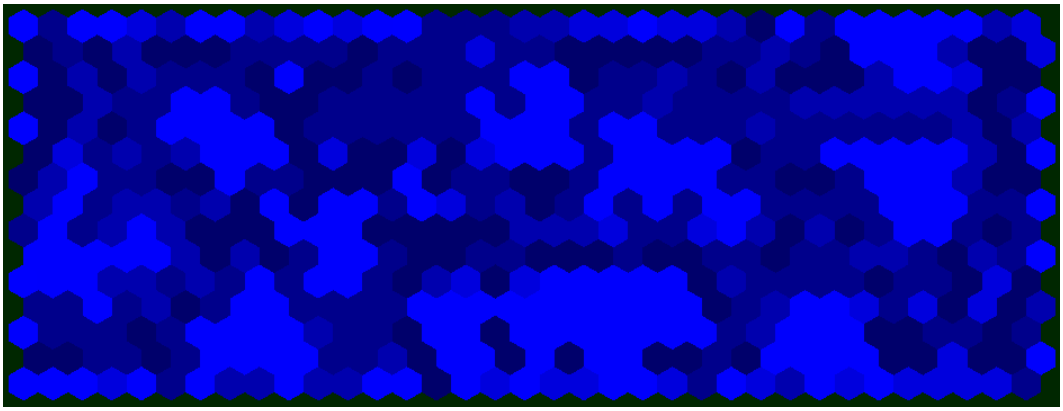


Figure 3-19 Example of the U-matrix

The **hit histogram of input vectors** (see Figure 3-20) shows distribution of input vectors (correspondingly, individuals) on the topology-preserving Kohonen-layer. As far as an input vector assigned to a Kohonen-neuron must have the best match with its weight vector, the hit histogram of input vectors presents nothing else as distribution of the best matches between input vectors and weight vectors on the topology-preserving Kohonen-layer.[364] Different quantities of input vectors (correspondingly, individuals) assigned to Kohonen-neurons can be depicted in a two-dimensional histogram through shades of blue (light shades illustrating big quantities, dark shades – small ones) or in a three-dimensional histogram through a height of diagram bars (high bars standing for big quantities, low bars – for small ones).

[363] See Kohonen, 2001, p. 166.
[364] See Rüping, 1995, p. 19 and Speckmann, 1995, p. 20.

Two-dimensional case



Three-dimensional case

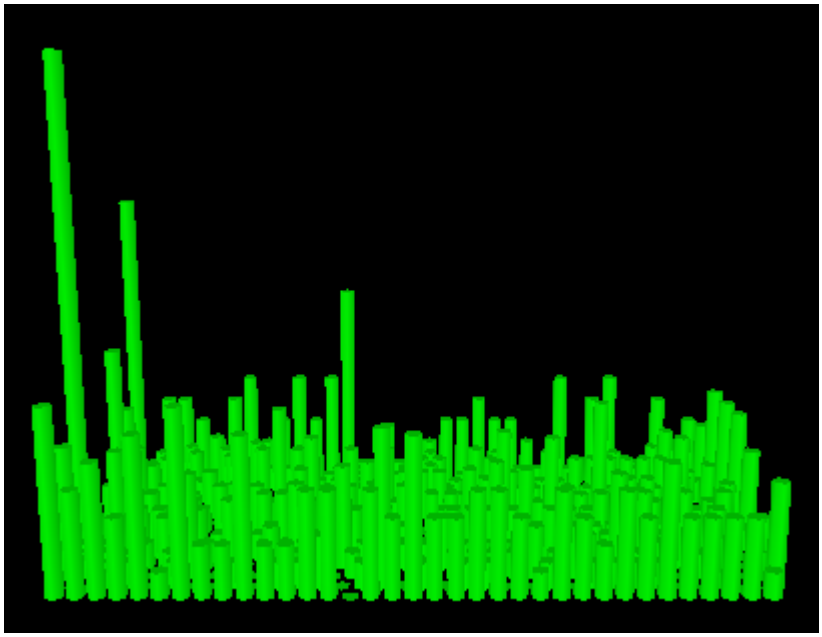


Figure 3-20 Example of the hit histogram of input vectors

If dark-grey channels in the U-matrix presented above are vague, the overlap of the hit histogram of input vectors and the U-matrix may simplify identification of cluster borderlines. Coincidence of channels of neurons having small quantities of assigned input vectors in the hit histogram with dark-grey channels in the U-matrix increases confidence in the fact that one deals with cluster borderlines.[365]

The **component planes** (see Figure 3-21) show distribution of the n^{th} component (n = 1,…, N) of weight vectors $W_{xy} = (w_{xy1}, w_{xy2}, \ldots, w_{xyN})$ associated with

[365] See Rüping, 1995, p. 20.

Kohonen-neurons on the topology-preserving Kohonen-layer.[366] Here the highest value of a particular component is displayed using a red color, the lowest one – using a black color. The intermediate values are presented through a smooth transition between "warm" and "cold" colors.

Due to the fact that components of a weight vector of each particular Kohonen-neuron on the topology-preserving map match with corresponding characteristics of an individual assigned to this neuron in the best possible way, component planes allow to analyse the distribution of the n^{th} characteristic (n = 1,…, N) of individuals on the Kohonen-layer.

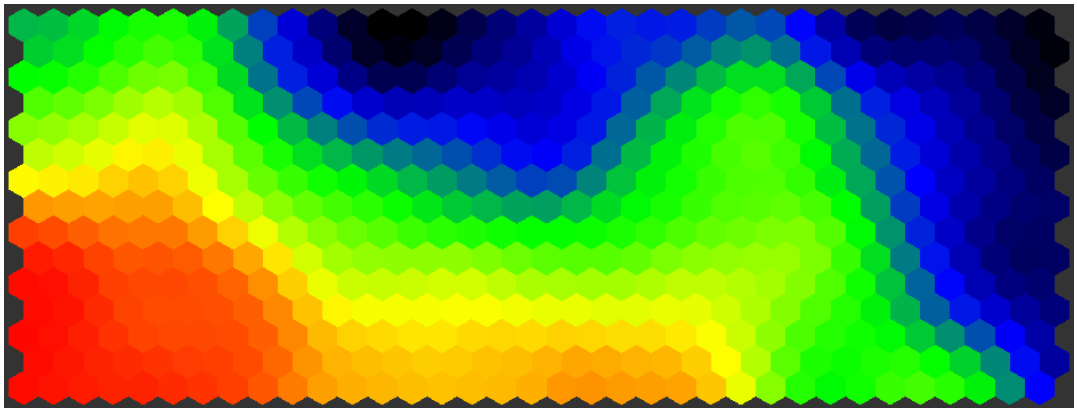


Figure 3-21 Example of the component plane

3.5.2.2.4 Assessment of Topology-Preserving Map

To assess the goodness of the topology-preserving map, three following quality measures can be used: **average quantization error**, **topographic error**, and **percentage of used Kohonen-neurons**.

The **average quantization error** $\mathbf{E_q}$ helps to assess the map fit to input data, in other words, the quality of input data compression into a finite number of weight vectors.[367] It is defined as follows:[368]

$$E_q = \frac{1}{J}\sum_{j=1}^{J}\left(\left\|X_j - W_{x^w y^w}\right\|\right), \tag{3-44}$$

[366] See Tryba, 1992, p. 28.
[367] See Kohonen, 2001, p. 161 and de Bodt/Cottrell/Verleysen, 2002, p. 968.
[368] See Porrmann, 2002, p. 36.

where

X_j is an input vector j (j = 1,…, J)

$W_{x^w y^w}$ is a weight vector of the corresponding winner Kohonen-neuron $k_{x^w y^w}$

The smaller the value of the average quantization error E_q is, the better the map's fit to input data is.[369]

The **topographic error E_{topo}** helps to asses the map's accuracy in preserving the topology of input data.[370] It is defined as follows:[371]

$$E_{topo} = \frac{1}{J}\sum_{j=1}^{J} u(X_j), \qquad (3\text{-}45)$$

where

$$u(X_j) = \begin{cases} 1, & \text{if } m_{ws} = \left\| W_{x^w y^w} - W_{x^s y^s} \right\|_{Map} > 1. \\ 0, & \text{otherwise.} \end{cases}$$

where

$W_{x^w y^w}$ is a weight vector of the winner Kohonen-neuron $k_{x^w y^w}$

$W_{x^s y^s}$ is a weight vector of the Kohonen-neuron $k_{x^s y^s}$ – the neuron with the second best match between its weight vector $W_{x^s y^s}$ and corresponding input vector X_j

m_{ws} is a map distance between Kohonen-neurons $k_{x^w y^w}$ and $k_{x^s y^s}$

The smaller the value of the topographic error E_{topo} is, the higher the map's accuracy in preserving the topology of input data is.[372]

The **percentage of used Kohonen-neurons E_{used}** helps to asses the map's resolution.[373] It is defined as follows:[374]

$$E_{used} = \frac{\text{number of neurons that were winner neurons at least once}}{\text{total number of neurons}} \cdot 100\% \qquad (3\text{-}46)$$

[369] See Kohonen, 2001, p. 161.
[370] See ibid. p. 161.
[371] See Fanghänel, 2001, p. 43.
[372] See ibid. p. 44.
[373] See ibid.
[374] See ibid.

If the value of E_{used} is equal to 100%, the task of indicating cluster regions may become quite complicated, due to unclear transitions between them. In such case, the map is obviously too small. On the other hand, if the value of E_{used} is close to 0%, the map is insufficiently used.[375]

3.5.3 Validation of Cluster Solution

After a partition of individuals presenting an outcome of clustering is chosen, one should examine the quality of a corresponding cluster solution. Ways of doing this are presented in this chapter.

3.5.3.1 Assessment of Cluster Solution's Stability Using Results of Several Clustering Methods

In order to be protected from accepting purely accidental outcome of segmentation analysis, one should examine **stability of a cluster solution**. This can be done by applying several clustering methods to one and the same sample. A cluster solution is considered to be stable, if it or its slightly changed version is repeatedly found using different clustering methods.[376]

The conclusion about the similarity of an obtained cluster solutions can be made on the base of comparison of cluster profiles consisting of average values of each basis variable in a corresponding cluster (i.e., consisting of cluster centroids for each basis variable).[377]

3.5.3.2 Assessment of Homogeneity within Clusters Using F-Values

Clusters in a high-quality cluster solution have to satisfy conditions of the notion of homogeneity.[378] According to the first of them **homogeneity within clusters** have to exist.[379] To examine if the obtained clusters are homogeneous, the so-called **F-value** can be used. It is defined as follows:[380]

$$F = \frac{Var(n,r)}{Var(n)}, \tag{3-47}$$

[375] See ibid.
[376] See Eckes, 1980, p. 105 and Wiedenbeck/Züll, 2001, p. 17.
[377] See Müller, 1977, pp. 52-53.
[378] See Bacher, 1996, p. 253.
[379] See part 3.5.2.1 of the present thesis.
[380] See Backhaus/Erichson/Plinke/Weiber, 2003, p. 533.

where

Var(n, r) is variance of a basis variable n in a cluster r

Var(n) is variance of a basis variable n in the total sample

The smaller the F-value is, the lower the variance of a basis variable in the cluster is in comparison to its variance in the total sample. In fact, it is desirable that the F-value does not exceed 1 because only in this case variance of a corresponding basis variable in a cluster is smaller than its variance in the total sample. If F-values are smaller than 1 for all basis variables in a corresponding cluster, it is considered to be completely homogeneous.[381]

3.5.3.3 Assessment of Heterogeneity between Clusters Using t-Values

The second condition of the notion of homogeneity requires **heterogeneity between clusters**.[382] The so-called **t-values** can give one hints with regard to its existence. The t-value is defined as follows:[383]

$$t = \frac{\bar{x}_{nr} - \bar{x}_{n}}{s_{n}}, \tag{3-48}$$

where

$\bar{x}_{nr}$ is the average value of a basis variable n in a cluster r

$\bar{x}_{n}$ is the average value of a basis variable n in the total sample

s_{n} is standard deviation of values of a basis variable n in the total sample

The t-values present standardized values, where positive (negative) values show that basis variables are overrepresented (underrepresented) in a corresponding cluster in comparison to the total sample.[384]

[381] See ibid.
[382] See part 3.5.2.1 of the present thesis.
[383] See Backhaus/Erichson/Plinke/Weiber, 2003, p. 534.
[384] See ibid.

3.5.3.4 Assessment of Heterogeneity between Clusters and of Cluster Solution Reliability Using Discriminant Analysis

An additional way to assess the quality of a cluster solution lies in conducting significance tests on basis variables by means of **discriminant analysis**. This statistical technique enables among other things examining existence of significant differences between clusters with respect to several variables simultaneously and evaluating accuracy of representation of real groupings in the data or, in other words, assessing reliability of a cluster solution.[385]

Feature profiles of individuals consisting of feature variables (characteristics of individuals) measured on a metric scale and **group variable** presenting priori defined group memberships of individuals and measured on a nominal scale are required for conduction of discriminant analysis.[386]

Discriminant analysis attempts to separate (to discriminate) priori defined groups in the most optimal way. Formally, discriminant analysis tries to explain values of a group variable in terms of values of feature variables or, in other words, to explore dependency of a group variable on feature variables.[387]

Discriminant analysis starts with deriving discriminant functions. Then, their performance is tested. Testing criteria used here additionally enable making judgments about existence of significant differences between groups or about reliability of a cluster solution. Both derivation and examination of discriminant functions are presented below.

3.5.3.4.1 Derivation of Discriminant Functions

Discriminant analysis works by combining original feature variables into linear composites that maximize differences between priori defined groups.[388] These linear combinations are called **(canonical) discriminant functions** and defined as follows:[389]

$$D = d_0 + d_1 x_1 + d_2 x_2 + \ldots + d_N x_N, \qquad (3\text{-}49)$$

[385] See Aldenderfer/Blashfield, 1985, p. 64 and Backhaus/Erichson/Plinke/Weiber, 2003, p. 156.
[386] See Backhaus/Erichson/Plinke/Weiber, 2003, p. 156.
[387] See Keysberg, 1989, p. 38 and Backhaus/Erichson/Plinke/Weiber, 2003, p. 156.
[388] See Green/Tull/Albaum, 1988, p. 513.
[389] See Klecka, 1982, p. 15 and Backhaus/Erichson/Plinke/Weiber, 2003, p. 161.

where

D is a (canonical) discriminant score

d_0 is a constant

d_n is a discriminant coefficient of a feature variable n (n = 1,…, N)

x_n is a feature variable n

The maximum number of discriminant functions is equal to $\min\{R-1, N\}$, where R is the number of groups, and N is the number of feature variables. Correspondingly, only one discriminant function exists in a two-group case. If there are more than two groups, several mutually uncorrelated functions can be derived.[390]

For better understanding of the notion of a discriminant function, graphical representation of a discriminant function in the case of only two groups of individuals and only two feature variables (characteristics of individuals) should be considered (see Figure 3-22).

The two ellipses schematically show locus of points presenting associations (x_1, x_2) of feature variables (characteristics) x_1 and x_2 for the two priori defined groups of individuals.[391]

A discriminant function builds a plane over the two-dimensional coordinate space of feature variables x_1 and x_2. Inside this coordinate space, it can be represented through a **discriminant axis** – a straight line defined for a discriminant function of a form $D = d_0 + d_1x_1 + d_2x_2$ (a two-group-two-variable case) as follows:[392]

$$x_1 = \frac{d_2}{d_1} \cdot x_2 \qquad (3\text{-}50)$$

[390] See Klecka, 1982, p. 34 and Backhaus/Erichson/Plinke/Weiber, 2003, pp. 177-178.
[391] See Green/Tull/Albaum, 1988, p. 510.
[392] See Backhaus/Erichson/Plinke/Weiber, 2003, p. 173.

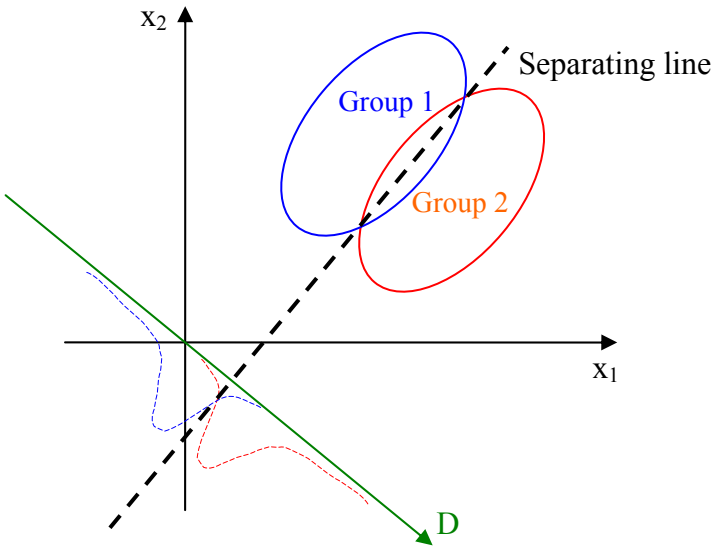


Figure 3-22 Graphical representation of a discriminant function in a two-group-two-variable case
Source: Pytlik, 1995, p. 135.

In other words, a discriminant axis crosses the zero point of the two-dimensional coordinate space, and its slope is defined by the ratio of discriminant coefficients d_1 and d_2.[393]

A discriminant axis is chosen by discriminant analysis from a variety of all possible axes, which cross the zero point of the two-dimensional coordinate space, through estimation of discriminant coefficients d_1 and d_2. A discriminant axis is the axis allowing for the best separation of groups of individuals.[394] This can be seen in Figure 3-22 too: separation of the two groups of individuals by means of the thick dotted line leads to the smallest overlap between univariate distributions of projections of associations (x_1, x_2) for each individual onto a discriminant axis D.[395] These projections are nothing else as corresponding discriminant scores of individuals.[396]

By estimating the appropriate value of a constant d_0 a scale of a discriminant axis D can be chosen so that the projection of a separating line on a discriminant axis (called a **critical discriminant score**) has the value of 0, and discriminant scores

[393] See ibid.
[394] See Pytlik, 1995, p. 136.
[395] See Green/Tull/Albaum, 1988, p. 510.
[396] See Backhaus/Erichson/Plinke/Weiber, 2003, p. 173.

of individuals positioned to the left from the separating line appear to have negative values, and those to the right – positive ones. In fact, changes in values of a constant d_0 shift the scale of a discriminant axis D and thereby affect values of discriminant scores, but do not influence a degree of group separation.[397]

The central problem of discriminant analysis is thus the next **optimisation problem**:[398]

$$\max_{d_1,\ldots,d_n} \{\Gamma\}, \tag{3-51}$$

where

Γ is the **discriminant criterion** measuring the difference between groups of individuals

The discriminant criterion Γ is defined as follows:[399]

$$\Gamma = \frac{\sum_{r=1}^{R} J_r(\overline{D}_r - \overline{D})^2}{\sum_{r=1}^{R}\sum_{j=1}^{J_r}(D_{rj} - \overline{D}_r)^2} = \frac{SS_b}{SS_w}, \tag{3-52}$$

where

J_r is the number of individuals in a group r (r=1,…, R)

D_{rj} is a discriminant score of an individual j (j=1,…, J) belonging to a group r

$\overline{D}_r$ is the centroid of a group r defined as follows:

$$\overline{D}_r = \frac{1}{J_r}\sum_{j=1}^{J_r} D_{rj}$$

$\overline{D}$ is the total average discriminant score defined in the following way:

$$\overline{D} = \sum_{j=1}^{J} D_j$$

SS_b is the between-groups sum of squares (variance explained by a discriminant function)

SS_w is the within-groups sum of squares (variance not explained by a discriminant function)[400]

[397] See ibid. pp. 162-176.
[398] See ibid. p. 166.
[399] See ibid. pp. 165-166.

The discriminant criterion is maximized for every feasible discriminant function. The maximum value of the discriminant criterion $\gamma = \text{Max}\{\Gamma\}$ presents an **eigenvalue of a corresponding discriminant function**.[401]

In the process of maximization of the discriminant criterion, discriminant functions are derived in such way that the discriminant function derived first has the maximum value of the discriminant criterion, and each following discriminant function has the conditionally biggest value of the discriminant criterion. In other words, discriminant analysis discloses dimensions of differences between groups, where the dimension disclosed first presents maximum group differences, the dimension disclosed next – maximum group differences not accounted by the first one, and so on.[402]

3.5.3.4.2 Testing Performance of Discriminant Functions

Performance (discriminating power) of a discriminant function decreases with the decrease in a corresponding eigenvalue. In other words, an eigenvalue presents a performance measure of a discriminant function. Nevertheless, it can be useful only for measuring relative performance of a discriminant function.[403] In particular, one can compare eigenvalues of different functions or **eigenvalue shares** defined as follows:[404]

$$ES_i = \frac{\gamma_i}{\gamma_1 + \gamma_2 + ... + \gamma_I}, \qquad (3\text{-}53)$$

where

γ_i is an eigenvalue of a discriminant function i (i = 1,…, I)

In order to define the absolute performance of a discriminant function, other performance measures should be used. One of them is the **canonical correlation coefficient** defined as follows:[405]

[400] The within-groups sum of squares is defined in part 3.5.2.1.2.1 of the present thesis as the total error sum of squares.
[401] See Backhaus/Erichson/Plinke/Weiber, 2003, p. 178.
[402] See Tatsuoka, 1988, p. 217.
[403] See Klecka, 1982, pp. 35-36.
[404] See Backhaus/Erichson/Plinke/Weiber, 2003, p. 178.
[405] See Klecka, 1982, p. 36 and Backhaus/Erichson/Plinke/Weiber, 2003, p. 182.

$$r_i^c = \sqrt{\frac{\gamma_i}{1+\gamma_i}} = \sqrt{\frac{SS_b}{SS_{total}}}, \qquad (3\text{-}54)$$

where

$SS_{total} = \sum_{r=1}^{R}\sum_{j=1}^{J_r}(D_{rj} - \overline{D})^2 = SS_b + SS_w$ is the total variance of discriminant scores[406]

The squared canonical correlation presents "the proportion of variation in the discriminant function explained by the groups"[407]. In other words, the canonical correlation coefficient indicates strength of relationship between the discriminant function and the groups. Its values vary between 0 and 1, where the zero value denotes no relationship, and the value equal to one – strong relationship.[408]

The canonical correlation coefficient also gives one a hint about the size of differences between groups on chosen feature variables. If there are no big differences between groups, canonical correlation coefficients of all discriminant functions are low.[409]

Another performance measure used for testing the absolute performance of a discriminant function is the so-called **Wilks's lambda**. It is defined as follows:[410]

$$\Lambda_i = \frac{1}{1+\gamma_i} = \frac{SS_w}{SS_{total}} \qquad (3\text{-}55)$$

Values of the Wilks's lambda also vary between 0 and 1, but it is an inverse performance measure. Its zero value denotes a big discriminating power of a discriminant function, whereas the value equal to one – a small one.[411]

The Wilks's lambda can also be used for testing on existence of differences between groups on chosen feature variables and therewith for examining statistical significance of a discriminant function. In order to do this, the **multivariate Wilks's lambda** should be obtained first through multiplying Wilks's lambdas of all feasible discriminant functions:[412]

[406] See Backhaus/Erichson/Plinke/Weiber, 2003, p. 166.
[407] Klecka, 1982, p. 37.
[408] See Cooley/Lohnes, 1971, p. 249 and Klecka, 1982, p. 36.
[409] See Klecka, 1982, p. 37.
[410] See Backhaus/Erichson/Plinke/Weiber, 2003, p. 182.
[411] See ibid.
[412] See ibid. p. 184.

$$\Lambda^{m} = \prod_{i=1}^{I} \frac{1}{1+\gamma_i} \tag{3-56}$$

Then, it should be converted into the chi-square:[413]

$$\chi^2 = -\left[J - \frac{N+R}{2} - 1 \right] \ln \Lambda^{m} \tag{3-57}$$

distributed with $N \cdot (R-1)$ degrees of freedom,

where

J is the number of individuals

N is the number of variables

R is the number of groups

Finally, χ^2 should be compared with standard tables presenting corresponding significance levels. Here the significance test presents the test of the null hypothesis that there are no differences between groups against the alternative hypothesis that there are differences between groups.[414]

Low significance levels denote that there are differences between groups. This also means that at least the discriminant function derived first is statistically significant.[415] Moreover, higher values of χ^2 denote bigger differences between the groups.[416]

With every derived discriminant function some part of discriminating information is removed from the data. In order to determine if after derivation of the first i discriminant functions there is residual discrimination in the data sufficient for derivation of further discriminant functions contributing significantly to group differentiation, one should refer to the **Wilks's lambda for residual discrimination**

$$\Lambda_i^{r} = \prod_{k=i+1}^{I} \frac{1}{1+\gamma_k} \qquad (i = 0, 1, \ldots, I-1), \tag{3-58}$$

where

γ_k is an eigenvalue of a discriminant function k

[413] See ibid. pp. 183-184.
[414] See Klecka, 1982, p. 40 and Backhaus/Erichson/Plinke/Weiber, 2003, p. 183.
[415] See Klecka, 1982, p. 40.
[416] See Backhaus/Erichson/Plinke/Weiber, 2003, p. 183.

and to a corresponding χ^2 with $(N-i)\cdot(R-i-1)$ degrees of freedom.[417]

If residual discrimination is not significant, derivation of a further discriminant function is meaningless. It is important to mention that in this way no assurance that each of the derived discriminant functions is statistically significant (with exception of k = 1) can be provided. It can be only stated that all derived discriminant functions are statistically significant as a set.[418]

Performance of a discriminant function can also be assessed with the help of the **classification matrix** (also called **confusion matrix**).[419] An example of the classification matrix is presented in Figure 3-23.[420]

Classified by function / Actual membership	Group 1	Group 2	Σ
Group 1	j_{11}	j_{12}	$j_{1\cdot}$
Group 2	j_{21}	j_{22}	$j_{2\cdot}$
Σ	$j_{\cdot 1}$	$j_{\cdot 2}$	J

Figure 3-23 Classification matrix for a two-group case
Source: Morrison, 1971, p. 130.

Here j_{12} (j_{21}) indicates the number of individuals who actually belong to group 1 (group 2) and were classified by a discriminant function into group 2 (group 1); J is the total number of individuals. Correspondingly, $\frac{j_{11}+j_{22}}{J}\cdot 100\%$ presents the **hit rate of a discriminant function** – the percentage of individuals classified by a discriminant function correctly.[421] A discriminant function is effective in

[417] See Klecka, 1982, pp. 38-40 and Backhaus/Erichson/Plinke/Weiber, 2003, p. 184.
[418] See Klecka, 1982, p. 41 and Backhaus/Erichson/Plinke/Weiber, 2003, p. 185.
[419] See Backhaus/Erichson/Plinke/Weiber, 2003, p. 180.
[420] For matter of explanation simplicity a two-group case is considered here again.
[421] In the case of more than two groups, one talks about a hit rate of all discriminant functions as a set.

separating individuals, only if its hit rate is higher than a hit rate obtained by chance.[422] Moreover, high values of the hit rate (of about 90-95%) denote that the quality (reliability) of a grouping as a partition of individuals is high.[423]

3.5.4 Description and Interpretation of Cluster Solution

The final task that a researcher has to complete while segmenting individuals is to describe and interpret clusters in a cluster solution. Due to the fact that the Ward's and K-means methods are aimed at building clusters that can be characterized through their cluster centroids,[424] it makes sense to base description and interpretation of a cluster on the analysis of its profile consisting of cluster centroids for each basis variable – an approach frequently used for these purposes.[425] Moreover, the same way of cluster description can be used in the case of SOM.[426]

The cluster profiles can be presented in the form of a table containing cluster centroids or in the form of a graph (see Figure 3-24).[427]

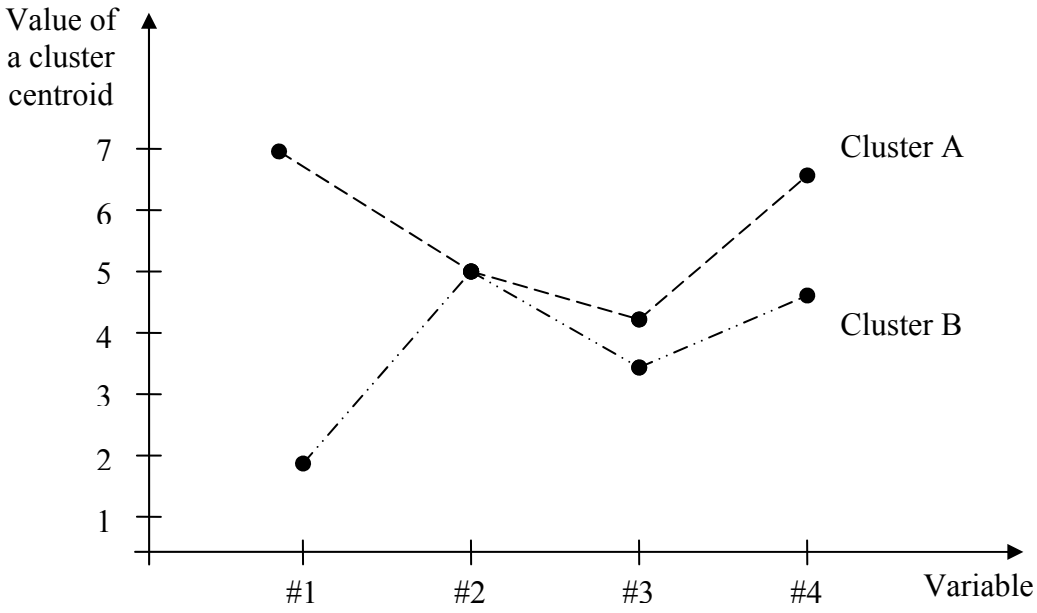


Figure 3-24 Profiles of cluster A and cluster B
Source: Müller, 1977, p. 41.

[422] See Morrison, 1971, pp. 130-131 and Backhaus/Erichson/Plinke/Weiber, 2003, p. 180.
[423] See Steinhausen/Langer, 1977, p. 170.
[424] See Bacher, 1996, p. 143.
[425] See Green/Tull/Albaum, 1988, p. 585.
[426] The description of cluster regions through cluster centroids is in line with the description of SOM clusters presented in Bock, 2004, p. 191. Moreover, such way of description allows for comparison of SOM results with results of the Ward's and K-means methods.
[427] See Müller, 1977, pp. 40-41.

Additionally, clusters should be described by means of **descriptor variables**, in order to allow for more precise description and interpretation of clusters and to facilitate the development and implementation of cluster-specific marketing programs.[428]

[428] See Frank/Massy/Wind, 1972, p. 19 and Steinhausen/Langer, 1977, p. 21.

4 International Market Segmentation Study

4.1 Study Purpose and Design

The international market segmentation study presented in this part of the thesis is aimed at investigation of advantages and limitations of additive intranational market segmentation and integral market segmentation as well as evaluation of effectiveness of segmentation approaches based on the Ward's method, K-means method, and SOM in finding transnational segments.

The following general steps were done while conducting this study:

1. Defining the relevant market.
2. Deciding on the segmentation approach and methodology.
3. Procuring the data.
4. Selecting basis and descriptor variables.
5. Conducting the analysis:
   a) conducting additive intranational market segmentation using three segmentation approaches (based on the Ward's method, K-means method, and SOM) and assessing their effectiveness;
   b) conducting integral market segmentation using three segmentation approaches (based on the Ward's method, K-means method, and SOM) and assessing their effectiveness;
   c) contrasting additive intranational market segmentation and integral market segmentation.

4.2 Defining Relevant Market

While defining the market considered in the case of the international market segmentation study, instructions of the Beiersdorf company – the initiator of the study and provider of the data for the analysis – were followed. In particular, the next market parameters were set:

- **business:** business of the Beiersdorf company at the female skin and body care market, where the company is presented through NIVEA brand;
- **products:** thirteen general skin and body care product categories;
- **market geographical boundaries:** twenty one countries;

- **market temporal boundaries:** years 2003 and 2004.

A more detailed description of the relevant issues is presented below.

4.2.1 Essence of Study Initiator's Business

For better understanding of the essence of Beiersdorf's business at the market considered, a brief portrayal of both the Beiersdorf company and its brand NIVEA is presented below.

4.2.1.1 Portrayal of Beiersdorf

Beiersdorf is a leading international company developing, manufacturing, and distributing branded consumer products for skin and beauty care, wound treatment, and adhesive products.[429]

The Beiersdorf company was established on the 28th of March 1882 in Hamburg as the pharmacist Carl Paul Beiersdorf took out patent number 20057 describing the new method developed by him for manufacturing of medical plasters (see Figure 4-1).[430]

Carl Paul Beiersdorf
Founder of the company

The date of the patent document is taken as the establishment date

Dr. Oscar Troplowitz
1890 took over the company

Figure 4-1 Establishment of the Beiersdorf company
Source: Beiersdorf-Aktiengesellschaft (Hrsg.) (1999), Das Unternehmen Beiersdorf, p. 9.

[429] See Beiersdorf-Aktiengesellschaft (Hrsg.) (1999), Das Unternehmen Beiersdorf, p. 7 and www.beiersdorf.com.
[430] See Beiersdorf-Aktiengesellschaft (Hrsg.) (1982), "100 Jahre Beiersdorf", p. 4.

In 1890 the Beiersdorf's laboratory was acquired by the pharmacist Dr. Oskar Troplowitz (see Figure 4-1). This talented entrepreneur and scientist possessing a keen sense of consumer needs started developing innovative products and brands.[431]

Since that time, the assortment of the Beiersdorf company has been constantly expanding, and today it includes such core brands as NIVEA, atrix, Elastoplast, Eucerin, Florena, Futuro, Hansaplast, Juvena, Labello, la prairie, tesa, and 8x4 (see Figure 4-2).[432]

Figure 4-2 Core brands of the Beiersdorf company

The headquarter of the contemporary Beiersdorf company is still located in Hamburg. Moreover, the company is presented through more than 130 affiliates and joint ventures in a big number of countries. All together around 17 thousand employees work at the Beiersdorf company worldwide.[433]

The Beiersdorf company is a typical example of a multi-product manufacturer dealing with heterogeneous needs and wants of consumers worldwide. No wonder that the issue of international market segmentation gains currently in importance

[431] See Beiersdorf-Aktiengesellschaft (Hrsg.) (1982), "100 Jahre Beiersdorf", p. 4 and Beiersdorf-Aktiengesellschaft (Hrsg.) (1999), Das Unternehmen Beiersdorf, p. 8.
[432] See www.beiersdorf.com.
[433] See ibid.

for this company. Especially, in the case of such truly international brand as NIVEA.

4.2.1.2 Portrayal of Umbrella Brand NIVEA

The history of NIVEA brand begins in 1911. That year Dr. Oscar Troplowitz has acquired the patent of Dr. Isaac Lifschütz describing the method for developing the first water-in-oil emulsifier called "Eucerit". This product has enabled combining oil and water to a stable emulsion used as a base for ointments. Dr. Oscar Troplowitz inspired by his scientific advisor Prof. Paul Gerson Unna could make use of "Eucerit" for invention of the first long-lasting cream. Due to its stable consistency, the cream had a white color. Correspondingly, it was named "NIVEA", from the Latin word "niveus/nivea/niveum" meaning "Snow-white".[434]

Since 1911, the world of NIVEA has expanded dramatically. NIVEA brand has become an umbrella brand including a big variety of subbrands (see Figure 4-3).

Although each subbrand has a stand-alone visual identity, one can easily notice that they belong to one and the same "family". This uniformity is based on two fundamental elements: NIVEA font (in particular, "NIVEA" logo in capital letters) and NIVEA colors (in particular, blue/white color combination).[435]

Today, NIVEA is the world's biggest skin and body care brand. It is sold in about 150 countries. Despite the high level of competition consisting of both numerous local brands and such truly international brands as Dove, L'Oreal, and Oil of Olay, NIVEA succeeds to remain a highly trusted and used brand all over the world.[436] It stands for "successful interplay of groundbreaking research, creativity, and entrepreneurial expertise"[437]. The essence of NIVEA brand is expressed through the next statement: **"Empathetic, mild yet effective care to look and feel your best"**[438].

[434] See Beiersdorf-Aktiengesellschaft (Hrsg.) (1982), 100 Jahre Beiersdorf: 1882-1982, pp. 22-23, Hansen, 2001, p. 27, and www.nivea.co.uk.
[435] See Verlagsgruppe Milchstrasse (Hrsg.) (1998), Märkte und Marken, Fallstudie NIVEA, pp. 2-3, Hansen, 2001, p. 102, and NIVEA Brand Philosophy 2003, p. 32.
[436] See www.beiersdorf.com and www.nivea.co.uk.
[437] www.beiersdorf.com.
[438] NIVEA Brand Philosophy 2003, p. 17.

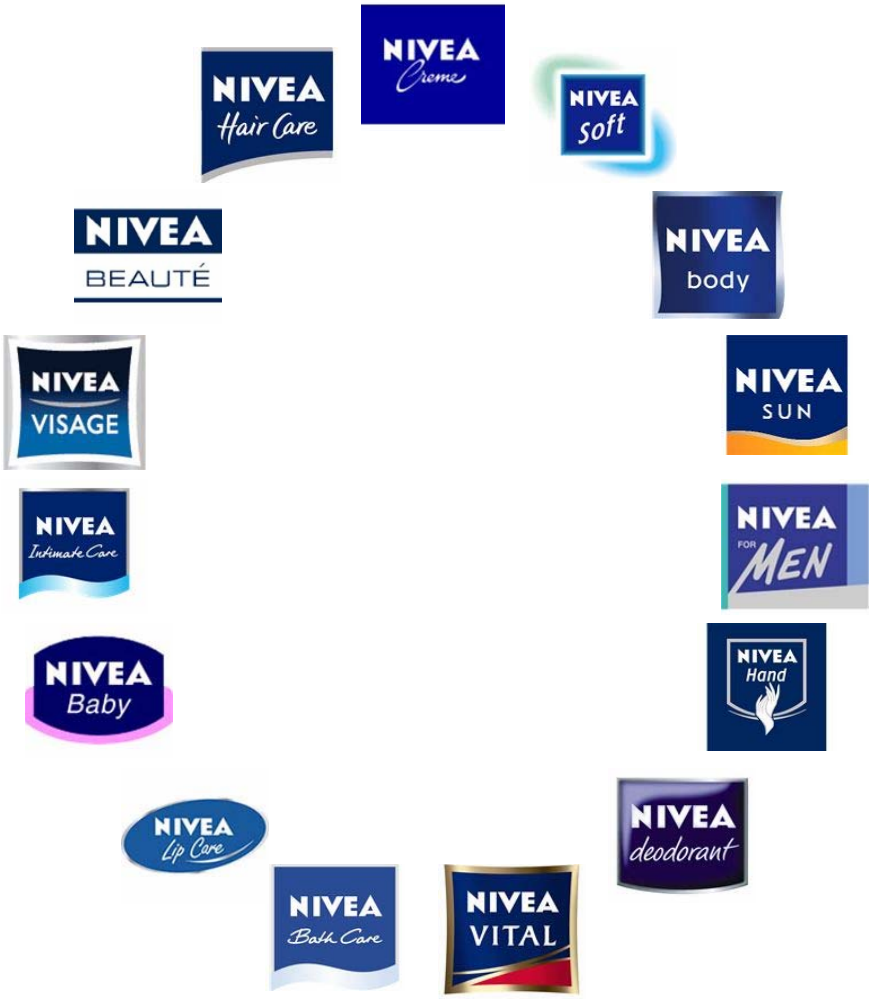


Figure 4-3 World of NIVEA

4.2.2 Skin and Body Care Product Categories

As it was already mentioned above, female users of skin and body care products were considered within the scope of the present study. In particular, the following general categories of skin and body care products were regarded:[439]

1. All purpose creams
2. Hand creams
3. Face care and cleansing
4. Body milk/ lotions
5. Lip care

[439] See Master Skin Care Questionnaire 2003.

6. Sun protection
7. Baby care
8. Men's care (i.e., shaving products, face care)
9. Deodorants
10. Soap, bath and shower products
11. Hair care (i.e., shampoo, rinse, cure)
12. Hair styling (i.e., spray, setting foam, gel)
13. Decorative cosmetics (i.e., lipsticks, make-up, nail varnish, mascara)

4.2.3 Geographical and Temporal Market Boundaries

Twenty one countries were investigated in the scope of the present study (see Table 4-1). Correspondingly, the next five regions of the world were taken into consideration:

- Africa;
- Asia;
- Australia;
- Europe;
- South America.

Although, data from a bigger number of countries were originally available, it was decided to limit investigation to the data from years 2003 and 2004. In particular, it was assumed that the data from a time period of two subsequent years could be considered as the data from one wave of data collection because country-specific data collection did not normally take place every year, and its planning had differed from country to country.

Country	Year of data collection	
	2003	2004
South Africa	+	
China	+	
Hong Kong	+	
Indonesia	+	
Korea	+	
Philippines	+	
Taiwan	+	
Thailand	+	
Australia		+
Belgium		+
Germany		+
Italy		+
Netherlands	+	
Spain		+
Switzerland	+	
Russia	+	
Denmark		+
Norway		+
Argentina		+
Paraguay	+	
Venezuela		+

Table 4-1 Investigated countries

4.3 Deciding on Segmentation Approach and Methodology

Three types of choice were done at this step. Firstly, the type of a segmentation model was defined. It was decided to conduct neither a-priori nor hybrid, but a-posteriori segmentation. This can be explained by the fact that the study was intended for forming segments on the base of similarities in characteristics of the market members. No information on the number or type of these segments was available in advance.

Secondly, as far as similarities within one set of basis variables had to be investigated, and no distinction between dependent and independent variables had to be made, the nature of segmentation methods was determined to be descriptive, not predictive. In particular, as it was already mentioned above, the Ward's method, K-means method, and SOM were considered.

Thirdly, it was decided to conduct exclusively consumer-related market segmentation. Exclusively country-related segmentation was not considered as an option for conducting international market segmentation analysis, due to the fact that the interest of the study was in segments consisting of individuals, not of countries. Moreover, as far as all relevant countries were defined in advance, conducting macro-level market segmentation as a part of country- and consumer-related market segmentation appeared to be redundant.

As it was already mentioned above, both forms of exclusively consumer-related market segmentation (additive intranational market segmentation and integral market segmentation) were considered within the scope of this study.

4.4 Procuring Data

Each of the twenty one national data sets used in this study was chosen from data in the data bank of the **International NIVEA Brand Monitor** – an individual quantitative survey representing users of skin and body care products of a corresponding country.[440] It is primarily aimed at evaluating and tracking the standing of the umbrella brand NIVEA, its subbrands, and its main competitors in terms of

[440] See Krapp/Grieb/Voss, 2003, p. 2.

- brand awareness, sympathy, and usage;
- brand image and fulfillment of consumer requirements;
- brand communication effectiveness.[441]

Data from the data banks of International NIVEA Brand Monitors used for this study should be viewed as **company-internal secondary data**. Due to the fact that market segmentation belongs to specific purposes of the International NIVEA Brand Monitor and is conducted officially and on a regular basis for all countries investigated in this study, it can be stated that such disadvantages of secondary data as mismatch of measurement units and data classification definitions with those required for the current study, lack of the data timeliness, and limited possibility to assess the data credibility are minimized.

Peculiarities of collecting data for the data bank of the International NIVEA Brand Monitor in the case of each of the twenty one countries are presented below.

4.4.1 Fieldwork Dates

The decision about the date of a fieldwork in each particular country was made jointly by the headquarter of the Beiersdorf company, its corresponding local subsidiaries, and market research institutes involved into the survey. It depended mainly on such criteria as strategies and budgeting of the Beiersdorf company, importance of changes and developments taking place at each particular market, and working style of the market research institutes. The dates of the fieldworks in each of the twenty one countries considered in this study are presented in Table 4-2.

[441] See International NIVEA Brand Monitor Presentation 2004: Germany and International NIVEA Brand Monitor Presentation 2004: Spain.

Region	Country	Fieldwork date
Africa	South Africa	October 2003
Asia	China	July/August 2003
Asia	Hong Kong	July/August 2003
Asia	Indonesia	July/August 2003
Asia	Korea	July/August 2003
Asia	Philippines	July/August 2003
Asia	Taiwan	July/August 2003
Asia	Thailand	July/August 2003
Australia	Australia	June 2004
Europe	Belgium	Mai 2004
Europe	Germany	February 2004
Europe	Italy	April 2004
Europe	Netherlands	September/October 2003
Europe	Spain	July 2004
Europe	Switzerland	November/December 2003
Europe (East)	Russia	February 2003
Europe (Nordics)	Denmark	September 2004
Europe (Nordics)	Norway	September 2004
South America	Argentina	June 2004
South America	Paraguay	November/December 2003
South America	Venezuela	June 2004

Table 4-2 Fieldwork dates
Source: International NIVEA Brand Monitor Presentations 2003-2004: each of the presented countries.

4.4.2 Fieldwork Locations

The primary criteria for making a choice of a fieldwork location were the scope of activities of the Beiersdorf company and market peculiarities in each particular country. In countries, where buying and consumption of NIVEA brand were considered to be rather equally spread across large and small towns, interviews were normally conducted in towns of a different size (for instance, in Germany). At the same time, in countries, where NIVEA brand buyers and consumers were expected to be concentrated in central locations, interviews were conducted in major cities only (for instance, in China). Other reasons for choosing only major cities as fieldwork locations were, for instance, budgeting of the Beiersdorf

company and security of interviewers (the latter criterion was especially important in South Africa). Detailed information on the fieldwork locations is presented in Table 4-3.

Region	Country	Fieldwork location
Africa	South Africa	Johannesburg, Cape Town, Durban
Asia	China	Shanghai, Beijing
Asia	Hong Kong	Hong Kong
Asia	Indonesia	Jakarta, Bandung, Surabaya
Asia	Korea	Seoul
Asia	Philippines	Manila
Asia	Taiwan	Taipei
Asia	Thailand	Bangkok, Chiang Mai, Pitsanulok, Khon Kean, Sakonnakorn, Songkla, Trang
Australia	Australia	Sydney, Melbourne, Brisbane, Adelaide
Europe	Belgium	Provinces
Europe	Germany	West and East states
Europe	Italy	Medium/large towns in North-West, North-East, Center, and South/Islands areas
Europe	Netherlands	Regions
Europe	Spain	Madrid, Barcelona, Valencia, Seville, Bilbao
Europe	Switzerland	Western Switzerland, German-speaking Switzerland
Europe (East)	Russia	Medium/large towns in North-West, Center/Chernozem/North Caucasus, Volga Region/Volga-Vyatka, The Urals, West and East Siberia/Far East areas
Europe (Nordics)	Denmark	Regions
Europe (Nordics)	Norway	Regions
South America	Argentina	Areas: Capital and GBA; Córdoba and Greater Córdoba; Rosario and Greater Rosario
South America	Paraguay	Urban geographic zones of Asunción and main cities of the suburbs of Asunción (Luque, San Lorenzo, Fernando de la Mora, Lambaré)
South America	Venezuela	Caracas, Maracaibo, Valencia, Barquisimeto, Pto. La Cruz/ Barcelona

Table 4-3 Fieldwork locations
Source: Krapp/Grieb/Voss, 2003, p. 2, Skin Care Questionnaire: Netherlands 2003, and International NIVEA Brand Monitor Presentations 2003-2004: each of the presented countries (except for South Africa and Netherlands).

4.4.3 Fieldwork Methodology, Sample Definition, and Questionnaire Contents

One of the three following fieldwork methodologies was used for the data collection in the considered countries:

- Verbal survey: face-to-face (conventional survey), in-home;
- Verbal survey: Computer Assisted Personal Interview (CAPI), in-home;
- Computer survey: Computerized Self-Administered Questionnaire Survey (CSAQ-Survey), online.

In each country, the data were collected from a representative sample reflecting local population composition. Normally, only female respondents were considered. In some countries, men were interviewed too, but their answers were ignored within the scope of the present study.

General contents of the questionnaires consisted of the following topics:[442]

- **awareness:**
  - unprompted and prompted awareness of brands,
  - prompted awareness of NIVEA subbrands;
- **likeability:**
  - likeability of brands,
  - likeability of NIVEA subbrands;
- **usage of brands:**
  - usage of brands,
  - brands used in the past,
  - brands never used,
  - usage of skin and body care products,
  - usage of NIVEA subbrands;
- **image:**
  - brand image (based on fulfilment of requirements towards a product/brand),

[442] See International NIVEA Brand Monitor Presentation 2003: Russia, International NIVEA Brand Monitor Presentation 2003: Switzerland, Master Skin Care Questionnaire 2003, Skin Care Questonnaires 2003-2004: each of the investigated countries, and International NIVEA Brand Monitor Presentation 2004: Germany.

  - scaled assessment of importance of requirements towards a product/brand (for instance, “Products offer good value for money”, “Products are of higher quality”, “It is a trustworthy brand”),
  - attributes of brands (for instance, “Familiar”, “Reliable”, “Classic”)
  - suitability of NIVEA subbrands to NIVEA;
- **advertising:**
  - prompted advertising recall of brands,
  - scaled assessment of advertising for NIVEA,
  - prompted advertising recall of NIVEA subbrands;
- **statistics:**
  - demographic characteristics:
    - age of a respondent,
    - marital status of a respondent,
    - number of people in a household,
    - children in a household,
    - education level of a respondent,
    - employment status of a respondent,
    - monthly household income/ social class,
    - location,
  - type and sensitivity of face and body skin,
  - media usage,
  - point of purchase;
- **genesis of NIVEA:**
  - spontaneous associations with NIVEA,
  - first contact with NIVEA,
  - known activities of NIVEA;
- **personal attitudes towards beauty/life** (for instance, “I like to look nice at all times”, “I keep up to date with the latest fashions”, “I put my family’s needs before mine”).

Fieldwork methodologies used in the case of each particular country as well as age ranks and sizes of representative female samples are presented in Table 4-4.

Region	Country	Fieldwork methodology	Sample definition
Africa	South Africa	Face-to-face (conventional survey), in-home	Females aged 18 – 49 years using skin and body care products; N=801
Asia	China	Face-to-face (conventional survey), in-home	Females aged 18 – 59 years using skin and body care products; n=800
Asia	Hong Kong	Face-to-face (conventional survey), in-home	Females aged 18 – 59 years using skin and body care products; n=504
Asia	Indonesia	Face-to-face (conventional survey), in-home	Females aged 15 – 54 years using skin and body care products; N=826
Asia	Korea	Face-to-face (conventional survey), in-home	Females aged 18 – 59 years using skin and body care products; N=500
Asia	Philippines	Face-to-face (conventional survey), in-home	Females aged 18 – 59 years using skin and body care products; N=500
Asia	Taiwan	Face-to-face (conventional survey), in-home	Females aged 18 – 59 years using skin and body care products; N=504
Asia	Thailand	Face-to-face (conventional survey), in-home	Females aged 18 – 59 years using skin and body care products; N=1000
Australia	Australia	CSAQ-Survey, online	Females aged 18 – 65 years using skin and body care products; N=581
Europe	Belgium	CAPI, in-home	Females aged 15 years and older using skin and body care products; N=372
Europe	Germany	CAPI, in-home	Females aged 14 – 65 years using skin and body care products; N=1047
Europe	Italy	Face-to-face (conventional survey), in-home	Females aged 14 – 65 years using skin and body care products; N=521
Europe	Netherlands	Face-to-face (conventional survey), in-home	Females aged 18 – 65 years using skin and body care products; N=491
Europe	Spain	CAPI, in-home	Females aged 14 – 65 years using skin and body care products; N=755
Europe	Switzerland	Face-to-face (conventional survey), in-home	Females aged 18 – 65 years using skin and body care products; N=506

Europe (East)	Russia	Face-to-face (conventional survey), in-home	Females aged 18 – 64 years using skin and body care products; N=1200
Europe (Nordics)	Denmark	CSAQ-Survey, online	Females aged 15 – 65 years using skin and body care products; N=400
Europe (Nordics)	Norway	CSAQ-Survey, online	Females aged 15 – 65 years using skin and body care products; N=366
South America	Argentina	Face-to-face (conventional survey), in-home	Females aged 18 – 65 years using skin and body care products; N=516
South America	Paraguay	Face-to-face (conventional survey), in-home	Females aged 15 – 65 years using skin and body care products; N=402
South America	Venezuela	Face-to-face (conventional survey), in-home	Females aged 18 – 65 years using skin and body care products; N=800

Table 4-4 Fieldwork methodologies, age ranks and sizes of samples
Source: Krapp/Grieb/Voss, 2003, p. 2 and International NIVEA Brand Monitor Presentations 2003-2004: each of the presented countries.

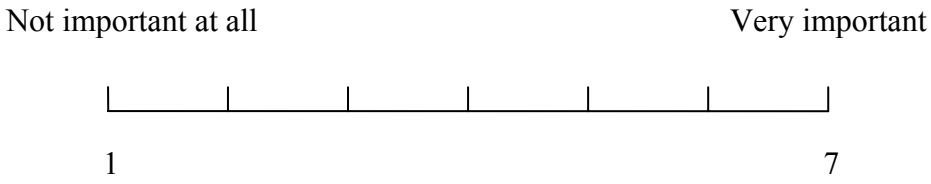
4.5 Selecting Basis and Descriptor Variables

As far as collecting data for the data bank of the International NIVEA Brand Monitor is the standard procedure, it was impossible to influence the contents of the questionnaires before the fieldworks took place. Therefore, basis and descriptor variables used in this study were chosen from the contents of the International NIVEA Brand Monitor data banks after the data procurement took place.

In particular, it was decided to use **requirements of respondents towards a product/brand (i.e., needs of respondents)** as basis variables.

Such choice was done primarily because basis variables were expected to be **measured on a metric scale**, in order to enable conduction of factor analysis, cluster analyses, SOM, and discriminant analysis. In particular, the next two types of variables were considered first: requirements towards a product/brand and attitudes towards beauty/life. Both of them were measured on a seven point rating scale (see Figure 4-4).

Assessment scale used in the case of requirements towards a product/brand



Assessment scale used in the case of attitudes towards beauty/life

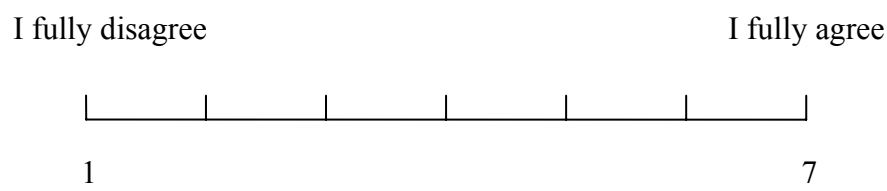


Figure 4-4 Assessment scales

Furthermore, basis variables were expected to be **present in all countries investigated**, in order to guarantee comparability of results of intranational segmentations as well as to allow for conducting integral market segmentation and comparing its results with results of additive intranational market segmentation. Attitudes towards beauty/life (except for only a very few of them) failed to fulfill this requirement and were not considered any longer. The number and composition of requirements towards a product/brand available in the data bank also varied strongly from country to country. Nevertheless, the next fourteen requirements towards a product/brand were found in every country and assigned the status of **basis variables**:

- products offer good value for money
- products are of high quality
- it is a trustworthy brand
- products fulfill current expectations towards skin care
- products perform better than those of other brands
- products contain highly effective ingredients
- this brand is highly advertised
- it is a modern brand
- this brand offers mild skin care products
- products are suitable for sensitive skin
- products rely on the latest scientific findings

- products are highly appropriate for skin
- products have a pleasant fragrance
- this brand is for demanding women who give importance to their appearance

It was decided, that such segmentation base is **highly appropriate for the present study**, due to the fact that results of this study were expected to be used for constructing international market segmentation strategies.[443]

Moreover, **assessment of the quality** of the chosen segmentation base by means of examining the fourteen statements themselves as well as results of the several first intranational segmentations has demonstrated rather satisfactory results. In particular, it was concluded that

- the chosen segmentation base allowed to find segments of respondents with distinct requirements towards brands/products easily (i.e., **fulfillment of the identifiably condition**);
- the size of obtained segments was normally substantial enough for considering them while constructing marketing strategies (i.e., **fulfillment of the substantiality condition**);
- relationship between obtained segments and media types was often (but not always) quite strong and clear; moreover, members of one and the same segment were often (but not always) concentrated in the same geographical area and visited the same purchase locations (i.e., **partial fulfillment of the accessibility condition**);
- as far as the fourteen requirements towards a product/brand were linked to rather basic, thus rather stable needs of respondents, the character of segments were not likely to change dramatically with the time (i.e., **high probability of fulfillment of the stability condition**);
- as far as the fourteen requirements towards a product/brand were directly connected to the core element of the marketing mix – the product[444], obtained segments could be considered as actionable and responsive (i.e., **fulfillment of the actionability and responsiveness conditions**).

[443] This conclusion was made on the base of the guideline for choosing segmentation bases presented in part 3.4.1.1 of this thesis (the present study refers to the category "Positioning studies").
[444] As defined by Bauer, 2000, p. 2797.

The chosen segmentation base has also demonstrated the ability to exhibit **construct equivalence**. In particular, the following statements could be made:

- the chosen basis variables present skin and body care characteristics performing the same function of describing a product/brand (requirements to a product/brand) in all countries investigated (i.e., **fulfillment of the functional equivalence condition**);
- the chosen basis variables present such skin and body care characteristics that are existent and normally identically interpreted in all countries investigated (i.e., **fulfillment of the conceptual equivalence condition**);
- in all considered countries, concepts presented through the chosen basis variables belong to the same category "Skin and Body Care Characteristics" (i.e., **fulfillment of the category equivalence condition**).

Finally, as far as data in the data banks of International NIVEA Brand Monitors conducted in different countries are used by the Beiersdorf company for comparative and combinational purposes officially and on a regular basis, it was assumed that **equivalence of research methods, objects, situations, and data processing** was guaranteed, and thus no discrepancies would be expected with regard to the quality of the chosen basis variables and reliability of corresponding transnational segments.

After the basis variables were defined, it was decided to choose descriptor variables for more precise description and interpretation of segments as well as facilitation of development and implementation of international market segmentation strategies. It was attempted to select variables which could be related to both the fourteen requirements towards a product/brand presented above and elements of marketing mix (product, promotion, distribution, and price). Due to the fact that the size and structure of data available in the International NIVEA Brand Monitor data banks differed across the investigated countries, existence of cross-national distinctions in the number, type and scaling of the variables chosen as descriptor variables could not be avoided. All descriptor variables considered within the scope of the present study are listed in Table 4-5.

Country	Descriptor variables
All countries	Requirements towards a product/brand not used for cluster building Attitudes towards beauty/life Demographic characteristics (age of a respondent, marital status of a respondent, number of people in a household, employment status of a respondent, living location of a respondent) Brand assessments (prompted awareness, likeability, usage and prompted advertising recall of brands) Skin conditions (face skin type and sensitivity, body skin type and sensitivity)
All countries (except for Spain)	Media usage
All countries (except for Spain and Russia)	Number of children under 16 years in a household
Spain	Presence of children below 15 years in a household
Russia	Presence of children below 14 years in a household
All countries (except for Germany, Italy, Spain, Denmark, Norway and Venezuela)	Point of purchase
All countries (except for South Africa, Australia, Germany, Spain, Denmark, Norway)	Education level of a respondent
Asia, Australia, Russia, Denmark, Norway, Venezuela	Monthly household income
South Africa, Belgium, Italy, Spain, Switzerland, Argentina, Venezuela	Social class

Table 4-5 Descriptor variables

4.6 Conducting Analysis

4.6.1 Additive Intranational Market Segmentation

4.6.1.1 Data Preparation Using Factor Analysis

Before conducting segmentation analyses, it was decided to transform the fourteen basis variables (requirements towards a product/brand) by means of factor analysis into factor values, in order to exclude correlations in the input data and thus to avoid overemphasis distortions while clustering respondents.

The newest program running factor analysis is the **SPSS software**[445] – a versatile computer package enabling performing a wide variety of complex statistical analyses.[446]

All calculations necessary for conduction of factor analysis were done by means of the **Factor procedure** of the SPSS software.[447]

In order to make a conclusion about the reasonability of conducting factor analysis on the input data used in the case of each of the twenty one investigated countries, correlation matrices were examined first. Due to the fact that values of majority of correlation coefficients were rather not very high (of about 0.2 - 0.5), it was decided to consider other criteria too. The following observations were made for all countries:

- significance levels of majority of correlation coefficients are close to zero meaning that majority of correlation coefficients are significantly different from zero;
- majority of non-diagonal elements of the inverse correlation matrices and anti-image covariance matrices are close to zero;
- significances of the Bartlett's test are equal to zero meaning that the probability that the data are correlated is equal to 100%, and thus the correlation matrix is definitely different from the unit matrix;
- MSA $\geq$ 0.8 (see Table 4-6).

[445] According to Pinnekamp/Siegmann, 2001, p. 268, SPSS stands for "Superior Performing Software System".
[446] See Voelkl/Gerber, 1999, p. 3 and Hinton/Brownlow/McMurray/Cozens, 2004, p. XV.
[447] Here and in the following the eleventh version of the SPSS software was used.

Region	Country	MSA
Africa	South Africa	0.81
Asia	China	0.83
Asia	Hong Kong	0.86
Asia	Indonesia	0.85
Asia	Korea	0.84
Asia	Philippines	0.83
Asia	Taiwan	0.84
Asia	Thailand	0.86
Australia	Australia	0.83
Europe	Belgium	0.86
Europe	Germany	0.91
Europe	Italy	0.86
Europe	Netherlands	0.82
Europe	Spain	0.91
Europe	Switzerland	0.85
Europe (East)	Russia	0.87
Europe (Nordics)	Denmark	0.86
Europe (Nordics)	Norway	0.89
South America	Argentina	0.83
South America	Paraguay	0.80
South America	Venezuela	0.88

Table 4-6 Measures of sampling adequacy (MSA)

All this has allowed assuming that conducting factor analysis is reasonable in all countries.

To determine the number of factors to be extracted by means of PCA, the Kaiser criterion was used first in the case of all countries.

Factor interpretation and naming were started then on the base of the rotated component matrices obtained after conducting the Varimax rotation. The name of a factor had to present the collective term for all variables highly loaded on it. At that stage, it was noticed that, in the case of some countries, factors were too aggregated, and their further diversification was required. Correspondingly, factor solutions with a bigger number of factors were inquired. The final factor solutions chosen in the case of each country as well as the respective percentages of the total variance explained by extracted factors individually and cumulatively are

demonstrated in Table 4-7. Statement compositions of the factors can be found in Appendix A-1.

Region	Country	Factors	% of total variance explained	Cumulative %
Africa	South Africa	Quality Brand glamor Sensitivity and mildness	27.78 15.23 8.15	51.16
Asia	China	Quality Brand glamor Sensitivity and mildness	32.34 15.44 7.67	55.44
Asia	Hong Kong	Quality Brand glamor Sensitivity and mildness	32.45 18.02 8.08	58.56
Asia	Indonesia	Quality Sensitivity and mildness Brand glamor	30.53 12.25 8.10	50.90
Asia	Korea	Quality Sensitivity and mildness Brand glamour	32.83 13.04 7.14	53.00
Asia	Philippines	Sensitivity, mildness, and effectiveness Quality Brand popularity	31.52 10.71 10.45	52.68
Asia	Taiwan	Quality Mildness, sensitivity, and effectiveness Brand glamor	38.74 12.89 8.25	59.88
Asia	Thailand	Quality Brand glamor Sensitivity and mildness	32.61 13.42 8.18	54.21
Australia	Australia	Quality Brand glamor Sensitivity and mildness	30.24 14.84 9.06	54.13
Europe	Belgium	Sensitivity and quality Brand glamor Good value for money Pleasant fragrance	32.13 14.85 6.90 6.57	60.46
Europe	Germany	Quality Brand glamor Sensitivity and mildness	37.62 14.98 6.68	59.28
Europe	Italy	Quality Sensitivity and mildness Brand glamor	35.09 15.52 6.60	57.21

Europe	Netherlands	Quality Brand glamor Sensitivity and mildness Pleasant fragrance	30.65 14.84 8.50 7.26	61.25
Europe	Spain	Quality and mildness Brand glamor Suitability for sensitive skin	37.09 15.53 5.96	58.58
Europe	Switzerland	Quality Brand glamor Sensitivity and mildness	32.38 15.70 8.43	56.50
Europe (East)	Russia	Quality Sensitivity and mildness Brand glamor	32.77 12.08 7.37	52.22
Europe (Nordics)	Denmark	Sensitivity and mildness Brand glamor and progressiveness Quality	33.46 15.77 8.04	57.27
Europe (Nordics)	Norway	Quality Sensitivity and mildness Brand glamor	38.93 13.21 7.75	59.89
South America	Argentina	Mildness and effectiveness Brand glamor Quality and value	28.61 12.73 8.07	49.40
South America	Paraguay	Quality Product excellence Brand popularity Sensitivity and mildness	28.14 11.77 7.84 7.79	55.55
South America	Venezuela	Quality and mildness Product excellence Brand glamor	35.64 11.85 7.11	54.60

Table 4-7 Final factor solutions

4.6.1.2 Finding Cluster Solutions

4.6.1.2.1 Segmentation Approach Based on Ward's Method

Cluster analysis based on the Ward's method was used as the first approach to separating respondents into groups. All necessary calculations were done by means of the **Cluster procedure** of the SPSS software.

The SPSS software has transformed factor values for all respondents into squared Euclidean distances between them. The Ward's method was applied then to the obtained distance matrix.

The first hint about the number of clusters, at which combining of respondents had to be stopped, was obtained through examining increases in values of the error sum of squares at the last ten[448] fusion steps (see Appendix A-2) and finding a relatively significant increase among them (see Table 4-8).[449] The final decision about the number of clusters in a cluster solution was made afterwards in accordance with meaningfulness of cluster interpretation.

Region	**Country**	**Step with a relatively significant increase in the error sum of squares**
Africa	South Africa	# 797 (5 clusters are being combined to 4) # 798 (4 clusters are being combined to 3)
Asia	China	# 795 (6 clusters are being combined to 5) # 797 (4 clusters are being combined to 3)
Asia	Hong Kong	# 499 (6 clusters are being combined to 5) # 500 (5 clusters are being combined to 4)
Asia	Indonesia	# 822 (5 clusters are being combined to 4) # 823 (4 clusters are being combined to 3)
Asia	Korea	# 496 (5 clusters are being combined to 4) # 497 (4 clusters are being combined to 3)
Asia	Philippines	# 497 (4 clusters are being combined to 3)
Asia	Taiwan	# 500 (5 clusters are being combined to 4) # 501 (4 clusters are being combined to 3)
Asia	Thailand	# 996 (5 clusters are being combined to 4) # 997 (4 clusters are being combined to 3)
Australia	Australia	# 577 (5 clusters are being combined to 4) # 578 (4 clusters are being combined to 3)
Europe	Belgium	# 367 (6 clusters are being combined to 5) # 369 (4 clusters are being combined to 3)
Europe	Germany	# 1042 (6 clusters are being combined to 5) # 1044 (4 clusters are being combined to 3)
Europe	Italy	# 518 (4 clusters are being combined to 3)

[448] This number corresponds to the first rough assumption about the possible maximum number of clusters in a cluster solution, which was equal to ten.
[449] Two- and three-cluster solutions were not taken into consideration here as too aggregated.

Europe	Netherlands	# 486 (6 clusters are being combined to 5) # 487 (5 clusters are being combined to 4) # 488 (4 clusters are being combined to 3)
Europe	Spain	# 751 (5 clusters are being combined to 4)
Europe	Switzerland	# 502 (5 clusters are being combined to 4) # 503 (4 clusters are being combined to 3)
Europe (East)	Russia	# 1195 (6 clusters are being combined to 5) # 1196 (5 clusters are being combined to 4) # 1197 (4 clusters are being combined to 3)
Europe (Nordics)	Denmark	# 395 (6 clusters are being combined to 5) # 397 (4 clusters are being combined to 3)
Europe (Nordics)	Norway	# 361 (6 clusters are being combined to 5) # 362 (5 clusters are being combined to 4)
South America	Argentina	# 512 (5 clusters are being combined to 4) # 513 (4 clusters are being combined to 3)
South America	Paraguay	# 398 (5 clusters are being combined to 4)
South America	Venezuela	# 795 (6 clusters are being combined to 5) # 797 (4 clusters are being combined to 3)

Table 4-8 Clustering steps with a relatively significant increase in the error sum of squares

4.6.1.2.2 Segmentation Approach Based on K-means Method

Cluster analysis based on the K-means method was used as the second approach to separating respondents into groups. In this case, all necessary calculations were done by means of the **Quick Cluster procedure** of the SPSS software.

The K-means method was applied to the factor values directly. It was decided to run the optimization-partitioning algorithm for up to ten[450] clusters in a cluster solution. Values of the within-groups sum of squares were then plotted against corresponding quantities of clusters (see Appendix A-3). Relatively sharp decreases in these values served as an approximate indication of a correct number of clusters in a cluster solution (see Table 4-9).[451] These cluster quantities were then reviewed while assessing meaningfulness of cluster interpretation.

[450] Again, this number corresponds to the first rough assumption about the possible maximum number of clusters in a cluster solution, which was equal to ten.
[451] Two- and three-cluster solutions were not taken into consideration here as too aggregated.

Region	Country	Relatively sharp decrease in the within-groups sum of squares is found
Africa	South Africa	at 4 clusters at 6 clusters
Asia	China	at 5 clusters at 6 clusters
Asia	Hong Kong	at 4 clusters
Asia	Indonesia	at 4 clusters at 6 clusters
Asia	Korea	at 4 clusters
Asia	Philippines	at 4 clusters
Asia	Taiwan	at 5 clusters
Asia	Thailand	at 4 clusters at 5 clusters
Australia	Australia	at 4 clusters at 5 clusters
Europe	Belgium	at 5 clusters
Europe	Germany	at 4 clusters at 5 clusters
Europe	Italy	at 4 clusters
Europe	Netherlands	at 4 clusters at 5 clusters at 6 clusters
Europe	Spain	at 4 clusters
Europe	Switzerland	at 4 clusters at 5 clusters
Europe (East)	Russia	at 4 clusters at 6 clusters at 7 clusters
Europe (Nordics)	Denmark	at 4 clusters at 6 clusters
Europe (Nordics)	Norway	at 4 clusters at 5 clusters at 6 clusters
South America	Argentina	at 4 clusters at 6 clusters
South America	Paraguay	at 4 clusters at 8 clusters
South America	Venezuela	at 4 clusters

Table 4-9 Quantities of clusters, at which a sharp decrease in the within-groups sum of squares was found

4.6.1.2.3 Segmentation Approach Based on Self-Organizing Map

Segmentation analysis based on the Self-Organizing Map was used as the third approach to separating respondents into groups. The necessary operations for creation, visualization and assessment of topology-preserving maps were done by means of the **NENET software**[452] developed in 1997 at the Helsinki University of Technology as a user-friendly program illustrating the use of SOM.[453]

Not factor values, but the fourteen basis variables (requirements towards a product/brand) were used here as a data input. This can be explained by the fact that, as it was already mentioned in part 3.5.2.2 of the present thesis, PCA transforms data in a linear way, whereas SOM – in a nonlinear one, and thus the low-dimensional data space created by SOM approximates the original data space more precisely. Therefore, conducting PCA before SOM should be avoided.

First of all, the NENET software has **initialized** maps consisting of Kohonen-neurons with randomly assigned weight vectors. To guarantee effectiveness of visual presentation, it was decided to use a hexagonal type of a neuron arrangement. The choice of a map size in the case of each country was made after experimenting with about thirty maps having different sizes and proportions. It was based on:

- evaluation of the map goodness using the average quantization error, topographic error, and percentage of used Kohonen-neurons criteria;
- visual inspection of obtained cluster regions and examining their size, form, and clearness of their borderlines;[454]
- assessment of meaningfulness of cluster interpretation.

Then, the initialized maps were **trained** by the NENET software. In other words, randomly initialized weights were adapted to input vectors presenting the fourteen product/brand requirements of respondents according to the SOM learning process described in part 3.5.2.2.2 of the present thesis. It was decided to use a neighborhood function of a Gaussian form. The length of the POW phase was calculated according to the next equation:

[452] According to http://koti.mbnet.fi/~phodju/nenet/Nenet/General.html, NENET stands for "Neural Networks Tool".
[453] See Kohonen, 2001, p. 318 and http://koti.mbnet.fi/~phodju/nenet/Nenet/General.html.
[454] The analysis was based on the U-matrix, hit histogram of input vectors, and component planes.

$$L_{pow} = L_x \cdot L_y \cdot 5, \quad (4\text{-}1)$$

where

L_x, L_y are lengths of map sides (measured in neurons)

The FTW phase was hundred times longer than the POW phase.[455]

At the beginning of the adaptation process the width parameter $\sigma(t_z)$ was set to the value equal to approximately 70% of the longer map side, and the learning-rate factor $\alpha(t_z)$ – to the value equal to 0.9. Both parameters were presented by the NENET software in the form of linear monotonically decreasing functions of time. After the POW phase, the width parameter $\sigma(t_z)$ was reduced to the value equal to 3, and learning-rate factor $\alpha(t_z)$ – to the value equal to 0.02.[456]

The size of the eventually chosen map in the case of each country together with a corresponding number of iteration steps in the POW and FTW phases and corresponding starting value of the width parameter $\sigma(t_z)$ in the POW phase are presented in Table 4-10.

The definition of cluster regions was done in the next stepwise way:

- small and very clear cluster regions were identified first;
- thereafter, the similarity of neighboring cluster regions was assessed using the U-matrix, hit histogram of input vectors, and component planes as well as cluster profiles consisting of cluster centroids for each variable presented in the form of a table;
- then, the most similar neighboring cluster regions were combined to bigger cluster regions and so on.

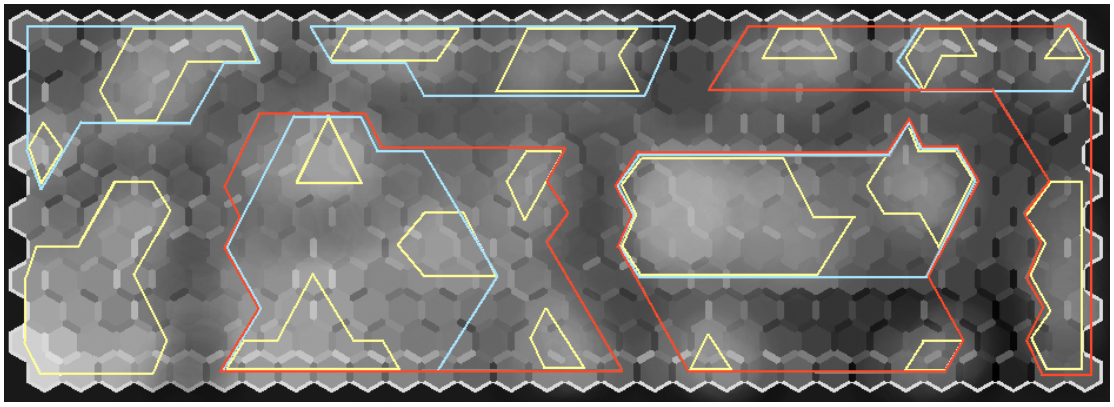
[455] The choice of the length of both phases was made on the base of recommendations presented in part 3.5.2.2.2 of this thesis.
[456] The choice of the parameter values was made on the base of recommendations presented in part 3.5.2.2.2 of this thesis.

Region	Country	Length of map side X (neurons)	Length of map side Y (neurons)	Number of iteration steps		Width parameter $\sigma(t_z)$
				POW	FTW	POW
Africa	South Africa	30	17	2550	255000	21
Asia	China	35	17	2975	297500	25
Asia	Hong Kong	30	17	2550	255000	21
Asia	Indonesia	30	12	1800	180000	21
Asia	Korea	30	12	1800	180000	21
Asia	Philippines	35	12	2100	210000	25
Asia	Taiwan	30	10	1500	150000	21
Asia	Thailand	25	10	1250	125000	18
Australia	Australia	25	12	1500	150000	18
Europe	Belgium	35	16	2800	280000	25
Europe	Germany	35	14	2450	245000	25
Europe	Italy	30	13	1950	195000	21
Europe	Netherlands	30	15	2250	225000	21
Europe	Spain	35	15	2625	262500	25
Europe	Switzerland	30	15	2250	225000	21
Europe (East)	Russia	30	11	1650	165000	21
Europe (Nordics)	Denmark	25	12	1500	150000	18
Europe (Nordics)	Norway	30	10	1500	150000	21
South America	Argentina	40	18	3600	360000	28
South America	Paraguay	40	17	3400	340000	28
South America	Venezuela	40	12	2600	260000	28

Table 4-10 SOM parameters

It should be mentioned that some neurons (correspondingly, respondents) could not be assigned to the final cluster regions (see, for instance, Figure 4-5). They were normally positioned in the so-called "transitional" areas between clusters. It was rather difficult to make a clear decision about cluster membership of respondents assigned to "transitional" neurons on the base of visual inspection of a map and examination of respondents' and cluster profiles. Therefore, it was decided to quantify similarities between profiles of respondents and clusters

through Euclidean distances and assign each of the respondents to a cluster with the corresponding smallest Euclidean distance.



where
initial cluster regions are outlined with yellow
combinations of several initial cluster regions (i.e., cluster regions of the second level) are outlined with light-blue
combinations of cluster regions of the second level and initial cluster regions (i.e., cluster regions of the third level) are outlined with red

Figure 4-5 Cluster regions (example of the U-matrix)

4.6.1.3 Validation of Cluster Solutions

For more precise validation, description and interpretation of cluster solutions, it was decided to consider the fourteen basis variables (requirements towards a product/brand) instead of the factors in all obtained solutions.

In order to examine stability of cluster solutions, the outcomes of the three approaches to separating respondents into groups presented above were compared in the case of each country. After visual inspection and confrontation of cluster profiles consisting of cluster centroids for each variable presented in the form of a table[457], it was concluded that obtained solutions were very alike.

To assess homogeneity within the clusters and heterogeneity between them, the respective F-values and t-values were calculated for the fourteen basis variables. As far as majority of F-values were below one, and there were completely homogeneous or highly homogeneous clusters in each solution (see Table 4-11), it

[457] In order to keep a good overview of the variables, they were grouped inside the cluster profiles according to the factors they belonged to.

was concluded that all obtained cluster solutions consisted of rather homogeneous clusters.

Region	Country	Number of completely homogeneous clusters (all F-values are below 1)			Number of highly homogeneous clusters (number of F-values above 1 is three or less)		
		Ward's	K-means	SOM	Ward's	K-means	SOM
Africa	South Africa	2	1	2	2	1	3
Asia	China	1	1	2	2	2	3
Asia	Hong Kong	3	2	3	4	3	6
Asia	Indonesia	1	1	1	1	1	3
Asia	Korea	0	1	1	3	2	5
Asia	Philippines	1	1	1	3	1	3
Asia	Taiwan	4	3	3	4	4	4
Asia	Thailand	1	1	3	3	3	5
Australia	Australia	2	0	0	3	3	3
Europe	Belgium	1	0	3	3	2	4
Europe	Germany	2	2	1	4	4	5
Europe	Italy	1	1	2	2	2	4
Europe	Netherlands	1	1	2	4	2	4
Europe	Spain	1	1	3	3	2	6
Europe	Switzerland	1	1	2	2	2	3
Europe (East)	Russia	1	1	2	2	2	2
Europe (Nordics)	Denmark	0	0	2	3	2	3
Europe (Nordics)	Norway	2	1	2	3	3	4
South America	Argentina	1	1	1	2	2	3
South America	Paraguay	1	1	2	1	1	3
South America	Venezuela	1	1	2	1	1	3

Table 4-11 Quantities of completely homogeneous and highly homogeneous clusters

Nevertheless, it should be emphasized that solutions found using SOM normally included the biggest number of completely/highly homogeneous clusters. In other words, it can be assumed that SOM tended to build the most homogeneous clusters in comparison to the Ward's and K-means methods.

While considering t-values, one could definitely notice existence of significant differences between clusters in all solutions. Furthermore, the results of discriminant analyses have demonstrated that in each case

- there were very high canonical correlation coefficients;[458]
- significance levels of χ^2 values calculated from values of the Wilks's lambda for residual discrimination were low;
- percentages of correctly classified respondents in majority of the countries were close to 90% (see Table 4-12)[459].

Region	Country	% of correctly classified respondents		
		Ward's	K-means	SOM
Africa	South Africa	90.0	92.4	86.6
Asia	China	84.9	93.4	83.6
Asia	Hong Kong	89.5	93.7	87.3
Asia	Indonesia	86.2	93.3	84.5
Asia	Korea	87.8	94.4	88.2
Asia	Philippines	92.6	90.8	90.0
Asia	Taiwan	89.1	93.1	90.5
Asia	Thailand	87.4	91.9	88.4
Australia	Australia	90.0	91.7	88.6
Europe	Belgium	90.1	90.9	90.1
Europe	Germany	86.9	93.3	89.1
Europe	Italy	89.6	92.7	87.1
Europe	Netherlands	87.2	93.9	88.6
Europe	Spain	86.5	91.8	91.5
Europe	Switzerland	91.9	91.9	85.0
Europe (East)	Russia	89.9	88.9	86.9
Europe (Nordics)	Denmark	87.5	91.5	87.8
Europe (Nordics)	Norway	90.4	94.0	89.3
South America	Argentina	91.7	91.7	85.9
South America	Paraguay	89.3	90.5	89.3
South America	Venezuela	90.8	91.0	89.9

Table 4-12 Percentages of respondents classified by discriminant analysis correctly

[458] The definition of correlation coefficients > 0.7 as very high ones presented in Backhaus/ Erichson/Plinke/Weiber, 2003, p. 273 was considered here.
[459] In the case of solutions found by the K-means method, some percentages of correctly classified respondents were even close to 95%.

These observations have proved that all cluster solutions consisted of clusters differing from each other significantly and constituted reliable partitions of respondents.

4.6.1.4 Description and Interpretation of Cluster Solutions

To describe and interpret the clusters, cluster profiles consisting of average values of the fourteen basis variables (requirements towards a product/brand) were considered first. In particular, they were examined and compared to corresponding total sample profiles. Thereby, it was distinguished between the next five deviation levels:

- **deviations lying in the interval [10%; +∞)**: high positive deviations of cluster centroids from corresponding total sample centroids;
- **deviations lying in the interval (5%; 10%)**: middle-high positive deviations of cluster centroids from corresponding total sample centroids;
- **deviations lying in the interval [-5%; 5%]**: (almost) equal cluster centroids and corresponding total sample centroids;
- **deviations lying in the interval (-5%; -10%)**: middle-high negative deviations of cluster centroids from corresponding total sample centroids;
- **deviations lying in the interval (-10%; -∞)**: high negative deviations of cluster centroids from corresponding total sample centroids.

Positive (negative) deviations of cluster centroids from total sample centroids were interpreted as indicators of basis variables (requirements towards a product/brand), which were important (unimportant) for members of a corresponding cluster. Moreover, it was assumed that, in the clusters with overall low level of importance of basis variables, deviations of cluster centroids from total sample centroids lying in the intervals [-5%; 5%] and (-5%; -10%) pointed at relatively important basis variables (requirements towards a product/brand).

Such description and interpretation procedure has helped to name the clusters (see Appendix A-4). Moreover, it has also contributed to making the final decision with regard to the number of clusters in a cluster solution in the case of segmentation approaches based on the Ward's and K-means methods and has been constantly facilitating conduction of segmentation analyses in the case of SOM.

In addition, the clusters were described by means of the descriptor variables presented in part 4.5 of this thesis. As far as such descriptor variables as requirements towards a product/brand not used for cluster building and attitudes towards beauty/life were measured on a seven point rating scale, the procedure of cluster description and interpretation based on these variables was analogous to the one used in the case of basis variables (requirements towards a product/brand). In the case of all other descriptor variables (in particular, demographic characteristics (respondent's age and marital status, number of people in a household, respondent's employment status and education level, children in a household, respondent's monthly household income and social class, respondent's living location), brand assessments (prompted awareness, likeability, usage, prompted advertising recall of brands), skin conditions (face skin type and sensitivity, body skin type and sensitivity), and behavioral characteristics (media usage and point of purchase)), not centroids, but percentages of affirmative answers of respondents in each of the clusters were compared to corresponding percentages in the total sample.

4.6.1.5 Finding Transnational Segments

4.6.1.5.1 Identification of Common Features

As cluster description and interpretation have demonstrated, there were alike segments in different countries. They could be combined into the next ten transnational segments.

1. Highly demanding

Table 4-13 presents the general structure of "Highly demanding" transnational segment.

Importance level	Requirements towards a product/brand
High	All
Middle	-
Low	-

Table 4-13 Structure of "Highly demanding" transnational segment

The segment can be described verbally as follows:

- All requirements of these women are high.
- They select modern and highly advertised brands offering attractive products with which they can indulge themselves. At the same time, quality, mildness, and skin caring effects as well as usage convenience and accessibility of the products have to be on the highest level. They believe that premium brands are more likely to provide them with all these benefits than retail or no-name brands.
- A personal attitude to a brand influences buying behavior of these women a lot: they have to like and trust a brand; they want a brand to fit their image and emphasize their personality.
- These women always try to look nice and stylish. They follow fashion and spend lots of time and money on taking care of their appearance.
- They want to be successful in all their undertakings.
- These women normally belong to rich families. They often prefer to stay at home rather than to work. If they work, they occupy only high positions.
- List of countries, where country-specific segments included into this transnational segment were found in the case of the three segmentation approaches, is shown in Table 4-14.

Country	Segmentation approach based on		
	Ward's method	K-means method	SOM
South Africa	x	x	x
China	x	x	x
Hong Kong	x	x	x
Indonesia		x	x
Korea		x	x
Philippines	x	x	x
Taiwan	x	x	x
Thailand	x	x	
Australia	x	x	x
Belgium	x	x	x
Germany	x	x	x
Italy	x	x	
Netherlands	x	x	x
Spain	x	x	x
Switzerland	x	x	x
Russia	x	x	x
Denmark	x		x
Norway	x	x	x
Argentina	x	x	x
Paraguay	x	x	x
Venezuela	x	x	x

Table 4-14 "Highly demanding" segments found

2. Rational demanding

Table 4-15 presents the general structure of "Rational demanding" transnational segment.[460]

Importance level	Requirements towards a product/brand
High	Products offer good value for money Products are of high quality It is a trustworthy brand Products fulfill current expectations towards skin care Products perform better than those of other brands Products contain highly effective ingredients This brand offers mild skin care products Products are suitable for sensitive skin Products rely on the latest scientific findings Products are highly appropriate for skin This brand is for demanding women who give importance to their appearance
Middle	This brand is highly advertised It is a modern brand Products have a pleasant fragrance
Low	-

Table 4-15 Structure of "Rational demanding" transnational segment

The segment can be described verbally as follows:

- Rational demanding can be viewed as a special case of highly demanding respondents.
- Here one talks about much more rational women. Such factors as advertising and brand modernity influence them to a significantly lower degree. In the first place, they tend to be interested in functional benefits of products, and, only afterwards, in what a commercial says or what is in trend.

[460] It should be mentioned that due to the fact that, in the case of segmentation approaches based on the Ward's and K-means methods, this segment was found only in one country, it can be viewed as transnational segment only in the case of the segmentation approach based on SOM.

- These women tend to be highly educated, to occupy high positions, and to have high incomes. They always want to be ahead of others, to be the best.
- List of countries, where country-specific segments included into this transnational segment were found in the case of the three segmentation approaches, is shown in Table 4-16.

Country	Segmentation approach based on		
	Ward's method	K-means method	SOM
China			x
Hong Kong			x
Indonesia			x
Korea			x
Taiwan		x	x
Thailand			x
Belgium			x
Germany	x		x
Italy			x
Netherlands			x
Spain			x
Switzerland			x
Norway			x
Paraguay			x
Venezuela			x

Table 4-16 "Rational demanding" segments found

3. Rationalists

Table 4-17 presents the general structure of "Rationalists" transnational segment.

Importance level	Requirements towards a product/brand
High	Products offer good value for money Products are of high quality It is a trustworthy brand Products fulfill current expectations towards skin care Products contain highly effective ingredients This brand offers mild skin care products Products are suitable for sensitive skin Products are highly appropriate for skin
Middle	Products perform better than those of other brands Products rely on the latest scientific findings Products have a pleasant fragrance
Low	This brand is highly advertised It is a modern brand This brand is for demanding women who give importance to their appearance

Table 4-17 Structure of "Rationalists" transnational segment

The segment can be described verbally as follows:

- Women included into this segment are not at all interested in modernity or attractiveness of skin care products.
- They are not influenced by advertising, but rather have their personal expectations towards skin care, which are concentrated on protection and moisturizing of their skin by means of highly efficient, mild and convenient products.
- These women do not attempt to create an image, but try to remain themselves and expect other people to take them just as they are.
- They want their life to be stable and secure: they like to follow a well-organized routine, never buy things on impulse, prefer to use

dermatologically tested products or products of highly experienced skin care brands, and tend to stick to their favorite brands.

- These women are normally of mature years. Their level of education is far above average. They work on middle or high positions, earn good money, and take care of their family.
- List of countries, where country-specific segments included into this transnational segment were found in the case of the three segmentation approaches, is shown in Table 4-18.

Country	Segmentation approach based on		
	Ward's method	K-means method	SOM
South Africa	x	x	x
China	x	x	x
Hong Kong	x	x	x
Indonesia	x	x	x
Korea	x	x	x
Philippines	x	x	x
Taiwan	x		
Thailand	x	x	x
Australia	x	x	x
Belgium	x	x	x
Germany	x	x	x
Italy	x	x	x
Netherlands	x	x	x
Spain	x	x	x
Switzerland	x	x	x
Russia	x	x	x
Denmark	x	x	x
Norway	x	x	x
Argentina	x	x	x
Paraguay	x	x	x
Venezuela	x	x	x

Table 4-18 "Rationalists" segments found

4. Good quality at a fair price

Table 4-19 presents the general structure of "Good quality at a fair price" transnational segment.

Importance level	Requirements towards a product/brand
High	Products offer good value for money Products are of high quality It is a trustworthy brand Products fulfill current expectations towards skin care
Middle	Products perform better than those of other brands Products contain highly effective ingredients
Low	This brand is highly advertised It is a modern brand This brand offers mild skin care products Products are suitable for sensitive skin Products rely on the latest scientific findings Products are highly appropriate for skin Products have a pleasant fragrance This brand is for demanding women who give importance to their appearance

Table 4-19 Structure of "Good quality at a fair price" transnational segment

The segment can be described verbally as follows:

- This segment includes women wanting to pay a fair price for products of at least good quality, which are readily accessible and uncomplicated in use.
- These women normally have healthy (normal and not sensitive) skin. Correspondingly, they are not interested in such product benefit as mildness.
- They do not care about public image of a brand. Brands can gain their trust only through fulfillment of their personal expectations towards skin care.
- The motto of the members of this segment can be stated as follows: "Pay only for what you really need".

- They are very pragmatic. They never mind to make use of special offers or to buy products through the internet. They are likely to use one and the same products for both their face and body.
- They do not have any special fantasies with regard to skin care: they do not try to indulge themselves, but just want to feel comfortable with the products they use; they do not need to demonstrate anything to people in their circle – they just do their own thing, regardless of what others think.
- These women normally study or work. In fact, both women with money and women with limited budgets can be found in this group.
- List of countries, where country-specific segments included into this transnational segment were found in the case of the three segmentation approaches, is shown in Table 4-20.

Country	Segmentation approach based on		
	Ward's method	K-means method	SOM
South Africa	x	x	x
China		x	x
Hong Kong	x	x	x
Korea	x	x	x
Philippines	x	x	x
Taiwan	x	x	x
Australia	x	x	x
Belgium	x		x
Italy	x	x	x
Netherlands	x	x	x
Spain	x	x	x
Switzerland	x	x	x
Russia	x	x	x
Norway	x	x	x
Argentina	x	x	x
Paraguay	x	x	x
Venezuela		x	x

Table 4-20 "Good quality at a fair price" segments found

5. Quality and good value for money from a strong brand

Table 4-21 presents the general structure of "Quality and good value for money from a strong brand" transnational segment.

Importance level	Requirements towards a product/brand
High	Products offer good value for money Products are of high quality It is a trustworthy brand Products fulfill current expectations towards skin care
Middle	Products perform better than those of other brands Products contain highly effective ingredients This brand is highly advertised It is a modern brand This brand is for demanding women who give importance to their appearance
Low	This brand offers mild skin care products Products are suitable for sensitive skin Products rely on the latest scientific findings Products are highly appropriate for skin Products have a pleasant fragrance

Table 4-21 Structure of "Quality and good value for money from a strong brand" transnational segment

The segment can be described verbally as follows:

- The only difference between this segment and the previous one is that these women consider positive public image of a brand as quite important. Buying products of well-known, leading brands assures them that the products are of good quality.
- Obviously, one talks here about different approach to building trust in a brand. These women prefer to rely on the feedback of others, rather than to form their opinion through trial and error.
- List of countries, where country-specific segments included into this transnational segment were found in the case of the three segmentation approaches, is shown in Table 4-22.

Country	Segmentation approach based on		
	Ward's method	K-means method	SOM
China	x		
Indonesia	x	x	x
Thailand	x	x	x
Germany	x	x	x
Venezuela	x		

Table 4-22 "Quality and good value for money from a strong brand" segments found

6. Brand glamor driven mainstream

Table 4-23 presents the general structure of "Brand glamor driven mainstream" transnational segment.[461]

Importance level	Requirements towards a product/brand
High	This brand is highly advertised It is a modern brand Products have a pleasant fragrance This brand is for demanding women who give importance to their appearance
Middle	Products offer good value for money Products are of high quality It is a trustworthy brand Products fulfill current expectations towards skin care Products perform better than those of other brands Products contain highly effective ingredients This brand offers mild skin care products Products are suitable for sensitive skin Products rely on the latest scientific findings Products are highly appropriate for skin
Low	-

Table 4-23 Structure of "Brand glamor driven mainstream" transnational segment

[461] It should be mentioned that due to the fact that, in the case of the segmentation approach based on the K-means method, this segment was found only in one country, it can be viewed as transnational segment only in the case of segmentation approaches based on the Ward's method and SOM.

The segment can be described verbally as follows:

- These women use skin care products to make their life more exciting and colorful. An attractive packaging, rare design, label of an exclusive and fashionable brand – that is what they need.
- They are easily influenced by all kinds of advertising. Trying a sample often encourages them to buy a product. They are addicted to buying products for their beauty and often spend more money on them than they plan.
- Of course, they expect products to be of at least good quality, but, in the first place, they just want to indulge themselves and do not think too rationally.
- As far as they normally have no skin problems, they do not have any special requirements with regard to mildness of products.
- These women are always seeking for beauty and pleasure in their life. Not only their personal appearance, but the whole world around them has to be admirable.
- They do care about opinion of others. They want the products they use to underline their lovely personality. They often need an advice or approval of people from their circle.
- These women normally belong to a middle social class. The level of their education is not very high.
- List of countries, where country-specific segments included into this transnational segment were found in the case of the three segmentation approaches, is shown in Table 4-24.

Country	Segmentation approach based on		
	Ward's method	K-means method	SOM
South Africa	x		x
China			x
Hong Kong	x		x
Indonesia	x		x
Korea	x		x
Philippines	x		x
Thailand			x
Belgium			x
Italy			x
Spain	x		x
Russia	x		x
Denmark	x	x	x
Argentina			x
Paraguay			x
Venezuela			x

Table 4-24 "Brand glamor driven mainstream" segments found

7. Only brand attractiveness driven (very little skin care involved)

Table 4-25 presents the general structure of "Only brand attractiveness driven (very little skin care involved)" transnational segment.

Importance level	Requirements towards a product/brand
High	This brand is highly advertised It is a modern brand
Middle	Products have a pleasant fragrance This brand is for demanding women who give importance to their appearance
Low	Products offer good value for money Products are of high quality It is a trustworthy brand Products fulfill current expectations towards skin care Products perform better than those of other brands Products contain highly effective ingredients This brand offers mild skin care products Products are suitable for sensitive skin Products rely on the latest scientific findings Products are highly appropriate for skin

Table 4-25 Structure of "Only brand attractiveness driven (very little skin care involved)" transnational segment

The segment can be described verbally as follows:

- Here one talks about much more spontaneous and much less skin care involved women than in the previous segment.
- They switch brands all the time. Trying a sample can easily make them buy a product.
- They do not really care about functional product characteristics – they just have to like a packaging and design.
- These women spend hours on pampering themselves. They cannot imagine going out without putting on make-up or fragrance. They dream of looking like models and stars in magazines.

- They like changes and surprises in their life. They are more likely to spend an evening together with their friends at the pub than watching TV on a cozy couch at home.
- These women are normally very young. They are singles. Many of them are students.
- List of countries, where country-specific segments included into this transnational segment were found in the case of the three segmentation approaches, is shown in Table 4-26.

Country	Segmentation approach based on		
	Ward's method	K-means method	SOM
Hong Kong		x	x
Korea	x	x	x
Taiwan	x	x	x
Thailand	x	x	
Australia	x	x	x
Belgium	x	x	x
Germany	x	x	x
Italy	x	x	x
Netherlands	x		x
Spain		x	x
Switzerland	x	x	x
Russia		x	
Norway	x	x	x
Argentina	x	x	x
Venezuela	x	x	x

Table 4-26 "Only brand attractiveness driven (very little skin care involved)" segments found

8. Sensitivity and mildness driven

Table 4-27 presents the general structure of "Sensitivity and mildness driven" transnational segment.

Importance level	Requirements towards a product/brand
High	This brand offers mild skin care products Products are suitable for sensitive skin Products are highly appropriate for skin
Middle	Products offer good value for money Products are of high quality It is a trustworthy brand Products fulfill current expectations towards skin care Products perform better than those of other brands Products contain highly effective ingredients Products rely on the latest scientific findings Products have a pleasant fragrance
Low	This brand is highly advertised It is a modern brand This brand is for demanding women who give importance to their appearance

Table 4-27 Structure of "Sensitivity and mildness driven" transnational segment

The segment can be described verbally as follows:

- Members of this segment need mild products, which are highly compatible to sensitive skin and therefore can be used everyday.
- These women tend to have problematic (dry and sensitive) skin. Taking care of it, protecting and moisturizing it are always in their minds.
- The lifestyle of these women is quite simple. They do not look for products, which could help them to create image, but rather for products, which could help them to feel well. Products with natural ingredients or products recommended by dermatologists are more likely to draw their attention than attractive and modern products.

- All kinds of women can be found in this group: young and old, singles and married, poor and rich, well-educated and not.
- List of countries, where country-specific segments included into this transnational segment were found in the case of the three segmentation approaches, is shown in Table 4-28.

Country	Segmentation approach based on		
	Ward's method	K-means method	SOM
Hong Kong	x		
Indonesia		x	x
Philippines	x	x	x
Taiwan			x
Australia	x	x	x
Belgium	x	x	x
Germany	x	x	x
Netherlands	x	x	x
Switzerland	x	x	x
Russia	x	x	x
Denmark	x	x	x
Norway	x	x	x
Argentina			x
Paraguay	x		x

Table 4-28 "Sensitivity and mildness driven" segments found

9. Moderate level of mildness from a popular and modern brand

Table 4-29 presents the general structure of "Moderate level of mildness from a popular and modern brand" transnational segment.

Importance level	Requirements towards a product/brand
High	This brand is highly advertised It is a modern brand This brand offers mild skin care products Products are suitable for sensitive skin Products are highly appropriate for skin
Middle	Products rely on the latest scientific findings Products have a pleasant fragrance This brand is for demanding women who give importance to their appearance
Low	Products offer good value for money Products are of high quality It is a trustworthy brand Products fulfill current expectations towards skin care Products perform better than those of other brands Products contain highly effective ingredients

Table 4-29 Structure of "Moderate level of mildness from a popular and modern brand" transnational segment

The segment can be described verbally as follows:

- Members of this segment are much more emotionally driven than members of the previous one.
- They also tend to have dry and sensitive skin. However, their skin is healthier, and they are not concentrated only on dealing with this problem. Of course, they expect the products they use to be mild, but they also do not mind them to be attractive and modern.
- These women like to experiment with brands. They tend to try and buy new products and can be easily influenced by advertising.
- While keeping their problematic skin in mind, they try to follow the latest trends and to buy innovative and popular brands.

- List of countries, where country-specific segments included into this transnational segment were found in the case of the three segmentation approaches, is shown in Table 4-30.

Country	Segmentation approach based on		
	Ward's method	K-means method	SOM
South Africa	x	x	x
China	x	x	x
Indonesia	x		
Taiwan	x	x	
Thailand	x	x	x
Argentina	x	x	

Table 4-30 "Moderate level of mildness from a popular and modern brand" segments found

10. Uninvolved

Table 4-31 presents the general structure of "Uninvolved" transnational segment.

Importance level	Requirements towards a product/brand
High	-
Middle	-
Low	All

Table 4-31 Structure of "Uninvolved" transnational segment

The segment can be described verbally as follows:

- Overall requirements of this group are very low. Skin care is obviously not high on the agenda of these women.
- The driving force of their buying behavior is very unclear. It seems that good value for money or mildness most likely to play this role.
- In the former case, one talks about women who have money saving in mind: they tend to look for special offers and to use multipurpose products.

Nevertheless, their buying behavior is much less deliberate than that of a "good quality at a fair price oriented" segment. For instance, they may buy a product just because it is the cheapest one, or because it smells nice.

- In the latter case, one talks about women who have to deal with some skin problems and are forced to look for a minimum level of mildness and protection.
- In general, one talks here about indifferent observers. They prefer just to be natural and do not really care about the opinion of others.
- Unemployed or housewives can be often found in this group. In other words, women who tend to spend their life at home.
- List of countries, where country-specific segments included into this transnational segment were found in the case of the three segmentation approaches, is shown in Table 4-32.

Country	Segmentation approach based on		
	Ward's method	K-means method	SOM
Hong Kong	x		x
Thailand			x
Spain	x		x
Denmark	x	x	x
Paraguay		x	

Table 4-32 "Uninvolved" segments found

Analysis of bar diagrams depicting the number of countries, where each particular transnational segment was found, has allowed making the following conclusions:

- **in the case of solutions found using the Ward's method:**
  - "Rationalists", "Highly demanding" and "Good quality at a fair price" groups have the broadest (i.e., the most "global") character (see Figure 4-6). Only these three groups extend across all five regions of the world (Africa, Asia, Australia, Europe, and South America).

- "Only brand attractiveness driven (very little skin care involved)" and "Sensitivity and mildness driven" groups extend across more than a half of all countries.
- "Rational demanding" is a national segment.

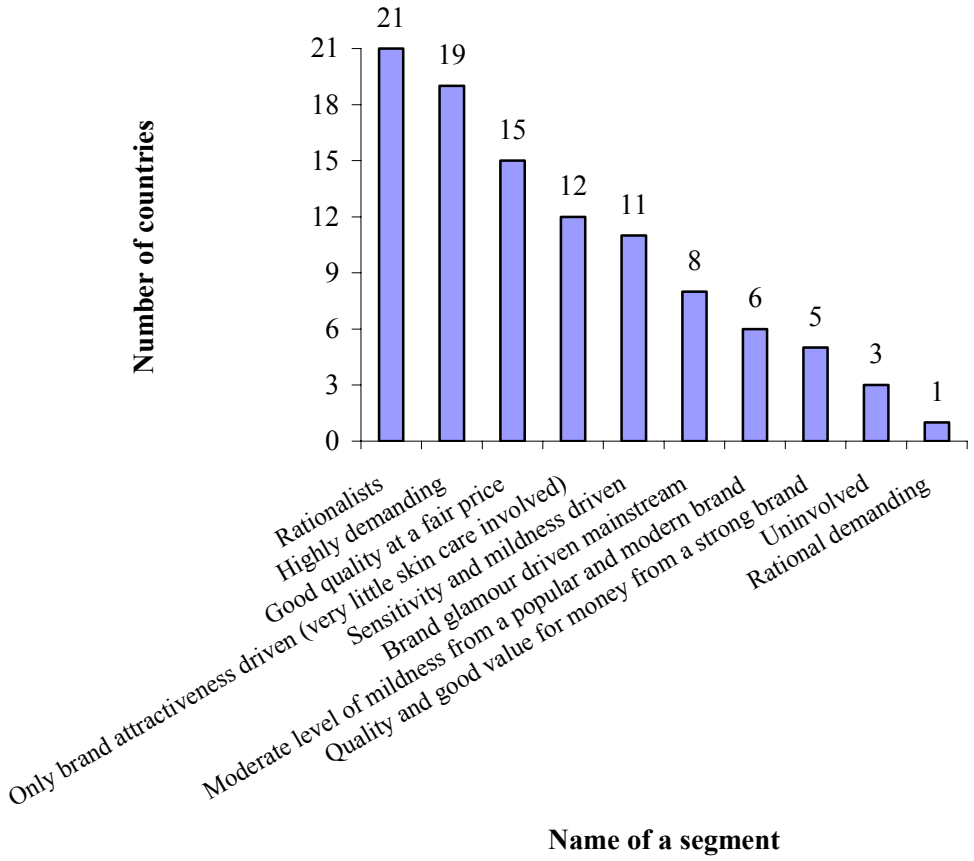


Figure 4-6 Number of countries, where a transnational segment was found (the Ward's method)

- **in the case of solutions found using the K-means method:**
  - "Highly demanding", Rationalists" and "Good quality at a fair price" groups have the broadest (i.e., the most "global") character (see Figure 4-7). Again, only these three groups extend across all five world regions.
  - "Only brand attractiveness driven (very little skin care involved)" group extends across more than a half of all countries.
  - "Rational demanding" and "Brand glamor driven mainstream" are national segments.

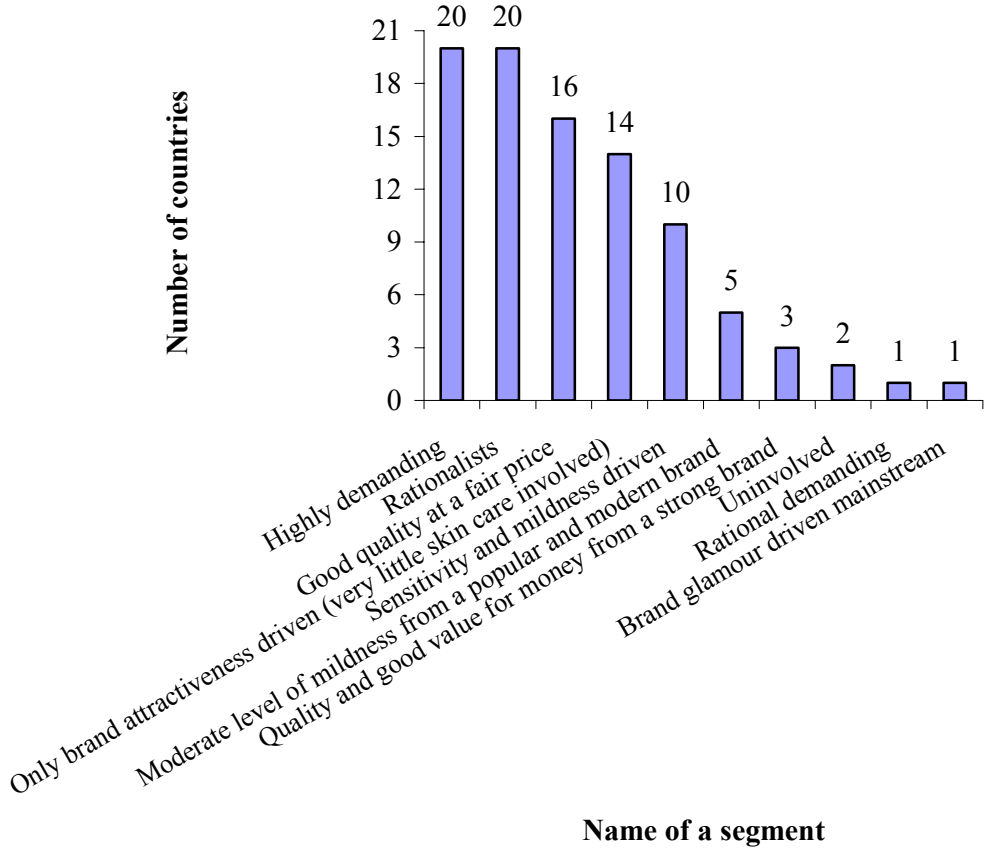


Figure 4-7 Number of countries, where a transnational segment was found (the K-means method)

- **in the case of solutions found using SOM:**
  - "Rationalists", "Highly demanding" and "Good quality at a fair price" groups have the broadest (i.e., the most "global") character and extend across all five world regions also here (see Figure 4-8).
  - Nevertheless, the total number of groups extending across more than a half of countries has increased in this case to seven.
  - All groups extend across national borders.

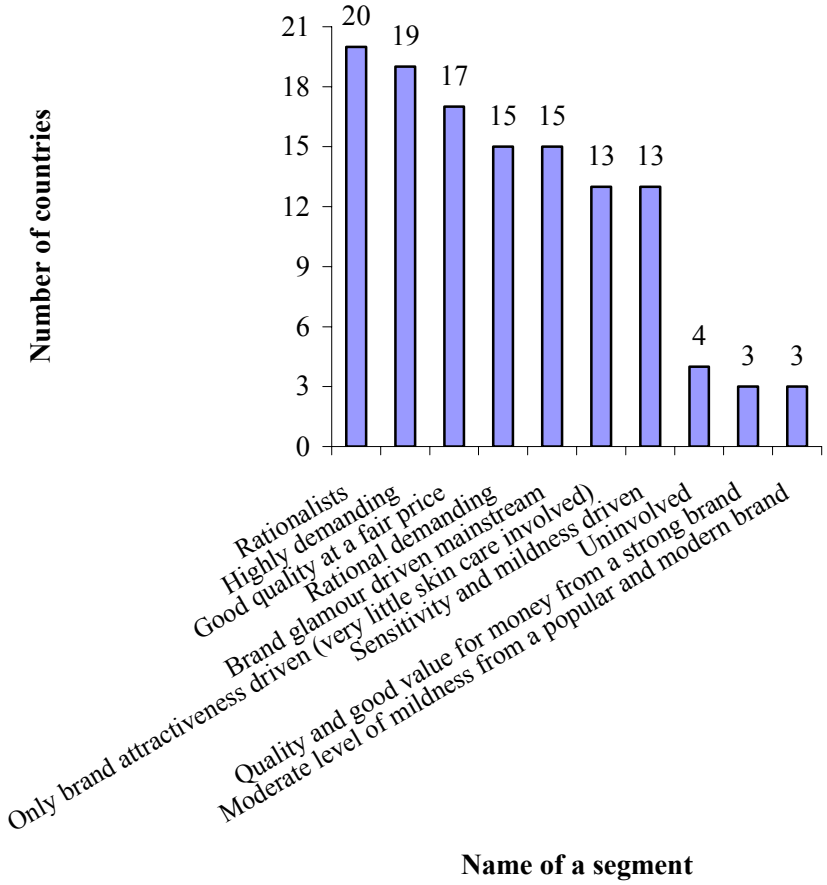


Figure 4-8 Number of countries, where a transnational segment was found (SOM)

The overview demonstrating presence of each of the ten transnational segments in the twenty one countries can be found in Table 4-33.

Country	Transnational segment									
	Highly demanding	Rational demanding	Rationalists	Good quality at a fair price	Quality and good value for money from a strong brand	Brand glamor driven mainstream	Only brand attractiveness driven (very little skin care involved)	Sensitivity and mildness driven	Moderate level of mildness from a popular and modern brand	Uninvolved
South Africa	w/k/s		w/k/s	w/k/s		w/s			w/k/s	
China	w/k/s	s	w/k/s	k/s	w	s			w/k/s	
Hong Kong	w/k/s	s	w/k/s	w/k/s		w/s	k/s	w		w/s
Indonesia	k/s	s	w/k/s		w/k/s	w/s		k/s	w	
Korea	k/s	s	w/k/s	w/k/s		w/s	w/k/s			
Philippines	w/k/s		w/k/s	w/k/s		w/s		w/k/s		
Taiwan	w/k/s	k/s	w	w/k/s			w/k/s	s	w/k	
Thailand	w/k	s	w/k/s		w/k/s	s	w/k		w/k/s	s
Australia	w/k/s		w/k/s	w/k/s			w/k/s	w/k/s		
Belgium	w/k/s	s	w/k/s	w/s		s	w/k/s	w/k/s		
Germany	w/k/s	w/s	w/k/s		w/k/s		w/k/s	w/k/s		
Italy	w/k	s	w/k/s	w/k/s		s	w/k/s			
Netherlands	w/k/s	s	w/k/s	w/k/s			w/s	w/k/s		
Spain	w/k/s	s	w/k/s	w/k/s		w/s	k/s			w/s
Switzerland	w/k/s	s	w/k/s	w/k/s			w/k/s	w/k/s		
Russia	w/k/s		w/k/s	w/k/s		w/s	k	w/k/s		
Denmark	w/s		w/k/s			w/k/s		w/k/s		w/k/s
Norway	w/k/s	s	w/k/s	w/k/s			w/k/s	w/k/s		
Argentina	w/k/s		w/k/s	w/k/s		s	w/k/s	s	w/k	
Paraguay	w/k/s	s	w/k/s	w/k/s		s		w/s		k
Venezuela	w/k/s	s	w/k/s	k/s	w	s	w/k/s			

Note:
w means that a segment belongs to a solution found using the Ward's method
k means that a segment belongs to a solution found using the K-means method
s means that a segment belongs to a solution found using SOM

Table 4-33 Presence of transnational segments in twenty one countries

4.6.1.5.2 Examples of Regional/Country-Specific Peculiarities

Not only common features, but also regional/country-specific peculiarities were identified while analyzing and combining country-specific segments. Most significant of them are presented below.

4.6.1.5.2.1 Differences in Demographic Characteristics, Brand Assessments, and Behavioral Characteristics

While combining country-specific segments into transnational ones, accepting a certain degree of divergence in demographic characteristics, brand assessments, and behavioral characteristics of country-specific segments appeared to be unavoidable.

For instance, education levels of respondents included into one and the same transnational segment and their professions differed from country to country. This can be explained by existence of distinctions in national educational systems and types of professions as well as in national social meanings of completing a particular degree or occupying a particular position.

Although there was normally no variation in country-specific relative levels of monthly household incomes (i.e., high, middle, low) of respondents included into one and the same transnational segment, clear differences were identified while comparing them cross-nationally. These differences should be addressed to distinctions in overall levels of monthly household incomes existing between the countries.

Moreover, there were differences in brand awareness, likeability, usage, and advertising recall. The reason for this is variation in the composition of brands as well as in their role and image across the countries.

Furthermore, choices of purchase locations varied from country to country. This is obviously due to differences in the number and type of distribution channels existing between the countries.

Finally, differences in media usage behavior were observed. They seem to be caused by variation in availability and prevalence of media types across the countries.

4.6.1.5.2.2 Differences in Character/Structure of Cluster Solution

During the analysis of country-specific segments, it was realized that regional/country-specific cultural or economic factors have often strongly influenced formation of segments and caused creation of regional/country-specific features in a character or structure of a cluster solution. Examples of such peculiarities are presented below.

South Africa

Dealing with South Africa means dealing with a multiracial society. According to the representative sample collected in South Africa, white, black, colored and Asian females live there. Of course, representatives of different races have different cultural backgrounds. Moreover, while comparing white and black females, it becomes clear that females of a white race still tend to belong to higher social classes than females of a black race (see Figure 4-9).[462] Correspondingly, clear racial differentiation can be observed between segments in South Africa.

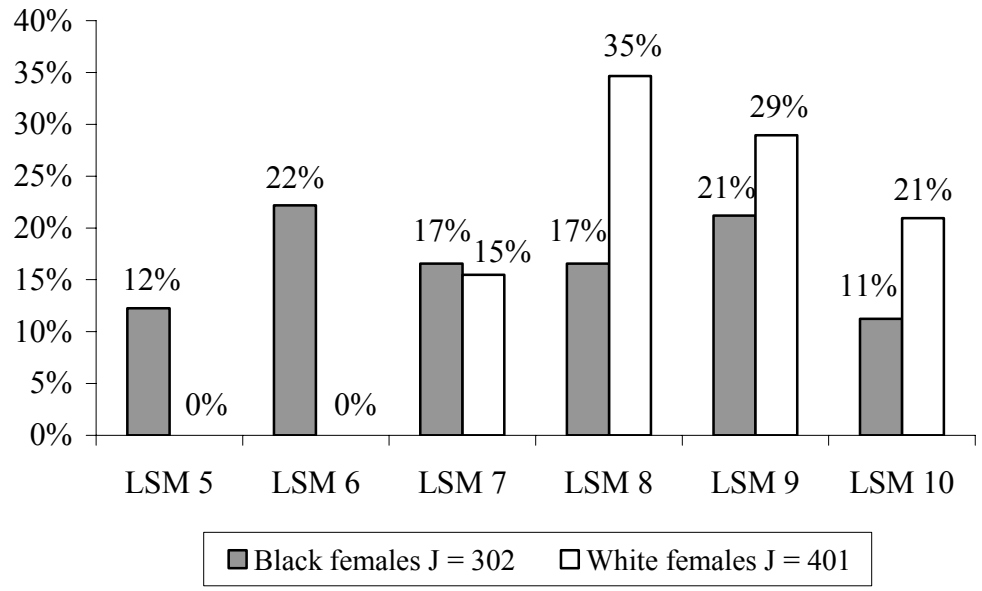


Figure 4-9 Percentages of black and white females in a social class

East Europe: Russia

[462] LSM 10 (LSM 5) is the highest (lowest) class among all social classes considered.

In Russia, as in any developing market economy, requirements and preferences of respondents are affected by the amount of money they possess much stronger than in West Europe. Correspondingly, separation of Russian respondents into clusters is primarily defined by the level of their household income. In particular, the following observations can be made:

- according to percentages presenting different household income levels, respondents are very clearly subdivided into poor, middle reach, and reach groups;
- age differences are often neglected: very young and very old age groups, which actually present the poorest stratum in Russia, appear to be mixed in one and the same segment;
- differences between students and pensioners are neglected: these two normally low-income groups appear to be combined together;
- a rational or unpretentious character of segments strongly corresponds to low household incomes of its members.

South America

Argentineans, Paraguayans, and Venezuelans are impulsive maximalists as typical Latinos. Their requirements tend to be at the highest level. Females in the representative sample collected in South America tick "7" on a seven point rating scale much oftener than females in Europe (see Figure 4-10)[463]. Correspondingly, sizes of demanding segments appear to be bigger in South America.

[463] A percentage for each point on a rating scale was calculated here in the following way:

$$\%_{point} = \frac{\bar{J}_{point}}{J},$$

where

J is the total number of respondents

$\bar{J}_{point}$ is the average number of respondents ticking this point on a rating scale. It is equal to

$$\frac{\sum_{n=1}^{14} J^{n}_{point}}{14},$$

where

J^{n}_{point} is the number of respondents ticking this point on a rating scale in the case of a basis variable (requirement towards a product/brand) n (n = 1, …, 14)

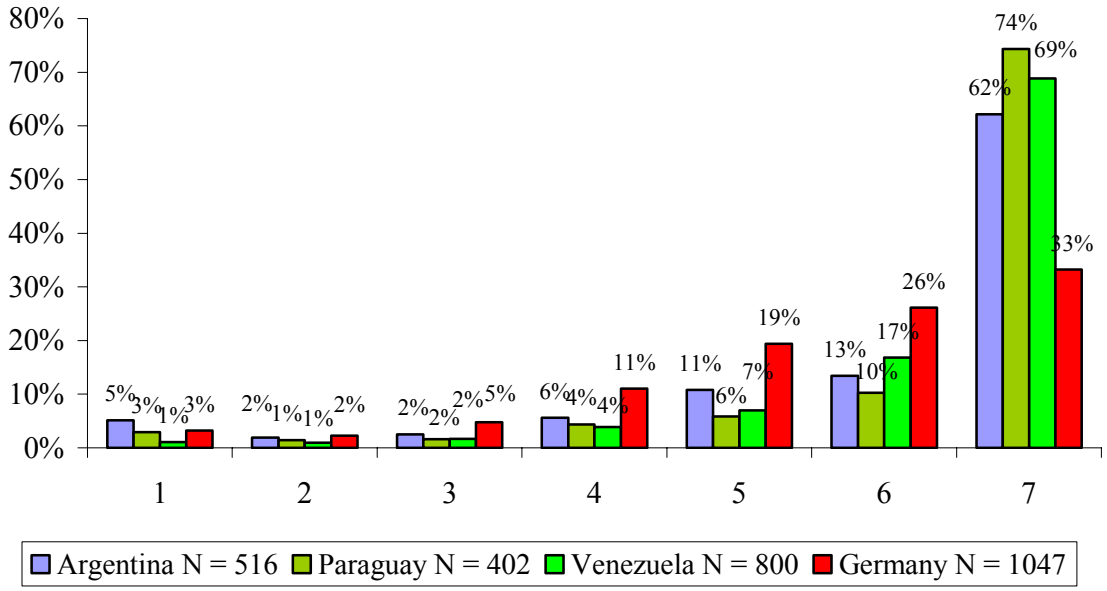


Figure 4-10 Percentages for a point on a rating scale

4.6.1.6 Assessment of Segmentation Approaches

As it was already demonstrated above, cluster solutions produced by all three segmentation approaches can be viewed as reliable partitions consisting of homogeneous clusters differing from each other significantly.[464] In this part of the thesis additional criteria indispensable for assessment of segmentation approaches are considered.

4.6.1.6.1 Application Convenience

It can be definitely stated that the segmentation approach based on SOM was the most complicated one among the three segmentation approaches used. Here the researcher had to go through the next three effort- and time-consuming stages of analysis:

- examining a big number of maps and corresponding cluster characteristics, in order to find the most appropriate map size;
- identifying cluster regions and finding cluster membership of respondents assigned to "transitional" neurons;
- describing and interpreting clusters.

[464] For more details see part 4.6.1.3 of the present thesis.

The other two segmentation approaches (based on the Ward's and K-means methods) appeared to be much more convenient in use. Of course, the researcher had to describe and interpret obtained cluster solutions here as well, but the process of finding the final cluster solution was much more methodically determined, easier, and faster in both cases: while determining the appropriate number of clusters, the researcher had to examine only a few cluster solutions resulted from statistical analyses conducted by the user-friendly SPSS software.

4.6.1.6.2 Structure, Meaningfulness and Coherency of Cluster Solution

Examination of structure, meaningfulness and coherency of three cluster solutions in the case of each country has allowed concluding that the worst solutions were normally found using the K-means method.

First of all, the K-means method tended to building one relatively big cluster with overall high requirements that exceeded by far corresponding segments produced by the Ward's method and SOM.[465] Increasing the number of clusters in a cluster solution has not produced better results in such cases, as far as one or several clusters including only a very small number of respondents normally appeared making a corresponding solution unacceptable. Secondly, the content of the obtained big clusters was rather vague. This has complicated description and interpretation of cluster solutions.

Solutions found using the Ward's method were normally most well-structured, meaningful, and coherent. Nevertheless, the most detailed and informative solutions were found using SOM. These solutions normally consisted of a bigger number of clusters than in the case of solutions found using the other two segmentation approaches (see Table 4-34). At the same time, cluster sizes remained substantial, and cluster contents were quite meaningful and coherent. Moreover, examination of not only differences, but also similarities between clusters was enabled by visualization of cluster regions.

[465] In South Africa, Paraguay, and Venezuela the size of such clusters is even larger than 50% of the total sample.

Region	Country	Ward's	K-means	SOM
Africa	South Africa	5 clusters	4 clusters	5 clusters
Asia	China	4 clusters	4 clusters	6 clusters
Asia	Hong Kong	6 clusters	4 clusters	7 clusters
Asia	Indonesia	4 clusters	4 clusters	6 clusters
Asia	Korea	4 clusters	4 clusters	6 clusters
Asia	Philippines	5 clusters	4 clusters	5 clusters
Asia	Taiwan	5 clusters	5 clusters	5 clusters
Asia	Thailand	5 clusters	5 clusters	6 clusters
Australia	Australia	5 clusters	5 clusters	5 clusters
Europe	Belgium	5 clusters	4 clusters	7 clusters
Europe	Germany	6 clusters	5 clusters	6 clusters
Europe	Italy	4 clusters	4 clusters	5 clusters
Europe	Netherlands	5 clusters	4 clusters	6 clusters
Europe	Spain	5 clusters	4 clusters	7 clusters
Europe	Switzerland	5 clusters	5 clusters	6 clusters
Europe (East)	Russia	5 clusters	5 clusters	5 clusters
Europe (Nordics)	Denmark	5 clusters	4 clusters	5 clusters
Europe (Nordics)	Norway	5 clusters	5 clusters	6 clusters
South America	Argentina	5 clusters	5 clusters	6 clusters
South America	Paraguay	4 clusters	4 clusters	6 clusters
South America	Venezuela	4 clusters	4 clusters	6 clusters

Table 4-34 Cluster quantities

4.6.1.6.3 Basis for International Market Segmentation Strategies

The possibility to construct meaningful standardized marketing programs, to which the obtained segments would react in an internally homogeneous and externally heterogeneous way, was assessed as well, in order to guarantee that obtained segments were strategically useful and conducting market segmentation analyses was worthwhile.

Two criteria important for standardization of marketing programs were considered here:

- **geographical extension of transnational segments**;
- **possible degree of standardization of marketing mix elements**.

According to the first criterion, the segmentation approach based on SOM has produced the best results: majority of transnational segments found on the base of country-specific solutions obtained using SOM extended across more than a half of all considered countries. At the same time, results of the segmentation approach based on the K-means method have appeared to be the poorest.

According to the second criterion, all three segmentation approaches have shown similar results. On the one hand, it was concluded that transnational segments found in all three cases would allow for a high degree of standardization of a product (see Table 4-35). On the other hand, it was realized that other marketing mix elements (i.e., promotion, distribution, and pricing) would require some degree of differentiation. The reason for this was existence of regional/country-specific peculiarities described earlier in this part of the thesis.

Transnational segment	**Standardized product features**
Highly demanding	Upscale image, attractiveness, modernity, popularity, high quality, mildness, convenience
Rational demanding	High quality, mildness, convenience, attractiveness
Rationalists	High quality, mildness, convenience
Good quality at a fair price	Good quality, convenience
Quality and good value for money from a strong brand	Good quality, convenience, popularity
Brand glamor driven mainstream	Attractiveness, modernity, good quality
Only brand attractiveness driven (very little skin care involved)	Attractiveness, modernity, popularity
Sensitivity and mildness driven	Mildness
Moderate level of mildness from a popular and modern brand	Mildness, attractiveness, modernity, popularity
Uninvolved	Inexpensiveness, moderate level of quality and/or mildness

Table 4-35 Standardized product features

It should be additionally mentioned that as far as cluster solutions obtained by means of the segmentation approach based on SOM are most detailed and informative, international market segmentation strategies constructed on their base are likely to be most precise and efficient. For instance, SOM has enabled identification of "Rational demanding" segment, which is strategically important in such regions as South America, where requirements of majority of respondents are set to the highest level, and separation of respondents into groups has to be more perceptible to differences in their entries.

4.6.2 Integral Market Segmentation

4.6.2.1 Data Preparation

4.6.2.1.1 Defining Sample Size

For conducting integral market segmentation, the twenty one country samples had to be combined to one "world" sample. In order to guarantee representativeness of this sample, it was decided to combine the country samples after making their sizes proportional to corresponding female population sizes.

First of all, corresponding female population sizes were found on the base of information about an actual population size and sex ratio in each of the twenty one countries investigated (see Table 4-36).[466]

Then, the adjustment ratio was calculated in the case of each country. It is defined as follows:[467]

$$\text{Adjustment Ratio} = \frac{\text{FPS}}{\text{SS}}, \tag{4-2}$$

where

FPS is a share of a country female population in the total female population consisting of female populations in the twenty one countries

SS is a share of a country sample in the total sample consisting of the twenty one country samples

[466] As far as buying and consumption of NIVEA brand in China, Indonesia, Korea, Philippines, and Taiwan are concentrated in central locations only, not country populations, but populations in corresponding cities were considered in the case of these countries.

[467] See Ter Hofstede/Steenkamp/Wedel, 1999, p. 4.

Country	Total population in thousands	Sex ratio	% of females in total population	Female population in thousands
South Africa	42718.5	0.99 male(s)/1 female	50.3	21466.6
China (Shanghai/Beijing)	16800.0	1.06 male(s)/1 female	48.5	8155.3
Hong Kong	6690.0	0.96 male(s)/1 female	51.0	3413.3
Indonesia (Jakarta/Bandung/Surabaya)	14513.8	1 male(s)/1 female	50.0	7256.9
Korea (Seoul)	9853.0	1.03 male(s)/1 female	49.3	4854.2
Philippines (Manila)	1581.1	0.99 male(s)/1 female	50.3	794.5
Taiwan (Taipei)	2600.5	1.03 male(s)/1 female	49.3	1281.1
Thailand	64865.5	0.98 male(s)/1 female	50.5	32760.4
Australia	19913.1	1.02 male(s)/1 female	49.5	9858.0
Belgium	10348.3	1.02 male(s)/1 female	49.5	5122.9
Germany	82424.6	1.04 male(s)/1 female	49.0	40404.2
Italy	58057.5	1.02 male(s)/1 female	49.5	28741.3
Netherlands	16318.2	1.03 male(s)/1 female	49.3	8038.5
Spain	40280.8	1.01 male(s)/1 female	49.8	20040.2
Switzerland	7450.9	1.02 male(s)/1 female	49.5	3688.5
Russia	143782.3	0.94 male(s)/1 female	51.5	74114.6
Denmark	5413.4	1.02 male(s)/1 female	49.5	2679.9
Norway	4574.6	1.03 male(s)/1 female	49.3	2253.5
Argentina	39144.8	1 male(s)/1 female	50.0	19572.4
Paraguay	6191.4	1.01 male(s)/1 female	49.8	3080.3
Venezuela	25017.4	1.01 male(s)/1 female	49.8	12446.5

Table 4-36 Finding female population sizes
Source: www.cia.gov/cia/publications/factbook/ and Der Fischer Weltalmanach 2004.

To obtain country samples having sizes proportional to corresponding female population sizes, it was decided to extract randomly the percentage of each country sample equal to some common percentage multiplied by the adjustment ratio presented above. It was attempted to extract the highest possible number of respondents, in order to minimize information losses. As Table 4-37 demonstrates, the chosen common percentage is equal to 37.5%. Any further increase in this percentage would require extracting a sample bigger than the available one in the case of Russia. In other words, using 37.5% as the common percentage guaranteed

that the maximum possible number of respondents was included into the "world" sample.

Country	Size of an original sample	Sample share (SS)	Female population in thousands	Female population share (FPS)	Adjustment Ratio: PS/SS	Percentage of an original sample to be extracted (37.5%*adjustment ratio)	Size of a sample to be extracted
South Africa	801	6.0%	21467	6.9%	**1.16**	43.4%	348
China (Shanghai/Beijing)	800	6.0%	8155	2.6%	**0.44**	16.5%	132
Hong Kong	504	3.8%	3413	1.1%	**0.29**	11.0%	55
Indonesia (Jakarta/Bandung/ Surabaya)	826	6.2%	7257	2.3%	**0.38**	14.2%	118
Korea (Seoul)	500	3.7%	4854	1.6%	**0.42**	15.7%	79
Philippines (Manila)	500	3.7%	795	0.3%	**0.07**	2.6%	13
Taiwan (Taipei)	504	3.8%	1281	0.4%	**0.11**	4.1%	21
Thailand	1000	7.5%	32760	10.6%	**1.42**	53.1%	531
Australia	581	4.3%	9858	3.2%	**0.73**	27.5%	160
Belgium	372	2.8%	5123	1.7%	**0.59**	22.3%	83
Germany	1047	7.8%	40404	13.0%	**1.67**	62.5%	654
Italy	521	3.9%	28741	9.3%	**2.38**	89.3%	465
Netherlands	491	3.7%	8039	2.6%	**0.71**	26.5%	130
Spain	755	5.6%	20040	6.5%	**1.15**	43.0%	325
Switzerland	506	3.8%	3689	1.2%	**0.31**	11.8%	60
Russia	1200	9.0%	74115	23.9%	**2.67**	100.0%	1200
Denmark	400	3.0%	2680	0.9%	**0.29**	10.8%	43
Norway	366	2.7%	2254	0.7%	**0.27**	10.0%	36
Argentina	516	3.9%	19572	6.3%	**1.64**	61.4%	317
Paraguay	402	3.0%	3080	1.0%	**0.33**	12.4%	50
Venezuela	800	6.0%	12447	4.0%	**0.67**	25.2%	202
Total	13392	100.0%	310023	100.0%		37.5%	5022

Table 4-37 Finding sizes of samples to be extracted

Looking at the percentages of country samples to be extracted, it was realized that some of them were extremely low (for instance, 2.6% in the case of Philippines, 4.1% in the case of Taiwan, 10.0% in the case of Norway, etc.). Due to the fact that, in such cases, losses in country-specific information would be very high, and using such small country groups while describing and interpreting the results of integral market segmentation would be very unreliable, it was decided to adjust sample sizes to female population sizes approximately, in particular, according to the four-group system presented in Table 4-38.

Group number	Female population size	Size of a sample to be extracted
1	more than 30000 thousands	600 respondents
2	15000-30000 thousands	500 respondents
3	7000-15000 thousands	400 respondents
4	less than 7000 thousands	300 respondents

Table 4-38 Four-group system

After subdividing all countries into the four groups shown above, a sample of a corresponding size was extracted randomly in the case of each country (see Table 4-39). It was concluded that values of all extracted percentages were rather substantial, and the obtained "world" sample was used for the segmentation analyses described below.

Country	Female population size in thousands	Group number	Size of an original sample	Size of a sample to be extracted	Percentage of an original sample to be extracted
South Africa	21466.6	**2**	801	500	62.4%
China (Shanghai/Beijing)	8155.3	**3**	800	400	50.0%
Hong Kong	3413.3	**4**	504	300	59.5%
Indonesia (Jakarta/Bandung/Surabaya)	7256.9	**3**	826	400	48.4%
Korea (Seoul)	4854.2	**4**	500	300	60.0%
Philippines (Manila)	794.5	**4**	500	300	60.0%
Taiwan (Taipei)	1281.1	**4**	504	300	59.5%
Thailand	32760.4	**1**	1000	600	60.0%
Australia	9858.0	**3**	581	400	68.8%
Belgium	5122.9	**4**	372	300	80.6%
Germany	40404.2	**1**	1047	600	57.3%
Italy	28741.3	**2**	521	500	96.0%
Netherlands	8038.5	**3**	491	400	81.5%
Spain	20040.2	**2**	755	500	66.2%
Switzerland	3688.5	**4**	506	300	59.3%
Russia	74114.6	**1**	1200	600	50.0%
Denmark	2679.9	**4**	400	300	75.0%
Norway	2253.5	**4**	366	300	82.0%
Argentina	19572.4	**2**	516	500	96.9%
Paraguay	3080.3	**4**	402	300	74.6%
Venezuela	12446.5	**3**	800	400	50.0%
Total	310023		13392	8500	63.5%

Table 4-39 Finding sizes of samples to be extracted according to the four-group system

4.6.2.1.2 Factor Analysis

As in the case of additive intranational market segmentation, input variables were first transformed into factor values by means of the SPSS software.

Again, it was quite difficult to make a conclusion about the reasonability of conducting factor analysis on the base of examining the correlation matrix

alone.[468] Nevertheless, the following observations supporting the assumption that conducting factor analysis makes sense could be made:

- majority of correlation coefficients are significantly different from zero;
- majority of non-diagonal elements of the inverse correlation matrix and anti-image covariance matrix are close to zero;
- significance of the Bartlett's test is equal to zero;
- MSA = 0.89, in other words, it is higher than 0.8.

The factors were extracted using PCA, and the decision about their number was based on the Kaiser criterion. After conducting the Varimax rotation, factors were interpreted and named (see Table 4-40).

Requirements towards a product/brand	**Factors**		
	Quality	Brand glamor	Sensitivity and mildness
Products are of higher quality	0.749	0.002	0.176
Products offer good value for money	0.712	0.040	0.055
It is a trustworthy brand	0.681	0.217	0.205
Products fulfill current expectations towards skin care	0.667	0.170	0.297
Products contain highly effective ingredients	0.580	0.213	0.378
Products perform better than those of other brands	0.515	0.419	0.141
It is a modern brand	0.067	0.848	0.078
This brand is highly advertised	0.014	0.844	-0.027
This brand is for demanding women who give importance to their appearance	0.235	0.701	0.137
Products are suitable for sensitive skin	0.094	-0.003	0.860
This brand offers mild skin care products	0.303	0.175	0.660
Products are highly appropriate for skin	0.431	-0.081	0.606
Products rely on the latest scientific findings	0.167	0.418	0.603
Products have a pleasant fragrance	0.294	0.325	0.208

Note:
High factor loadings (≥ 0.5) are highlighted with yellow

Table 4-40 Chosen factor solution

The first factor "Quality" explained 35.35% of the total variance, the second factor "Brand glamor" – 13.20% of the total variance, and the third factor "Sensitivity

[468] As in the case of additive intranational market segmentation, the researcher has faced the problem of dealing with not very high values (of about 0.2 - 0.5) of majority of correlation coefficients.

and mildness" – 7.73% of the total variance. In other words, altogether they explained 56.28% of the total variance.

4.6.2.1.3 Data Unification

Due to the fact that demographic characteristics were assessed on scales differing from country to country, it was decided to develop common assessment scales, in order to combine these variables.

In particular, in the case of "Age of a respondent" variable, it was decided to transform all assessment scales with lengths varying between 5 and 11 points (age groups) into the following assessment scale:

1 = 14-17 years old
2 = 18-24 years old
3 = 25-34 years old
4 = 35-44 years old
5 = 45-54 years old
6 = 55-65 years old
7 = older than 65 years

Assessment scales for "Marital status of a respondent" variable varied in their length between 3 and 6 points (marital statuses) and were transformed as follows:

1 = Single
2 = Married
3 = Divorced/separated/widowed

Transformation of assessment scales for "Number of people in a household" variable with lengths varying between 4 and 12 points (persons) was done as follows:

1 = 1 person
2 = 2-4 persons
3 = 5 or more persons

It was decided to combine variables "Number of children under 16 years in a household" and "Presence of children below 14/15 years in a household" (used in

Russia and Spain) into the binary variable "Are there children under 16 years in household?".

As far as exact naming of professions in "Employment status of a respondent" variable was seldom and differed across the countries, it was decided to use the following assessment scheme in this case:

1= Works
2 = Studies
3 = Housewife
4 = Unemployed
5 = Retired

While combing assessment scales for "Education level of a respondent" variable, even bigger generalization was required, as far as educational systems differed from country to country dramatically. Correspondingly, the next common assessment scale was chosen:

1 = Lower educated
2 = Middle educated
3 = Higher educated

As far as meaning of social classes and monthly household incomes could be only approximately compared across the countries, and only one of the variables "Social class" and "Monthly household income" was normally used in each of the twenty one countries considered, it was decided to combine these two variables into "Social class" variable with the next highly generalized common assessment scale:

1 = Higher social class
2 = Middle social class
3 = Lower social class

4.6.2.2 Finding Cluster Solutions

4.6.2.2.1 Segmentation Approach Based on Ward's Method

As in the case of intranational segmentation analyses, cluster analysis based on the Ward's method was considered first.

A relatively significant jump in values of the error sum of squares was found at step number 8495, where six clusters were combined to five (see Table 4-41). Correspondingly, it was assumed that six is the correct number of clusters in the cluster solution. This assumption was supported by meaningful results of the cluster interpretation.

Step	Increase in the error sum of squares
# 8499 (2 clusters are being combined to 1)	4617.0
# 8498 (3 clusters are being combined to 2)	4335.3
# 8497 (4 clusters are being combined to 3)	2894.0
# 8496 (5 clusters are being combined to 4)	1557.3
# 8495 (6 clusters are being combined to 5)	1229.2
# 8494 (7 clusters are being combined to 6)	913.6
# 8493 (8 clusters are being combined to 7)	840.0
# 8492 (9 clusters are being combined to 8)	589.1
# 8491 (10 clusters are being combined to 9)	477.2
# 8490 (11 clusters are being combined to 10)	473.2

Table 4-41 Increases in the error sum of squares (the last ten fusion steps)

4.6.2.2.2 Segmentation Approach Based on K-means Method

Cluster analysis based on the K-means method was conducted in the second place.

Analogously to intranational segmentation analyses, it was decided to run the optimization-partitioning algorithm for the interval of 2 to 10 clusters in a cluster solution. According to the plot depicting values of the within-groups sum of squares for each of the successive runs of the optimization-partitioning algorithm (reading from left to right) (see Figure 4-11), the sharpest value decrease could be found while moving from three to four clusters. Correspondingly, the four-cluster solution was viewed as the correct cluster solution first.

Nevertheless, while assessing meaningfulness of cluster interpretation, it was realized that this solution was too aggregated, and five-, six-, seven- as well as eight-cluster solutions were considered instead.[469] Due to the fact that clusters in the six-cluster solution were most meaningful and coherent, it was eventually chosen as the correct cluster solution.

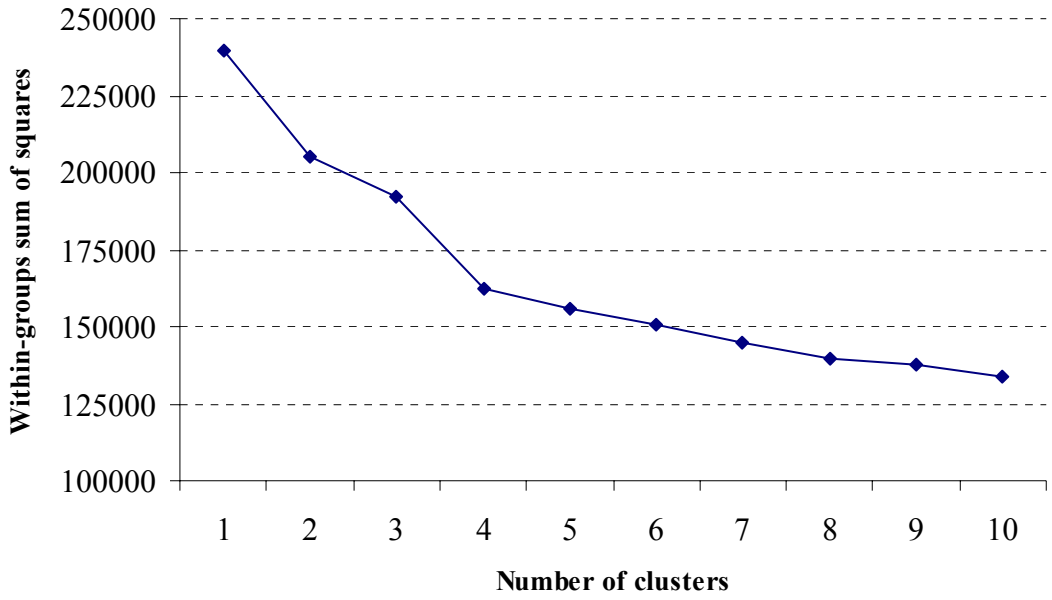


Figure 4-11 Values of the within-groups sum of squares plotted against corresponding quantities of clusters

4.6.2.2.3 Segmentation Approach Based on Self-Organizing Map

Segmentation analysis based on SOM was considered as the third approach to clustering respondents.

As in the case of intranational segmentations, the fourteen basis variables (requirements towards a product/brand) were used here as input data instead of factor values.

Thirty Kohonen maps of different size were first initialized with the help of the NENET software. Again, a hexagonal type of a neuron arrangement was used. The

[469] As it can be seen in Figure 4-11, decreases in values of the within-groups sum of squares observed while moving from eight to nine and from nine to ten clusters are relatively small. Correspondingly, it was decided not to take nine- and ten-cluster solutions into consideration.

map of size $45\,\text{neurons} \times 16\,\text{neurons}$ was chosen after evaluating the goodness of all maps,[470] examining a size, form and clearness of their cluster regions,[471] and assessing meaningfulness of cluster interpretations.

During map training, a neighborhood function was presented through the Gaussian function, and the following parameters were used:[472]

- the number of iteration steps in the POW phase equal to 3825;
- the number of iteration steps in the FTW phase equal to 382500;
- the starting value of the width parameter $\sigma(t_z)$ equal to 32 in the POW phase and to 3 in the FTW phase;
- the starting value of the learning-rate factor $\alpha(t_z)$ equal to 0.9 in the POW phase and to 0.02 in the FTW phase.

Seven finally obtained cluster regions are presented in Figure 4-12.

Respondents positioned on "transitional" neurons between these cluster regions were assigned to clusters with corresponding smallest Euclidean distances between a respondent's profile and cluster centroid. In other words, all respondents were subdivided into seven groups.

[470] The evaluation was based on the average quantization error, to ntage of used Kohonen-neurons criteria.

[471] The examination was based on the U-matrix, hit histogram nponent planes.

[472] The choice of parameter values was done in the way analog case of intranational segmentations.

th ligh:-blue
e third level) are outlined with red
fouth level) are outlined with green
e fifth level) are outlined with pink

where
initial cluster regions are outlined with yellow
combinations of several initial cluster regions (i.e. cluster regions of the second level) are outlined with light-blue
combinations of cluster regions of the second level and initial cluster regions (i.e. cluster regions of the third level) are outlined with red
combinations of cluster regions of the third level and initial cluster regions (i.e. cluster regions of the fourth level) are outlined with green
combinations of cluster regions of the fourth level and initial cluster regions (i.e. cluster regions of the fifth level) are outlined with pink

Figure 4-12 Cluster regions (the U-matrix)

4.6.2.3 Validation of Cluster Solutions

Analogously to intranational segmentation analyses, not the factors, but the fourteen basis variables (requirements towards a product/brand) were used for validation, description and interpretation of cluster solutions in the case of integral market segmentation.

Visual inspection and comparison of cluster profiles consisting of cluster centroids for each variable presented in the form of a table[473] have demonstrated that the outcomes of the three approaches to separating respondents into groups presented above had a big number of similar features. Correspondingly, it was concluded that the obtained cluster solution was stable.

Completely homogeneous clusters (in other words, clusters with F-values smaller than 1 for all variables) were found in all solutions: two in the case of the solution found using the Ward's method, one in the case of the solution found using the K-means method, and two in the case of the solution found using SOM. There were also highly homogeneous clusters (in other words, clusters with at most three F-values bigger than 1): three in the case of the solution found using the Ward's method, three in the case of the solution found using the K-means method, and six in the case of the solution found using SOM. Generally speaking, majority of F-values in the case of all three solutions were below 1. All this allowed concluding that clusters in the solutions were rather homogeneous. Nevertheless, it was clear that among the three segmentation approaches the one based on SOM tended to build the most homogeneous clusters.

A big number of high positive and negative t-values as well as results of discriminant analyses, which pointed at existence of very high canonical correlation coefficients and low significance levels of χ^2 values calculated from values of the Wilks's lambda for residual discrimination, supported the assumption that there were significant differences between clusters in all three solutions.

82.2% of respondents were correctly classified by discriminant analysis in the case of the solution found using the Ward's method, 90.3% – in the case of the solution

[473] Again, for a better overview, the variables were grouped here according to the factors they belonged to.

found using the K-means method, and 82.1% – in the case of the solution found using SOM. This demonstrated that the gap in levels of classification accuracy between the K-means solution and the other two solutions has grown with the increase in a sample size. Nevertheless, all three percentages were rather high, and therefore all three solutions could be considered as reliable.

4.6.2.4 Description and Interpretation of Cluster Solutions

Description and interpretation of the three cluster solutions were done analogously to description and interpretation of country-specific cluster solutions found while conducting additive intranational market segmentation. Again, they were based on

- cluster profiles consisting of cluster centroids for each of the fourteen basis variables (requirements towards a product/brand);
- cluster profiles consisting of cluster centroids for requirements towards a product/brand, which were not used for cluster building;
- cluster profiles consisting of cluster centroids for attitudes towards beauty/life;
- percentages of affirmative answers of respondents in each of the clusters for demographic characteristics (respondent's age and marital status, number of people in a household, respondent's employment status and education level, children in a household, respondent's monthly household income and social class, respondent's living location), brand assessments (prompted awareness, likeability, usage, prompted advertising recall of brands), skin conditions (face skin type and sensitivity, body skin type and sensitivity), and behavioral characteristics (media usage and point of purchase).

The cluster profiles/ percentages of affirmative answers were examined and compared to the corresponding total sample profiles/ percentages of affirmative answers. Again, it was distinguished between five deviation levels.[474]

Names and sizes of clusters obtained in the case of each of the three segmentation approaches are presented in Table 4-42.

[474] For more detailed information see part 4.6.1.4 of the present thesis.

Clusters (the Ward's method)	#1 Rationalists	#2 Highly demanding	#3 Good quality at a fair price	#4 Brand glamor driven mainstream	#5 Sensitivity and mildness driven	#6 Only brand attractiveness driven (very little skin care involved)	Total Sample
Number of respondents	2152	2188	947	1920	545	748	8500
% of total sample	25%	26%	11%	23%	6%	9%	100%

Clusters (the K-means method)	#1 Rationalists	#2 Highly demanding	#3 Good quality at a fair price	#4 Sensitivity and mildness driven	#5 Only brand attractiveness driven (very little skin care involved)	#6 Quality and good value for money from a strong brand	Total Sample
Number of respondents	1570	3262	929	598	1490	651	8500
% of total sample	18%	38%	11%	7%	18%	8%	100%

Clusters (SOM)	#1 Only brand attractiveness driven (very little skin care involved)	#2 Brand glamor driven mainstream	#3 Highly demanding	#4 Rational demanding	#5 Rationalists	#6 Good quality at a fair price	#7 Sensitivity and mildness driven	Total Sample
Number of respondents	753	1352	1602	1879	1147	1223	544	8500
% of total sample	9%	16%	19%	22%	13%	14%	6%	100%

Table 4-42 Cluster names and sizes

4.6.2.5 Results of Cluster Interpretation

As it can be seen in Table 4-42, segments obtained by all three segmentation approaches are likely to be very similar to corresponding transnational segments found by means of additive intranational market segmentation.

Interpretation of clusters based on requirements of respondents towards a product/brand, attitudes of respondents towards beauty/life, and skin conditions of

respondents appeared to be quite clear and supported the assumption about the similarity of segments stated above. At the same time, cluster interpretation based on demographic characteristics, brand assessments, and behavioral characteristics was rather vague, due to the fact that corresponding cluster description had many obscure characteristics. This can be addressed to

- information loss occurred while creating the "world" sample;
- information loss occurred while combining demographic characteristics and turning to more generalized assessment scales;
- dealing with a big number of brands and assessing often extremely small percentages of affirmative answers for their awareness, likeability, usage, and advertising recall;
- dealing with a big number of purchase locations and assessing often extremely small percentages of affirmative answers for corresponding choice behavior of respondents;
- national differences in demographic characteristics, brand assessments, and behavioral characteristics.

Additionally, it was noticed that countries belonging to one and the same region tended to be overrepresented in one and the same group of segments (see Table 4-43). In particular, respondents from South American countries tended to be assigned to more demanding segments, respondents from Australia and majority of European countries (in particular, from Belgium, Germany, Switzerland, Russia, Denmark, and Norway) – to more rational and/or less demanding segments, and respondents from South Africa and majority of Asian countries (in particular, from China, Indonesia, Korea, Philippines, Taiwan, and Thailand) – to more brand attractiveness driven segments. Cluster percentages for corresponding segments in each country normally appeared to be much lower in the case of intranational segmentation analyses than in the case of integral market segmentation (see Table 4-44). In other words, it can be definitely stated that results of integral market segmentation are biased by differences in regional/country-specific data entry patterns and reflect the actual state of affairs only approximately. It also means that the influence of regional/country-specific cultural or economic forces on formation of segments is broken and altered.

Country	Ward's							K-means							SOM							Total sample
	Rationalists	Highly demanding	Good quality at a fair price	Brand glamour driven mainstream	Sensitivity and mildness driven	Only brand attractiveness driven		Rationalists	Highly demanding	Good quality at a fair price	Sensitivity and mildness driven	Only brand attractiveness driven	Quality and good value for money from a strong brand		Only brand attractiveness driven	Brand glamour driven mainstream	Upscale demanding	Rational demanding	Rationalists	Good quality at a fair price	Sensitivity and mildness driven	
South Africa	4.0%	6.9%	8.2%	7.0%	0.6%	6.6%		3.2%	6.4%	8.3%	1.7%	7.0%	7.7%		5.4%	8.9%	6.0%	4.5%	3.4%	8.7%	2.2%	5.9%
China	2.3%	6.4%	6.2%	6.3%	0.4%	3.7%		1.4%	6.1%	5.6%	0.8%	5.2%	6.6%		3.9%	8.7%	5.7%	2.3%	2.7%	6.9%	0.4%	4.7%
Hong Kong	3.4%	1.5%	6.5%	3.8%	2.6%	5.9%		2.9%	1.2%	9.6%	2.7%	5.8%	3.7%		6.4%	1.9%	1.1%	2.2%	6.4%	7.0%	1.7%	3.5%
Indonesia	3.2%	6.4%	1.7%	7.0%	1.3%	4.4%		2.2%	7.0%	2.6%	3.5%	5.0%	2.8%		3.1%	10.7%	4.6%	3.7%	2.4%	4.3%	1.8%	4.7%
Korea	2.0%	3.8%	1.0%	7.1%	0.9%	2.9%		2.1%	4.5%	1.6%	1.0%	5.9%	1.8%		3.9%	7.0%	3.1%	3.0%	1.9%	3.8%	0.4%	3.5%
Philippines	1.5%	7.1%	1.2%	4.5%	0.7%	1.6%		1.3%	6.4%	1.3%	1.2%	2.5%	2.5%		1.1%	5.7%	8.1%	3.3%	1.0%	0.8%	0.2%	3.5%
Taiwan	0.7%	2.2%	1.2%	7.6%	0.2%	10.4%		0.6%	2.8%	1.4%	0.2%	11.4%	2.2%		16.6%	6.3%	1.6%	1.3%	0.3%	2.9%	**0.0%**	3.5%
Thailand	5.7%	8.3%	4.2%	9.7%	1.8%	8.0%		5.0%	8.4%	7.2%	4.2%	8.7%	4.1%		8.2%	10.4%	6.3%	8.9%	4.6%	5.6%	1.5%	7.1%
Australia	6.7%	1.2%	9.2%	1.0%	18.2%	3.2%		8.4%	1.3%	12.2%	12.2%	1.5%	2.9%		2.4%	0.7%	0.9%	3.1%	8.5%	7.4%	20.2%	4.7%
Belgium	5.5%	1.8%	2.9%	2.9%	6.4%	3.3%		6.6%	2.5%	4.1%	5.0%	2.9%	0.9%		3.2%	2.4%	1.7%	4.2%	6.8%	3.1%	4.0%	3.5%
Germany	7.6%	5.1%	3.4%	7.3%	9.2%	13.9%		7.3%	6.0%	3.7%	10.7%	10.9%	4.3%		13.1%	6.3%	3.3%	7.0%	7.5%	9.2%	5.9%	7.1%
Italy	8.7%	4.9%	2.4%	6.8%	2.6%	5.2%		9.0%	5.5%	4.7%	4.0%	6.7%	1.8%		4.9%	6.6%	3.7%	6.7%	9.2%	5.6%	2.8%	5.9%
Netherlands	**0.0%**	3.1%	21.8%	4.8%	**0.0%**	4.5%		**0.0%**	1.9%	0.3%	**0.0%**	4.4%	41.6%		9.6%	5.2%	13.1%	0.1%	**0.0%**	3.5%	0.6%	4.7%
Spain	6.3%	6.2%	2.9%	8.1%	2.4%	4.4%		5.7%	7.3%	4.7%	2.0%	7.6%	0.8%		4.8%	8.0%	5.3%	6.7%	5.7%	5.8%	1.8%	5.9%
Switzerland	4.9%	1.3%	1.8%	2.8%	12.3%	4.0%		5.5%	2.0%	2.2%	12.7%	3.1%	0.8%		3.1%	2.7%	0.7%	3.2%	7.3%	2.9%	9.0%	3.5%
Russia	12.5%	7.3%	8.2%	3.1%	2.8%	2.3%		12.4%	6.8%	10.4%	3.2%	2.6%	4.5%		2.0%	2.5%	6.1%	13.3%	9.8%	6.0%	3.5%	7.1%
Denmark	3.2%	0.4%	5.5%	1.3%	18.3%	6.3%		3.8%	0.4%	4.8%	17.6%	3.2%	4.8%		2.9%	0.5%	0.2%	1.3%	5.1%	5.6%	21.3%	3.5%
Norway	3.3%	0.9%	6.5%	1.2%	13.8%	6.6%		4.8%	0.8%	7.8%	12.7%	2.3%	2.5%		2.8%	0.4%	0.6%	1.6%	5.1%	5.6%	19.9%	3.5%
Argentina	10.5%	6.9%	3.2%	3.3%	4.4%	0.8%		11.6%	6.8%	5.4%	2.5%	1.2%	1.8%		0.8%	1.6%	6.7%	11.0%	9.0%	3.6%	1.8%	5.9%
Paraguay	4.4%	7.3%	1.3%	1.4%	0.6%	0.7%		3.3%	6.4%	1.6%	1.2%	0.7%	1.1%		0.5%	0.9%	7.4%	6.9%	1.9%	0.9%	0.6%	3.5%
Venezuela	3.5%	11.0%	0.8%	3.3%	0.7%	1.2%		3.0%	9.6%	0.5%	1.0%	1.5%	0.9%		1.5%	2.7%	13.7%	5.7%	1.5%	0.5%	0.6%	4.7%

Note:
Yellow (pink) highlights present positive (negative) deviations from the total sample above 10%
Absence of highlights corresponds to the deviations from the total sample lying in the interval [-10%; 10%]

Table 4-43 Percentages of respondents from twenty one countries included into each transnational segment

Country	Ward's						K-means						SOM					
	Rationalists	Highly demanding	Good quality at a fair price	Brand glamor driven mainstream	Sensitivity and nullness driven	Only brand attractiveness driven	Rationalists	Highly demanding	Good quality at a fair price	Sensitivity and nullness driven	Only brand attractiveness driven	Quality and good value for money from a strong brand	Only brand attractiveness driven Brand glamor driven mainstream	Upscale demanding	Rational demanding	Rationalists	Good quality at a fair price	Sensitivity and nullness driven
South Africa	17.2%	30.0%	15.6%	26.8%	0.6%	9.8%	10.0%	41.8%	15.4%	2.0%	20.8%	10.0%	8.2%	24.0%	19.2%	17.0%	7.8%	21.4%	2.4%
China	12.5%	35.3%	14.8%	30.0%	0.5%	7.0%	5.5%	50.0%	13.0%	1.3%	19.5%	10.8%	7.3%	29.5%	23.0%	11.0%	7.8%	21.0%	0.5%
Hong Kong	24.7%	11.0%	20.7%	24.3%	4.7%	14.7%	15.3%	13.0%	29.7%	5.3%	28.7%	8.0%	16.0%	8.7%	6.0%	13.7%	24.3%	28.3%	3.0%
Indonesia	17.3%	35.3%	4.0%	33.5%	1.8%	8.3%	8.5%	57.0%	6.0%	5.3%	18.8%	4.5%	5.8%	36.0%	18.5%	17.3%	6.8%	13.3%	2.5%
Korea	14.3%	28.0%	3.0%	45.7%	1.7%	7.3%	11.0%	48.7%	5.0%	2.0%	29.3%	4.0%	9.7%	31.3%	16.3%	19.0%	7.3%	15.7%	0.7%
Philippines	10.7%	51.7%	3.7%	28.7%	1.3%	4.0%	6.7%	69.3%	4.0%	2.3%	12.3%	5.3%	2.7%	25.7%	43.3%	20.7%	4.0%	3.3%	0.3%
Taiwan	5.3%	16.3%	3.7%	48.3%	0.3%	26.0%	3.3%	30.7%	4.3%	0.3%	56.7%	4.7%	41.7%	28.3%	8.7%	8.0%	1.3%	12.0%	0.0%
Thailand	20.3%	30.3%	6.7%	31.0%	1.7%	10.0%	13.0%	45.7%	11.2%	4.2%	21.5%	4.5%	10.3%	23.3%	16.8%	27.8%	8.8%	11.5%	1.3%
Australia	36.0%	6.8%	21.8%	4.8%	24.8%	6.0%	33.0%	10.3%	28.3%	18.3%	5.5%	4.8%	4.5%	2.5%	3.8%	14.8%	24.3%	22.8%	27.5%
Belgium	39.7%	13.0%	9.0%	18.3%	11.7%	8.3%	34.3%	26.7%	12.7%	10.0%	14.3%	2.0%	8.0%	11.0%	9.0%	26.0%	26.0%	12.7%	7.3%
Germany	27.2%	18.5%	5.3%	23.3%	8.3%	17.3%	19.0%	32.8%	5.7%	10.7%	27.2%	4.7%	16.5%	14.2%	8.8%	22.0%	14.3%	18.8%	5.3%
Italy	37.4%	21.4%	4.6%	26.0%	2.8%	7.8%	28.4%	35.6%	8.8%	4.8%	20.0%	2.4%	7.4%	17.8%	12.0%	25.0%	21.0%	13.8%	3.0%
Netherlands	0.0%	17.0%	51.5%	23.0%	0.0%	8.5%	0.0%	15.3%	0.8%	0.0%	16.3%	67.8%	18.0%	17.5%	52.5%	0.5%	0.0%	10.8%	0.8%
Spain	27.2%	27.2%	5.4%	31.0%	2.6%	6.6%	17.8%	47.4%	8.8%	2.4%	22.6%	1.0%	7.2%	21.6%	17.0%	25.0%	13.0%	14.2%	2.0%
Switzerland	35.0%	9.3%	5.7%	17.7%	22.3%	10.0%	29.0%	22.0%	6.7%	25.3%	15.3%	1.7%	7.7%	12.0%	3.7%	20.3%	28.0%	12.0%	16.3%
Russia	45.0%	26.7%	13.0%	10.0%	2.5%	2.8%	32.5%	37.0%	16.2%	3.2%	6.3%	4.8%	2.5%	5.7%	16.2%	41.7%	18.7%	12.2%	3.2%
Denmark	22.7%	2.7%	17.3%	8.3%	33.3%	15.7%	19.7%	4.0%	15.0%	35.0%	16.0%	10.3%	7.3%	2.3%	1.0%	8.0%	19.7%	23.0%	38.7%
Norway	24.0%	6.3%	20.7%	7.7%	25.0%	16.3%	25.0%	9.0%	24.0%	25.3%	11.3%	5.3%	7.0%	1.7%	3.0%	10.3%	19.3%	22.7%	36.0%
Argentina	45.4%	30.0%	6.0%	12.6%	4.8%	1.2%	36.4%	44.6%	10.0%	3.0%	3.6%	2.4%	1.2%	4.4%	21.6%	41.4%	20.6%	8.8%	2.0%
Paraguay	31.3%	53.3%	4.0%	8.7%	1.0%	1.7%	17.3%	69.3%	5.0%	2.3%	3.7%	2.3%	1.3%	4.0%	39.7%	43.0%	7.3%	3.7%	1.0%
Venezuela	18.8%	60.0%	2.0%	16.0%	1.0%	2.3%	11.8%	78.5%	1.3%	1.5%	5.5%	1.5%	2.8%	9.3%	54.8%	26.8%	4.3%	1.5%	0.8%

Table 4-44 Cluster sizes (percentages of a corresponding country sample) in the case of each country

4.6.2.6 Assessment of Segmentation Approaches

According to validation procedures presented in part 4.6.1.3 of the present thesis, the quality of cluster solutions found by means of all three segmentation approaches can be considered as rather high. Assessment of segmentation approaches on the base of their application convenience as well as on the base of their ability to build well-structured, meaningful and coherent cluster solutions and to create bases appropriate for conducting meaningful and efficient international market segmentation strategies is presented below.

4.6.2.6.1 Application Convenience

Because of the same reasons as in the case of intranational segmentation analyses, it can be stated here that the segmentation approach based on SOM appeared to be most effort- and time-consuming.[475]

It should be mentioned that convenience of the Ward's method has reduced, due to a very long process of forming a hierarchy of clusters executed by the SPSS software. At the same time, the speed of SPSS procedures in the case of the K-means method has remained the same.

4.6.2.6.2 Structure, Meaningfulness and Coherency of Cluster Solution

Analysis of cluster solutions has demonstrated that using the Ward's method has resulted in finding not very big, but still substantial segments; using the K-means method has led to producing the segment with overall high requirements including 38% of all respondents and exceeding by far corresponding segments built by the Ward's method and SOM; and using SOM has enabled the most detailed separation of respondents into groups and visual inspection of cluster regions.

In general, it was concluded that results of all three segmentation approaches were quite meaningful and coherent in terms of requirements of respondents towards a product/brand, their attitudes towards beauty/life, and their skin conditions. At the same time, the overall impression from analysis of demographic characteristics, brand assessments, and behavioral characteristics was rather vague in the case of all three segmentation approaches.

[475] For more details see part 4.6.1.6.1 of the present thesis.

4.6.2.6.3 Basis for International Market Segmentation Strategies

Analogously to the assessment procedure used within the scope of additive intranational market segmentation, the possibility of constructing meaningful standardized marketing programs, to which the obtained segments would react in an internally homogeneous and externally heterogeneous way, was assessed here on the base of geographical extension of transnational segments and possible degree of standardization of marketing mix elements.

As it can be seen in Table 4-43, all three segmentation approaches have produced only two segments extending across twenty countries. All other segments extend across all twenty one countries. From a purely structural point of view, all approaches have created bases appropriate for conduction of "global" standardized market segmentation strategies. This holds, however, only for such marketing mix element as a product (see Table 4-45). As far as obscurities in cluster descriptions based on demographic characteristics, brand assessments, and behavioral characteristics were found, complications in strategy planning with regard to other marketing mix elements (i.e., promotion, distribution, and pricing) are likely to be expected in the case of all three segmentation approaches.

Moreover, due to the fact that results of integral market segmentation appeared to be biased by differences in regional/country-specific data entry patterns and thus to reflect the actual state of affairs only approximately, and because the influence of regional/country-specific cultural or economic forces on formation of segments was broken and altered, it can be concluded that international market segmentation strategies constructed on the base of cluster solutions obtained in the case of all three segmentation approaches should not be expected to be precise and efficient.

Transnational segment	Standardized product features
Highly demanding	Upscale image, attractiveness, modernity, popularity, high quality, mildness, convenience
Rational demanding	High quality, mildness, convenience, attractiveness
Rationalists	High quality, mildness, convenience
Good quality at a fair price	Good quality, convenience
Quality and good value for money from a strong brand	Good quality, convenience, popularity
Brand glamor driven mainstream	Attractiveness, modernity, good quality
Only brand attractiveness driven (very little skin care involved)	Attractiveness, modernity, popularity
Sensitivity and mildness driven	Mildness

Table 4-45 Standardized product features (integral market segmentation)

4.6.3 Contrasting Additive Intranational Market Segmentation and Integral Market Segmentation

4.6.3.1 Preparation of Data for Analysis

While conducting additive intranational market segmentation, the researcher could work with already available representative samples. On the contrary, in the case of integral market segmentation, the researcher had to construct the "world" sample first. As it was already demonstrated above, this process was rather complicated. The attempt to combine country-specific samples after making their sizes proportional to corresponding female population sizes has failed, and the researcher had to develop and make use of an approximate adjustment scheme based on the four-group system.[476] Moreover, as far as assessment scales for demographic characteristics differed across the countries, new, more generalized assessment scales had to be generated, in order to combine these descriptor variables.[477]

[476] For more details see part 4.6.2.1.1 of the present thesis.
[477] For more details see part 4.6.2.1.3 of the present thesis.

Of course, it is important to emphasize at this point that difficulties described above are rather specific for this particular study. They are not likely to appear, if a data collection process is conducted across countries in a completely uniform way, and samples proportional to population sizes (in either exact or approximate way) are chosen from the very beginning. These are, nevertheless, idealized conditions. They are not typical for practice of market research because ways of data collection usually vary from country to country, and sizes of samples are normally not chosen on the base of proportionality to population sizes. In other words, researchers are very likely to deal with problems analogous to the ones described above.

Steps undertaken while preparing data for analysis in the case of both additive intranational market segmentation and integral market segmentation are presented in Figure 4-13.

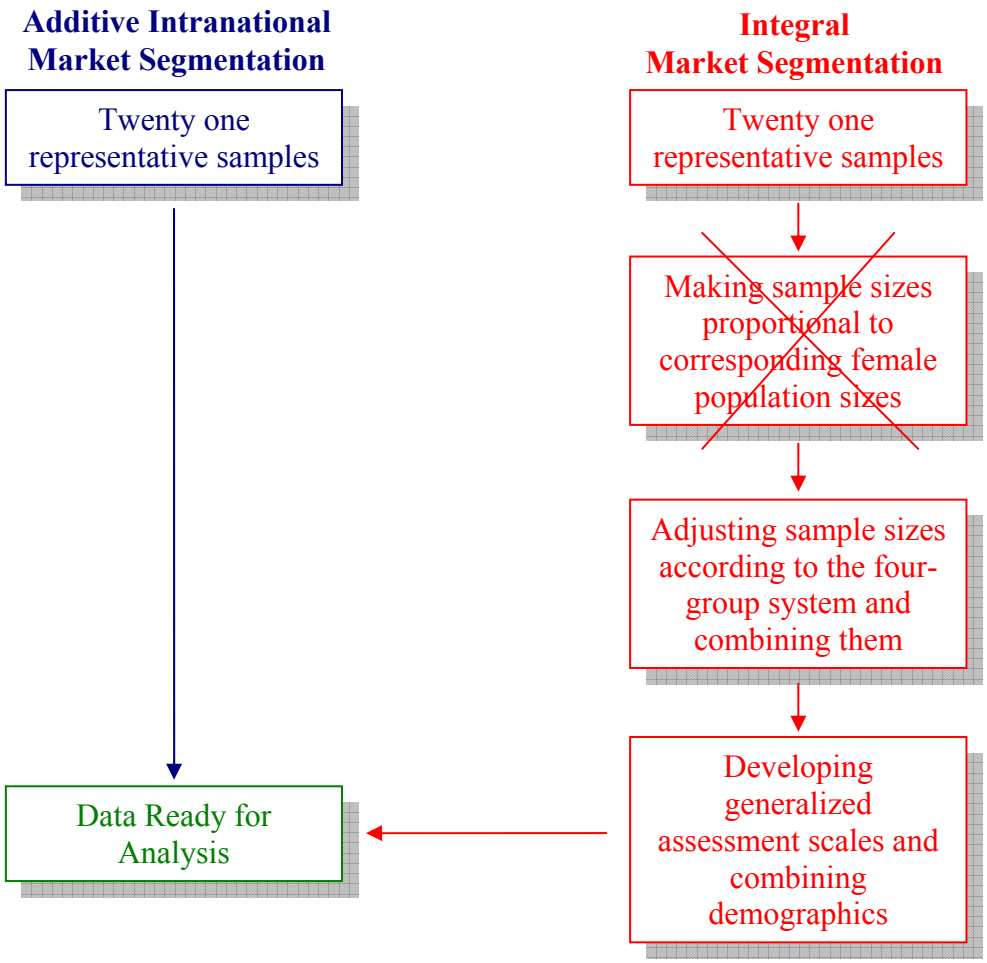


Figure 4-13 Preparation of data for analysis

4.6.3.2 Effort- and Time-Costs of Analysis

While carrying out additive intranational market segmentation, the researcher had to deal with twenty one data samples and conduct twenty one segmentation analyses in the case of each of the three segmentation approaches to separating respondents into groups (based on the Ward's method, K-means method, and SOM). Moreover, all cluster solutions had to be examined in detail, in order to find country-specific segments with internationally common features and combine them into transnational segments. Of course, the whole procedure has required a substantial amount of effort and time.

On the contrary, while carrying out integral market segmentation only one segmentation analysis was conducted on the base of only one data sample in the case of each of the three segmentation approaches. Transnational segments were found straight away. Correspondingly, arduous and long-lasting process of examining country-specific segments and combing them into transnational segments was avoided. Of course, it is a big and indisputable advantage of this type of international market segmentation methodology.

Steps undertaken while obtaining transnational samples in the case of both additive intranational market segmentation and integral market segmentation are presented in Figure 4-14.

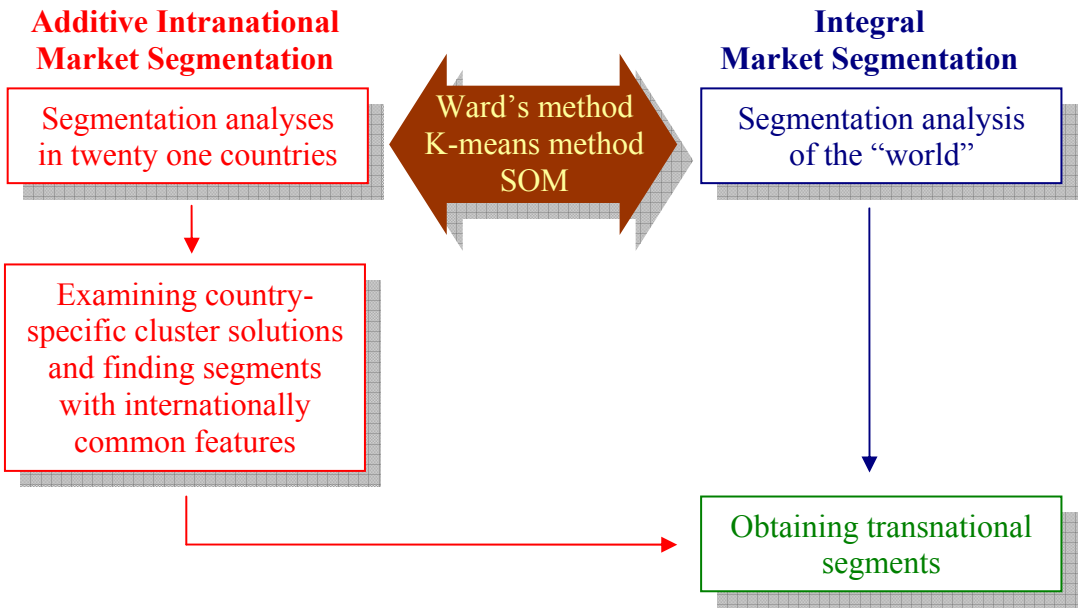


Figure 4-14 Process of obtaining transnational samples

4.6.3.3 Description and Interpretation of Segments

Despite the fact that interpretation of country-specific segments in the case of additive intranational market segmentation was normally clear and meaningful, interpretation of corresponding transnational segments appeared to be generalized to a certain degree, due to the fact that the researcher had to abstract off details and focus on common tendencies. Nevertheless, such generalization of interpretation can be viewed as a controlled one. It is always possible to go back to country-specific segments for more detailed information.

On the contrary, the vagueness[478] in segment interpretation based on demographic characteristics, brand assessments, and behavioral characteristics in the case of integral market segmentation as well as inaccuracy in its overall results biased by differences in regional/country-specific data entry patterns cannot be corrected.

In other words, it can be stated that segment interpretation appeared to be of higher quality in the case of additive intranational market segmentation than in the case of integral market segmentation.

4.6.3.4 Conduction of International Market Segmentation Strategies

As it was already demonstrated above, both additive intranational market segmentation and integral market segmentation have led to formation of transnational segments with a rather "global" character, which can be addressed with meaningful standardized product policies. At the same time, standardization of other marketing mix elements (in particular, promotion, distribution, and pricing) is likely to be problematic. The reason for this is obviously existence of regional/country-specific peculiarities in demographic characteristics, brand assessments, and behavioral characteristics. They can be clearly observed and dealt with (i.e., used as a base for differentiation of marketing programs) in the case of

[478] This vagueness is likely to be present even under idealized conditions, i.e., when a data collection process is conducted across countries in a completely uniform way, and samples proportional to population sizes (in either exact or approximate way) are chosen from the very beginning, because only such reason for its existence as information loss occurred while creating the "world" sample and turning to more generalized assessment scales while combining demographic characteristics would disappear. Other reasons (in particular, dealing with a big number of brands and assessing often extremely small percentages of affirmative answers for their awareness, likeability, usage, and advertising recall; dealing with a big number of purchase locations and assessing often extremely small percentages of affirmative answers for corresponding choice behavior of respondents; national differences in demographic charachteristics, brand assessments, and behavioral characteristics) would still be present.

additive intranational market segmentation. On the contrary, in the case of integral market segmentation, information on demographic characteristics, brand assessments, and behavioral characteristics is vague[479], and no good base for differentiation of marketing programs is provided.

Moreover, additive intranational market segmentation allows not only to identify regional/country-specific peculiarities, but also to consider regional/national segments separately and to address them with regional/national marketing programs.

Finally, as far as results of additive intranational market segmentation are more reliable, international market segmentation strategies planned and conducted on their base are likely to be more precise and efficient than in the case of integral market segmentation.

[479] Again, even under idealized conditions.

5 Conclusions and Outlook

5.1 Additive Intranational Market Segmentation vs. Integral Market Segmentation: Conclusions

The international market segmentation study presented in this doctor thesis has demonstrated that both additive intranational market segmentation and integral market segmentation have their advantages and limitations.

The former methodology is a quite labor-intensive process. However, it leads to meaningful and reliable results, which allow for a high degree of flexibility, precision, and responsiveness while planning and conducting international market segmentation strategies.

Effort- and time-costs in the case of the latter methodology are much lower. Nevertheless, irrevocable information losses occurring while combining country samples,[480] obscurities and inaccuracy in results limiting ability to assess the actual state of affairs, and impossibility to identify regional/national segments decrease the value of this methodology dramatically.

The findings of the present study support the opinion of Kale and Sudharshan (1987) and Bauer (2000) who pointed at such disadvantages of integral market segmentation as impossibility to provide information on regional/national segments and to describe national peculiarities of media usage and point of purchase choice behavior of consumers as well as estimating national sizes of transnational segments in a biased way.[481] The authors were convinced that additive intranational market segmentation is able to overcome these difficulties. The results of this study demonstrate that their opinion was correct.

In general, it can be concluded that conducting additive intranational market segmentation should be preferred while identifying transnational segments.

[480] Again, this argument does not hold under idealized conditions, when a data collection process is conducted in different countries in a completely uniform way, and samples proportional to population sizes (in either exact or approximate way) are chosen from the very beginning.
[481] See Kale/Sudharshan, 1987, p. 63 and Bauer, 2000, p. 2808. For more detailed information see also part 1.1 of the present thesis.

5.2 Statistical-Mathematical Segmentation Methods: Conclusions

All three segmentation approaches (based on the Ward's method, K-means method, and SOM) have succeeded to produce reliable partitions consisting of homogeneous clusters differing from each other significantly. In the case of intranational segmentation analyses, only slight distinctions between the approaches could be noticed while examining validation results. In particular, cluster solutions found using SOM tended to include the most homogeneous clusters, whereas cluster solutions found using the K-means method tended to represent the real groupings in the data in the most accurate way. In the case of integral market segmentation, where the researcher had to deal with a big sample including 8500 respondents, these two distinctions became more pronounced. Nevertheless, the overall impression from obtained validation results remained quite positive in the case of all three segmentation approaches.

More significant distinctions in the effectiveness of segmentation approaches were found while examining their application convenience as well as ability to build well-structured, meaningful and coherent cluster solutions and to create bases appropriate for conducting meaningful and efficient international market segmentation strategies. The segmentation approach based on the Ward's method makes good showings on all these criteria. Its only disadvantage is a very low speed of forming a hierarchy of clusters in the case of integral market segmentation. The segmentation approach based on the K-means method is also quite convenient in use, but it tends to produce cluster solutions with a worse structure, many obscurities, and clusters often extending across only several countries or not crossing national borders at all. Nevertheless, these disadvantages seem to be alleviated in the case of integral market segmentation, or, in other words, with the increase in a sample size. The segmentation approach based on SOM is the absolute leader among the three approaches in building high-quality cluster solutions in terms of criteria described above. Still, its obvious week point is a rather complicated analysis procedure.

In general, it can be concluded that

- the segmentation approach based on the Ward's method is a good classical segmentation procedure;
- the segmentation approach based on the K-means method produces quite poor results, which, however, can be improved, if a quite big sample is used;
- the segmentation approach based on SOM provides an innovative researcher with a big number of new opportunities in the field of international market segmentation, but also with challenges inherent in dealing with a complicated method.

5.3 Recommendations for Future Research

The doctoral research presented in this thesis is aimed at overcoming research deficits and providing both academicians and practitioners with valuable insights into the topic of international market segmentation. Nevertheless, further investigations in this highly important and complicated area are desirable. In particular, the following issues could be of interest:

- **with regard to international market segmentation in general and such its forms as additive intranational market segmentation and integral market segmentation:**
  - segmenting other than skin and body care markets,
  - conducting analysis on the base of data samples controlled for being proportional to corresponding population sizes and collected across countries in a completely uniform way;
- **with regard to statistical-mathematical segmentation methods:**
  - combining statistical-mathematical segmentation methods used in the present thesis with each other (for instance, finding initial cluster centroids used in the K-means method with the help of the Ward's method or SOM) and assessing efficiency of segmentation approaches based on such combinations,
  - improving and facilitating the analysis procedure of the segmentation approach based on SOM,
  - experimenting with other segmentation approaches (for instance, with the approach based on mixture models).

References

Books and Journals

Aldenderfer, M.S./Blashfield, R.K. (1985), Cluster Analysis, Sage Publications, Beverly Hills.

Althans, J. (1989), "Marktsegmentierung als Aufgabe des internationalen Marketing", in: Macharzina, K./Welge, M.K. (Hrsg.), Handwörterbuch Export und internationale Unternehmung, Poeschel Verlag, Stuttgart, pp. 1469-1477.

Anderberg, M.R. (1973), Cluster Analysis for Applications, Academic Press, New York.

Askegaard, S./Madsen, T.K. (1998), "The Local and the Global: Exploring Traits of Homogeneity and Heterogeneity in European Food Cultures", International Business Review, Vol. 7, No. 6, pp. 549-568.

Bacher, J. (1996), Clusteranalyse: Anwendungsorientierte Einführung, 2. Aufl., Oldenbourg Verlag, München.

Backhaus, K./Büschken, J./Voeth, M. (2005), International Marketing, Palgrave Macmillan, Basingstoke.

Backhaus, K./Erichson, B./ Plinke, W./ Weiber, R. (2003), Multivariate Analysemethoden: eine anwendungsorientierte Einführung, 10. Aufl., Springer-Verlag, Berlin.

Basilevsky, A. (1994), Statistical Factor Analysis and Related Methods: Theory and Applications, John Wiley & Sons, New York.

Bauer, E. (1976), Markt-Segmentierung als Marketing-Strategie, Duncker & Humblot, Berlin.

Bauer, E. (2000), "Market Segmentation in International Marketing", in: Dahiya, S.B. (Ed.), The Current State of Business Disciplines, Volume Six: Marketing, Spellbound Publications, Rohtak, pp. 2795-2814.

Bauer, E. (2002), Internationale Marketingforschung, 3. Aufl., Oldenbourg Wissenschaftsverlag, München.

Bauer, E./Liu, Y. (2006), Segmenting the Chinese Consumer Goods Market: A Hybrid Approach, IWIM, Bremen.

Becker, J. (2001), Marketing-Konzeption: Grundlagen des ziel-strategischen und operativen Marketing-Managements, 7. Aufl., Verlag Franz Vahlen, München.

Beiersdorf-Aktiengesellschaft (Hrsg.) (1982), 100 Jahre Beiersdorf: 1882-1982, Published by Beiersdorf AG, Hamburg.

Beiersdorf-Aktiengesellschaft (Hrsg.) (1982), "100 Jahre Beiersdorf", in: Beiersdorf-Aktiengesellschaft (Hrsg.) (1982), BDF International, Published by Beiersdorf AG, Hamburg, p. 4.

Beiersdorf-Aktiengesellschaft (Hrsg.) (1999), Das Unternehmen Beiersdorf, Published by Beiersdorf AG, Hamburg.

Berekoven, L. (1985), Internationales Marketing, 2. Aufl., Verlag Neue Wirtschafts-Briefe, Herne.

Berndt, R./Fantapié Altobelli, C./Sander, M. (2005), Internationales Marketing-Management, 3. Aufl., Springer-Verlag, Berlin.

Bieler, K. (1994), Vergleich von Multilayer Perzeptron, Kohonen Maps und Hidden Markov Modellen für die Fehlerdiagnose in Elektrischen Energieübertragungssystemen, Eidgenössische Technische Hochschule, Zürich.

Bijnen, E.J. (1973), Cluster Analysis: Survey and Evaluation of Techniques, University Press, Tilburg.

Bock, H.H. (1974), Automatische Klassifikation: theoretische und praktische Methoden zur Gruppierung und Strukturierung von Daten (Cluster - Analyse), Vandenhoeck & Ruprecht, Göttingen.

Bock, T. (2004), "A New Approach for Exploring Multivariate Data: Self-Organizing Maps", International Journal of Market Research, Vol. 2, pp. 189-203.

Böcker, F./Helm, R. (2003), Marketing, 7. Aufl., Lucius & Lucius, Stuttgart.

Böhler, H. (1977), Methoden und Modelle der Marktsegmentierung, Poeschel Verlag, Stuttgart.

Bolz, J. (1992), Wettbewerbsorientierte Standardisierung der internationalen Marktbearbeitung: eine empirische Analyse in europäischen Schlüsselmärkten, Wissenschaftliche Buchgeselschaft, Darmstadt.

Boote, A.S. (1983), "Psychographic Segmentation in Europe", Journal of Advertising Research, Vol. 22, No. 6, pp. 19-25.

Brosius F. (2002), SPSS 11, Mitp-Verlag, Bonn.

Cateora, P.R./Graham, J.L. (2005), International Marketing, 12th ed., McGraw-Hill/Irwin, Boston.

Cooley, W.W./Lohnes, P.R. (1971), Multivariate Data Analysis, John Wiley & Sons, New York.

Craig, C.S./Douglas, S.P. (2005), International Marketing Research, 3d ed., John Wiley & Sons, Chichester.

Crawford, J.C./Garland, B.C./Ganesh, G. (1988), "Identifying the Global Pro-Trade Consumer", International Marketing Review, Vol. 5, No. 4, pp. 25-33.

Curry, B. / Davies, F. / Evans, M. / Moutinho, L. / Phillips, P. (2003), "The Kohonen Self-Organizing Map As an Alternative to Cluster Analysis: An Application to Direct Marketing", International Journal of Market Research, Vol. 2, pp. 191-211.

Dawar, N./Parker, P. (1994), "Marketing Universals: Consumers' Use of Brand Name, Price, Physical Appearance, and Retailer Reputation as Signals of Product Quality", Journal of Marketing, Vol. 58, April, pp. 81-95.

Day, E./Fox, R.J./Huszagh, S.M. (1988), "Segmenting the Global Market for Industrial Goods: Issues and Implications", International Marketing Review, Vol. 5, No. 3, pp. 14-27.

de Bodt, E./Cottrell, M./Verleysen, M. (2002), "Statistical Tools to Assess the Reliability of Self-Organizing Maps", Neural Networks, Vol. 15, pp. 967-978.

Deichsel, G./Trampisch, H.J. (1985), Clusteranalyse und Diskriminanzanalyse, Gustav Fischer Verlag, Stuttgart.

Der Fischer Weltalmanach 2004, Fischer Taschenbuch Verlag, Frankfurt am Main.

Domzal, T./Unger, L. (1987), "Emerging Positioning Strategies in Global Marketing", Journal of Consumer Marketing, Vol. 4, No.4, pp. 23-40.

Douglas, S.P./Craig, C.S. (1982), "Information for International Marketing Decisions", in: Walter, I./Murray, T. (Eds.), Handbook of International Business, John Wiley & Sons, New York, pp. 29.1-29.33.

Douglas, S.P./Craig, C.S. (1995), Global Marketing Strategy, McGraw-Hill, New York.

Douglas, S.P./Craig, C.S. (1997), "The changing dynamic of consumer behavior: implications for cross-cultural research", International Journal of Research in Marketing, Vol. 14, pp. 379-395.

Douglas, S.P./Urban, C.D. (1977), "Life-Style Analysis to Profile Women in International Markets", Journal of Marketing, Vol. 41, July, pp. 46-54.

Dülfer, E. (2001), Internationales Management in unterschiedlichen Kulturbereichen, 6 Aufl., Oldenbourg Wissenschaftsverlag, München.

Duran, B.S./Odell, P.L. (1939), Cluster Analysis: A Survey, Springer-Verlag, Berlin.

Eckes, T. (1980), Clusteranalysen, Verlag W. Kohlhammer, Stuttgart.

Engel, J.F./Fiorillo, H.F./Cayley, M.A. (1972), Market Segmentation: Concepts and Applications, Holt, Rinehart and Winston, New York.

Everitt, B. (1974): Cluster Analysis, Heinemann Educational Books, London.

Everitt, B. (1993), Cluster Analysis, 3d ed., Edward Arnold, London.

Everitt, B. (2001), Applied Multivariate Data Analysis, 2nd ed., Edward Arnold, London.

Eimert, E. (1997), Beobachten und Klassifizieren von sportlichen Bewegungen mit neuronalen Netzen, Eberhard-Karls-Universität, Tübingen.

Elsen, I. (2000), Ansichtenbasierte 3D-Objekterkennung mit erweiterten Selbstorganisierenden Merkmalskarten, VDI Verlag, Düsseldorf.

Fanghänel, K. (2001), HF-Signalklassifikation mit Selbst-Organisierenden Karten, Verlag im Internet, Berlin.

Frank, R.E./Massy, W.F./Wind, Y. (1972), Market Segmentation, Prentice-Hall, Englewood Cliffs.

Freter, H. (1983), Marktsegmentierung, Verlag W. Kohlhammer, Stuttgart.

Gordon, A.D. (1981), Classification: Methods for the Exploratory Analysis of Multivariate Data, Chapman and Hall, London.

Gorsuch, R.L. (1974), Factor Analysis, Saunders, Philadelphia.

Green, P.E. (1977), "A New Approach to Market Segmentation", Business Horizons, Vol. 20, February, pp. 61-73.

Green, P.E./Tull, D.S./Albaum, G. (1988), Research for Marketing Decisions, 5th ed., Prentice-Hall, Englewood Cliffs.

Green, R.T./White, P.D. (1976), "Methodological Considerations in Cross-National Consumer Research", Journal of International Business Studies, Vol. 7, No. 2, pp. 81-87.

Hammann, P./Erichson, B. (2000), Marktforschung, 4. Aufl., Lucius & Lucius, Stuttgart.

Hansen, C. (2001), NIVEA: Evolution of a World-Famous Brand, Published by Beiersdorf AG, Hamburg.

Hassan, S.S./Katsanis, L.P. (1991), "Identification of Global Consumer Segments: A Behavioral Framework", Journal of International Consumer Marketing, Vol. 3, No. 2, pp. 11-28.

Hassoun, M. (1995), Fundamentals of Artificial Neural Networks, Massachusetts Institute of Technology Press, Cambridge.

Heenan, D.A./Perlmutter, H.V. (1979), Multinational Organization Development, Addison-Wesley publishing Company, Reading.

Heikkonen, J. (1994), Subsymbolic Representations, Self-Organizing Maps, and Object Motion Learning, University of Technology, Lappeenranta.

Helsen, K./Jedidi, K./DeSarbo, W.S. (1993), "A New Approach to Country Segmentation Utilizing Multinational Diffusion Patterns", Journal of Marketing, Vol. 57, October, pp. 60-71.

Hermanns, A./Wißmeier, U.K. (1993), "Bekleidung und Mode: Einstellungen und Verhalten im internationalen Vergleich", Marketing ZFP, Vol, 15, No. 1, pp. 26-33.

Hinton, P.R./Brownlow, C./McMurray, I./Cozens, B. (2004): SPSS Explained, Routledge, London.

Holm, K. (1976), Die Faktorenanalyse, Francke Verlag, München.

Hünerberg, R. (1994), Internationales Marketing, Verlag Moderne Industrie, Landsberg/Lech.

Huszagh, S.M./Fox, R.J./Day, E. (1986), "Global Marketing: An Empirical Investigation", Columbia Journal of World Business, Vol. 20, No. 4, pp. 31-43.

International NIVEA Brand Monitor Presentations 2003-2004: SouthAfrica/ China/ Hong Kong/ Indonesia/ Korea/ Philippines/ Taiwan/ Thailand/ Australia/ Belgium/ Germany/ Italy/ Netherlands/ Spain/ Switzerland/

Russia/ Denmark/ Norway/ Argentina/ Paraguay/ Venezuela, Beiersdorf AG, Unpublished.

Jain, S.C. (1989), "Standardization of International Marketing Strategy: Some Research Hypotheses", Journal of Marketing, Vol. 53, January, pp. 70-79.

Jambu, M./Lebeaux, M-O. (1983), Cluster Analysis and Data Analysis, North-Holland Publishing Company, Amsterdam.

Jockusch, S. (1995), Modellierung und Manipulation von Bild- und Grafikdaten mit neuronalen Netzen, Infix, Sankt Augustin.

Kaiser, A. (1977), Die Identifikation von Marktsegmenten, Duncker & Humblot, Berlin.

Kale, S.H. (1995), "Grouping Euroconsumers: A Culture-Based Clustering Approach", Journal of International Marketing, Vol. 3, No. 3, pp. 35-48.

Kale, S.H./Sudharshan, D. (1987), "A Strategic Approach to International Segmentation", International Marketing Review, Vol. 4, No. 2, pp. 60-70.

Kaufman, L./.Rousseeuw, P.J. (1990), Finding Groups in Data: An Introduction to Cluster Analysis, John Wiley & Sons, New York.

Keegan, W.J. (1980), Multinational Marketing Management, 2nd ed., Prentice Hall, Englewood Cliffs.

Keegan, W.J. (2002), Global Marketing Management, 7th ed., Prentice Hall, Upper Saddle River.

Keegan, W.J./Schlegelmilch, B.B./Stöttinger, B. (2002), Globales Marketing-Management: eine europäische Perspective, Oldenbourg Wissenschaftsverlag, München.

Keysberg, G. (1989), Die Anwendung der Diskriminanzanalyse zur statistischen Kreditwürdigkeitsprüfung im Konsumentenkreditgeselschaft, Müller BotermannVerlag, Köln.

Kim, J-O./Mueller, C.W. (1978), Factor Analysis: Statistical Methods and Practical Issues, Sage Publications, Beverly Hills.

Klecka, W.R. (1982), Discriminant Analysis, Sage Publications, Beverly Hills.

Köhler, R./Hüttemann, H. (1989), "Marktauswahl im internationalen Marketing", in: Macharzina, K./Welge, M.K. (Hrsg.), Handwörterbuch Export und internationale Unternehmung, Poeschel Verlag, Stuttgart, pp. 1428-1440.

Kohonen, T. (1989), Self-Organization and Associative Memory, 3d ed., Springer-Verlag, Berlin.

Kohonen, T. (2001), Self-Organizing Maps, 3d ed., Springer-Verlag, Berlin.

Kotabe, M./Helsen, K. (1998), Global Marketing Management, John Wiley & Sons, New York.

Kramer, S. (1991), Europäische Life-Style-Analysen zur Verhaltensprognose von Konsumenten, Verlag Dr. Kovac, Hamburg.

Krapp, N./Grieb, A./Voss, K. (August 2003): Research Proposal for International NIVEA Brand Monitor in South Africa, Beiersdorf AG, Unpublished.

Kreutzer, R. (1989), Global-Marketing – Konzeption eines Länderübergreifenden Marketing, Deutscher Universitäts-Verlag, Wiesbaden.

Kreutzer, R. (1991), "Länderübergreifende Segmentierungskonzepte – Antwort auf die Globalisierung der Märkte", Jahrbuch der Absatz- und Verbrauchsforschung, Vol. 37, No. 1, pp. 4-27.

Kropp, J. (1999), Neuronale Netze und qualitative Wissensbasen in der integrativen Umweltsystemanalyse, Verlag im Internet, Berlin.

Kulhavy, E. (1993) Internationales Marketing, 5th ed., Rudolf Trauner Verlag, Linz.

Kumar, V./Ganesh, J./Echambadi, R. (1998), "Cross-National Diffusion Research: What Do We Know and How Certain Are We?", Journal of Product Innovation Management, Vol. 15, No. 3, pp. 255-268.

Kumar, V./Stam, A./Joachimsthaler, E.A. (1994), "An Interactive Multicriteria Approach to Identifying Potential Foreign Markets", Journal of International Marketing, Vol. 2, No. 1, pp. 29-52.

Kutschker, M./Schmid, S. (2005), Internationales Management, 4. Aufl., Oldenbourg Wissenschaftsverlag, München.

Lampinen, J. (1992), Neural Pattern Recognition: Distortion Tolerance by Self-Organizing Maps, University of Technology, Lappeenranta.

Lauwerth, W. (1980), Zum Kommunalitätenproblem in der Faktorenanalyse, Verlag Anton Hain, Königstein.

Lee, C. (1990), "Determinants of National Innovativeness and International Market Segmentation", International Marketing Review, Vol. 7, No. 5, pp. 39-49.

Liander, B./Terpstra, V./Yoshino, M.Y./Sherbini, A.A. (1967), Comparative Analysis for International Marketing, Allyn and Bacon, Boston.

Lingenfelder, M. (1996), Die Internationalisierung im europäischen Einzelhandel: Ursachen, Formen und Wirkungen im Lichte einer theoretischen Analyse und empirischen Bestandsaufnahme, Duncker & Humblot, Berlin.

Liu, Y. (2005), Options for Implementing A Strategy of Market Segmentation in Chinese Consumer Goods Markets, Logos Berlin, Berlin.

Lorr, M. (1983), Cluster Analysis for Social Scientists, Jossey-Bass, San-Francisco.

Matiaske, W. (1994), Hierarchical Cluster Analysis with P-STAT, Diskussionspapier, 5, Technische Universität, Berlin.

Martinetz, T. (1992), Selbstorganisierende neuronale Netzwerkmodelle zur Bewegungssteuerung, Infix, Sankt Augustin.

McDonald, M./Dunbar, I. (1995), Market Segmentation: A Step-by-Step Approach to Creating Profiatble Market Segments, Macmillan Press, Basingstoke.

Meffert, H. (1977), "Marktsegmentierung und Marktwahl im internationalen Marketing", Die Betriebswirtschaft, Vol. 37, No.3, pp. 433-446.

Meffert, H. (1988), Strategische Unternehemensführung und Marketing: Beiträge zur marktorientierten Unternehmenspolitik, Gabler Verlag, Wiesbaden.

Meffert, H. (1994), Marketing-Management: Analyse, Strategie, Implementierung, Gabler Verlag, Wiesbaden.

Meffert, H. (2000), Marketing: Grundlagen marktorientierter Unternehmensführung, 9. Aufl., Gabler Verlag, Wiesbaden.

Meffert, H./Althans, J, (1982), Internationales Marketing, Verlag W. Kohlhammer, Stuttgart.

Meffert, H./Bolz, J. (1998), Internationales Marketing-Management, 3. Aufl., Verlag W. Kohlhammer, Stuttgart.

Mennicken, C. (2000), Interkulturelles Marketing: Wirkungszusammenhänge zwischen Kultur, Konsumverhalten und Marketing, Deutscher Universitäts-Verlag, Wiesbaden.

Morrison, D.G. (1971), “On the Interpretation of Discriminant Analysis”, in: Aaker, D.A. (Ed.), Multivariate Analysis in Marketing: Theory and Applications, Wadsworth Publishing Co., Belmont, pp. 127-142.

Moskowitz, H.R./Rabino, S. (1994), “Sensory Segmentation: An Organizing Principle for International Product Concept Generation”, Journal of Global Marketing, Vol. 8, No.1, pp. 73-93.

Müller, L. (1977), Auswertungsmethoden zur Clusteranalyse, Universität, Hamburg.

Müller, S./Gelbrich, K. (2004), Interkulturelles Marketing, Verlag Franz Vahlen, München.

Müller, S./Kornmeier, M. (2002), Strategisches internationales Management, Verlag Franz Vahlen, München.

Neidell, L.A. (1983), Strategic Marketing Management: An Integrated Approach, Macmillan Publishing Company, New York.

NIVEA Brand Philosophy 2003, Biersdorf AG, Unpublished.

Obermayer, K. (1993), Adaptive neuronale Netze und ihre Anwendung als Modelle der Entwicklung kortikaler Karten, Infix, Sankt Augustin.

Palmer, A. (2004), Introduction to Marketing: Theory and Practice, Oxford University Press, Oxford.

Perlmutter, H.V. (1969), “The Tortuous Evolution of the Multinational Corporation”, Columbia Journal of World Business, Vol. 4, No. 1, pp. 9-18.

Pinnekamp, H.-J./Siegmann, F. (2001), Deskriptive Statistik: mit einer Einführung in das Programm SPSS, Oldenbourg Wissenschaftsverlag, München.

Polani, D. (1996), Adaption der Topologie von Kohonen-Karten durch Genetische Algorithmen, Infix, Sankt Augustin.

Porrmann, M. (2002), Leistungsbewertung eingebetteter Neurocomputersysteme, Heinz Nixdorf Institut, Paderborn.

Pytlik, M. (1995), Diskriminanzanalyse und künstliche neuronale Netze zur Klassifizierung von Jahresabschlüssen: ein empirischer Vergleich, Peter Lang, Frankfurt am Main.

Quittek, J. (1997), Prozessorzuteilung in Parallelrechnern mit Hilfe selbstorganisierender Karten, Shaker Verlag, Aachen.

Retzko, R. (1996), Flexible Tourenplanung mit selbstorganisierenden neuronalen Netzen, Unitext-Verlag, Göttingen.

Ritter, H. (1988), Selbstorganisierende neuronale Karten, Technische Universität, München.

Ronen, S./Kraut, A.I. (1977), "Similarities Among Countries Based on Employee Work Values and Attitudes", Columbia Journal of World Business, Vol. 12, No. 2, pp. 89-96.

Rüping, S. (1995), VLSI-gerechte Umsetzung von selbstorganisierenden Karten und ihre Einbindung in ein Neuro-Fuzzy Analysesystem, VDI Verlag, Düsseldorf.

Rushmeier, H. / Lawrence, R. / Almasi, G. (1997), Case Study: Visualizing Customer Segmentations Produced by Self-Organizing Maps, IBM Watson Research Center, Yorktown Heights.

Sadeghi, A.A. (1996), Asymptotic Behaviour of Self-Organizing Maps with Non-Uniform Stimuli Distribution, Universität, Kaiserslautern.

Scherer, A. (1997), Neuronale Netze: Grundlagen und Anwendungen, Friedr. Vieweg & Sohn, Braunschweig.

Schwanenberg, S. (2001), Neuronale Netze als Segmentierungsverfahren für die Marktforschung: ein Vergleich mit traditionellen Segmentierungsansätzen auf der Basis von Daten aus Monte-Carlo-Simulationen, Josef Eul Verlag, Lohmar.

Schweizer, M. (1995), Wissensanalyse und -erhebung mit Kohonen-Netzen am praktischen Beispiel der Lawinenprognose, Universität, Zürich.

Segler, K. (1986), Basisstrategien im internationalen Marketing, Campus Verlag, Frankfurt am Main.

Seiffert, U. (1998), Wachsende mehrdimensionale Selbstorganisierende Karten zur Analyse bewegter Szenen, Otto-von-Guericke-Universität, Magdeburg.

Sethi, S.P. (1971), "Comparative Cluster Analysis for World Markets", Journal of Marketing Research, Vol. 8, August, pp. 348-354.

Sheth, J. (1986), "Global Markets or Global Competition?", Journal of Consumer Marketing, Vol. 3, No. 2, pp. 9-11.

Skin Care Questionnaires 2003-2004: SouthAfrica/ China/ Hong Kong/ Indonesia/ Korea/ Philippines/ Taiwan/ Thailand/ Australia/ Belgium/

Germany/ Italy/ Netherlands/ Spain/ Switzerland/ Russia/ Denmark/ Norway/ Argentina/ Paraguay/ Venezuela, Beiersdorf AG, Unpublished.

Smith, W.R. (1956), "Product Differentiation and Market Segmentation as Alternative Marketing Strategies", Journal of Marketing, Vol. 21, July, pp. 3-8.

Speckmann, H. (1995), Analyse mit fraktalen Dimensionen und Parallelisierung von Kohonen's selbstorganisierender Karte, Eberhard-Karls-Universität, Tübingen.

Steenkamp, J.-B.E.M. (2001), "The Role of National Culture in International Marketing Research", International Marketing Review, Vol. 18, No. 1, pp. 30-44.

Steenkamp, J.-B.E.M./Ter Hofstede, F. (2002), "International Market Segmentation: Issues and Perspectives", International Journal of Research in Marketing, Vol. 19, pp. 185-213.

Steffenhagen, H. (1992), "Marktforschung im Spannungsfeld länderübergreifender Standardisierung und Differenzierung", in: Breunig, G. (Hrsg.), Internationalisierung versus Regionalisierung: Grundsätzliches, Länderspezifisches, Methodisches, Vorträge zur Markt- und Sozialforschung, BVM-Schriftenreihe, Band 21, Offenbach, pp. 21-34.

Stegmüller, B. (1995), Internationale Marktsegmentierung als Grundlage für internationale Marketing-Konzeptionen, Josef Eul Verlag, Bergisch Gladbach.

Steinhausen, D./Langer, K. (1977), Clusteranalyse: Einführung in Methoden und Verfahren der automatischen Klassifikation, Walter de Gruyter & Co., Berlin.

Struhl, S.M. (1992), Market Segmentation: An Introduction and Review, Publisched by American Marketing Association, Chicago.

Tatsuoka, M.M. (1988), Multivariate analysis, Macmillan Publishing Company, New York.

Ter Hofstede, F./Steenkamp, J.-B.E.M./Wedel, M. (1999), "International Market Segmentation Based on Consumer-Product Relations", Journal of Marketing Research, Vol. 36, February, pp. 1-17.

Ter Hofstede, F./Wedel, M./Steenkamp, J.-B.E.M. (2002), "Identifying Spatial Segments in International Markets", Marketing Science, Vol. 21, No. 2, pp.160-177.

Terpstra, V./Sarathy, R. (1991), International Marketing, 5th ed., Dryden Press, Chicago.

Thorelli, H.B. (1980), "The Information Seekers: Multinational Strategy Target", in: Thorelli, H.B./Becker, H. (Eds.), International Marketing Strategy, Pergamon Press, New York, pp. 133-142.

Tryba, V. (1992), Selbstorganisierende Karten: Theorie, Anwendung und VLSI-Implementierung, VDI Verlag, Düsseldorf.

Tücke, M. (1976), "Tachometrische Methoden unter besonderer Berücksichtigung des WARDschen Algorithmus", in: Rollet, B./Bartram, M. (Hrsg.), Einführung in die hierarchische Clusteranalyse: für Psychologen, Pädagogen und Soziologen, Ernst Klett Verlag, Stuttgart, pp. 19-36.

Überla, K. (1977), Faktorenanalyse, 2. Aufl., Springer-Verlag, Berlin.

Verlagsgruppe Milchstrasse (Hrsg.) (1998), Märkte und Marken, Fallstudie NIVEA, Verlagsgruppe Milchstrasse, Hamburg.

Voelkl, K.E./Gerber, S.B. (1999), Using SPSS for Windows: Data Analysis and Graphics, Springer-Verlag, New York.

Weber, E. (1974), Einführung in die Faktorenanalyse, Gustav Fischer Verlag, Jena.

Wedel, M. / Kamakura, W. (2000), Market Segmentation: Conceptual and Methodological Foundations, 2nd ed., Kluwer Academic Publishers, Boston.

Wiedenbeck, M./Züll, C. (2001), Klassifikation mit Clusteranalyse: Grundlegende Techniken hierarchischer und K-means-Verfahren, ZUMA, How-to-Reihe, Nr. 10.

Wind, Y. (1978), "Issues and Advances in Segmentation Research", Journal of Marketing Research, Vol. 15, August, pp. 317-337.

Wind, Y./Douglas, S.P. (1972), "International Market Segmentation", European Journal of Marketing, Vol. 6, No. 1, pp. 17-25.

Wind, Y./Douglas, S.P./Perlmutter, H.V. (1973), "Guidlines for Developing International Marketing Strategies", Journal of Marketing, Vol. 37, April, pp. 14-23.

Wyss, W. (1991), Marktforschung von A-Z, Verlag DemoSCOPE, Adligenswil.

Yavas, U./Verhage, B.J./Green, R.T. (1992), "Global Consumer Segmentation Versus Local Market Orientation: Empirical Findings", Management International Review, Vol. 32, No. 3, pp. 265-272.

Zentes, J./Swoboda, B./Morschett, D. (2004), Internationales Wertschöpfungs-management, Verlag Franz Vahlen, München.

Internet Sources

www.beiersdorf.com (the official site of Beiersdorf company), visited in the period from 01.02.2006 to 05.02.2006.

www.cia.gov/cia/publications/factbook/ (CIA – The World Factbook; country information established in July 2004) visited on 24.01.2005.

http://koti.mbnet.fi/~phodju/nenet/Nenet/General.html (the official site of NENET Software), visited on 15.12.2005.

www.nivea.co.uk (the official site of NIVEA in the United Kingdom), visited in the period from 01.02.2006 to 05.02.2006.

Appendix A-1: Statement Compositions of Factors

Note:

high factor loadings (≥ 0.5) are highlighted with yellow in all tables included into this appendix.

South Africa

Requirements towards a product/brand	Factors		
	Quality	Brand glamor	Sensitivity and mildness
It is a trustworthy brand	0.813	0.017	-0.033
Products fulfill current expectations towards skin care	0.770	0.057	0.041
Products are of high quality	0.683	0.142	0.163
Products offer good value for money	0.631	-0.029	0.126
Products contain highly effective ingredients	0.521	0.195	0.332
It is a modern brand	-0.038	0.719	0.187
This brand is highly advertised	-0.147	0.685	0.315
Products perform better than those of other brands	0.263	0.659	0.034
This brand is for demanding women who give importance to their appearance	0.118	0.650	0.067
Products are suitable for sensitive skin	0.124	0.047	0.783
This brand offers mild skin care products	0.008	0.251	0.670
Products rely on the latest scientific findings	0.072	0.373	0.607
Products are highly appropriate for skin	0.464	-0.107	0.559
Products have a pleasant fragrance	0.270	0.248	0.371

China

Requirements towards a product/brand	Factors		
	Quality	Brand glamor	Sensitivity and mildness
Products are of higher quality	0.824	0.013	0.174
It is a trustworthy brand	0.797	0.161	0.103
Products offer good value for money	0.765	0.035	0.079
Products fulfill current expectations towards skin care	0.691	0.122	0.189
Products perform better than those of other brands	0.560	0.167	0.351
It is a modern brand	0.108	0.841	0.057
This brand is highly advertised	-0.018	0.758	0.068
This brand is for demanding women who give importance to their appearance	0.131	0.688	0.102
Products rely on the latest scientific findings	0.182	0.657	0.193
Products have a pleasant fragrance	0.048	0.621	0.234
Products are suitable for sensitive skin	-0.063	0.309	0.688
Products are highly appropriate for skin	0.302	0.013	0.632
This brand offers mild skin care products	0.257	0.310	0.623
Products contain highly effective ingredients	0.228	0.065	0.615

Hong Kong

Requirements towards a product/brand	Factors		
	Quality	Brand glamor	Sensitivity and mildness
Products fulfill current expectations towards skin care	0.814	0.038	0.046
It is a trustworthy brand	0.770	-0.050	0.179
Products are of higher quality	0.764	-0.016	0.109
Products contain highly effective ingredients	0.738	0.068	0.173
Products offer good value for money	0.718	0.013	-0.036
Products perform better than those of other brands	0.697	0.146	0.188
Products are highly appropriate for skin	0.611	-0.015	0.411
It is a modern brand	-0.041	0.825	0.137
This brand is highly advertised	-0.100	0.745	0.139
This brand is for demanding women who give importance to their appearance	0.142	0.664	0.236
Products have a pleasant fragrance	0.135	0.656	-0.276
Products rely on the latest scientific findings	0.038	0.538	0.583
Products are suitable for sensitive skin	0.153	0.088	0.776
This brand offers mild skin care products	0.363	0.103	0.627

Indonesia

Requirements towards a product/brand	Factors		
	Quality	Sensitivity and mildness	Brand glamor
Products fulfill current expectations towards skin care	0.727	0.156	0.046
Products perform better than those of other brands	0.707	0.133	0.193
It is a trustworthy brand	0.642	0.317	-0.038
Products are of higher quality	0.638	0.202	0.158
Products contain highly effective ingredients	0.601	0.132	0.207
Products offer good value for money	0.589	0.096	0.159
Products are suitable for sensitive skin	0.102	0.730	-0.007
Products are highly appropriate for skin	0.313	0.668	-0.113
This brand offers mild skin care products	0.360	0.591	0.005
Products rely on the latest scientific findings	0.032	0.586	0.407
This brand is highly advertised	0.157	-0.061	0.811
It is a modern brand	0.127	0.103	0.808
This brand is for demanding women who give importance to their appearance	0.173	0.106	0.653
Products have a pleasant fragrance	0.179	0.462	0.239

Korea

Requirements towards a product/brand	Factors		
	Quality	Sensitivity and mildness	Brand glamor
Products offer good value for money	0.704	0.231	-0.011
Products are of higher quality	0.687	0.177	-0.101
It is a trustworthy brand	0.642	0.132	0.299
Products perform better than those of other brands	0.617	0.307	0.189
Products fulfill current expectations towards skin care	0.534	0.199	0.444
Products are suitable for sensitive skin	0.102	0.771	0.105
This brand offers mild skin care products	0.292	0.627	0.133
Products are highly appropriate for skin	0.312	0.623	-0.014
Products rely on the latest scientific findings	0.314	0.614	0.150
Products have a pleasant fragrance	0.042	0.567	0.361
It is a modern brand	0.054	0.017	0.830
This brand is highly advertised	-0.081	0.127	0.823
This brand is for demanding women who give importance to their appearance	0.216	0.159	0.616
Products contain highly effective ingredients	0.436	0.464	-0.077

Philippines

Requirements towards a product/brand	Factors		
	Sensitivity, mildness, and effectiveness	Quality	Brand popularity
Products are highly appropriate for skin	0.743	0.084	0.086
This brand is for demanding women who give importance to their appearance	0.701	0.016	0.129
Products are suitable for sensitive skin	0.690	0.174	-0.090
Products rely on the latest scientific findings	0.635	0.128	0.296
This brand offers mild skin care products	0.552	0.286	0.088
It is a trustworthy brand	0.133	0.767	0.126
Products are of higher quality	0.141	0.717	-0.051
Products offer good value for money	-0.061	0.662	0.258
Products fulfill current expectations towards skin care	0.411	0.640	0.023
This brand is highly advertised	0.022	0.065	0.875
It is a modern brand	0.143	0.155	0.813
Products have a pleasant fragrance	0.446	0.011	0.433
Products perform better than those of other brands	0.369	0.312	0.399
Products contain highly effective ingredients	0.436	0.411	0.158

Taiwan

Requirements towards a product/brand	Factors		
	Quality	Mildness, sensitivity, and effectiveness	Brand glamor
Products contain highly effective ingredients	0.817	0.054	0.224
Products are highly appropriate for skin	0.765	0.150	-0.020
Products perform better than those of other brands	0.753	0.336	0.068
Products offer good value for money	0.734	0.394	0.161
Products are of higher quality	0.659	0.353	0.138
This brand offers mild skin care products	0.303	0.725	0.002
Products are suitable for sensitive skin	0.057	0.700	0.216
Products fulfill current expectations towards skin care	0.453	0.636	-0.140
It is a trustworthy brand	0.399	0.591	-0.062
Products rely on the latest scientific findings	0.371	0.517	0.224
This brand is highly advertised	0.010	0.019	0.831
It is a modern brand	-0.007	0.392	0.733
Products have a pleasant fragrance	0.174	-0.262	0.590
This brand is for demanding women who give importance to their appearance	0.314	0.348	0.519

Thailand

Requirements towards a product/brand	Factors		
	Quality	Brand glamor	Sensitivity and mildness
Products are of higher quality	0.756	0.084	0.091
It is a trustworthy brand	0.745	0.136	0.102
Products offer good value for money	0.682	-0.008	0.077
Products perform better than those of other brands	0.622	0.195	0.259
Products fulfill current expectations towards skin care	0.621	0.031	0.347
Products contain highly effective ingredients	0.554	0.156	0.375
It is a modern brand	0.139	0.839	-0.048
This brand is highly advertised	0.063	0.829	-0.128
Products rely on the latest scientific findings	0.109	0.583	0.311
Products have a pleasant fragrance	0.013	0.562	0.169
Products are suitable for sensitive skin	0.125	0.069	0.846
This brand offers mild skin care products	0.247	0.116	0.767
Products are highly appropriate for skin	0.422	0.054	0.587
This brand is for demanding women who give importance to their appearance	0.324	0.378	0.277

Australia

Requirements towards a product/brand	Factors		
	Quality	Brand glamor	Sensitivity and mildness
Products are of high quality	0.754	0.015	0.179
Products contains highly effective ingredients	0.716	0.180	0.106
Products fulfill current expectations towards skin care	0.683	0.038	0.266
Products perform better than those of other brands	0.539	0.445	-0.043
It is a modern brand	0.001	0.819	0.080
This brand is highly advertised	-0.129	0.802	0.105
This brand is for demanding women who give importance to their appearance	0.177	0.659	0.031
Products rely on the latest scientific findings	0.453	0.537	-0.001
Products are suitable for sensitive skin	0.139	0.057	0.879
This brand offers mild skin care products	0.118	0.147	0.855
Products are highly appropriate for skin	0.430	-0.106	0.570
Products offer good value for money	0.443	0.060	0.349
It is a trustworthy brand	0.476	0.386	0.195
Products have a pleasant fragrance	0.265	0.440	-0.036

Belgium

Requirements towards a product/brand	Factors			
	Sensitivity and quality	Brand glamor	Good value for money	Pleasant fragrance
Products are suitable for sensitive skin.	0.833	0.041	-0.092	0.063
This brand offers mild skin care products	0.825	0.147	-0.057	0.083
Products are highly appropriate for skin	0.743	-0.128	0.238	0.011
Products fulfill current expectations towards skin care	0.656	0.032	0.293	0.059
Products are of high quality	0.606	0.064	0.376	0.103
Products contain highly effective ingredients	0.567	0.152	0.393	-0.224
Is a trustworthy brand	0.513	0.278	0.323	-0.078
It is a modern brand	-0.057	0.805	-0.010	0.234
This brand is highly advertised	-0.072	0.732	-0.096	0.213
This brand is for demanding women who give importance to their appearance	0.114	0.700	0.227	-0.066
Products rely on the latest scientific findings	0.444	0.549	0.009	-0.182
Products offer a good value for money	0.156	0.034	0.862	0.080
Products have a pleasant fragrance	0.234	0.268	0.130	0.780
Products perform better than those of other brands	0.292	0.447	0.182	-0.368

Germany

Requirements towards a product/brand	Factors		
	Quality	Brand glamor	Sensitivity and mildness
Products are of high quality	0.719	0.108	0.268
Products contain highly effective ingredients	0.706	0.152	0.226
It is a trustworthy brand	0.702	0.200	0.190
Products offer good value for money	0.698	-0.087	0.211
Products fulfill current expectations towards skin care	0.684	0.145	0.250
Products rely on the latest scientific findings	0.614	0.384	0.105
Products have a pleasant fragrance	0.608	0.113	0.197
It is a modern brand	0.171	0.799	-0.014
This brand is highly advertised	-0.248	0.768	0.002
This brand is for demanding women who give importance to their appearance	0.278	0.679	0.101
Products perform better than those of other brands	0.346	0.655	-0.013
Products are suitable for sensitive skin	0.169	0.040	0.867
This brand offers mild skin care products	0.374	0.050	0.725
Products are highly appropriate for skin	0.439	-0.048	0.671

Italy

Requirements towards a product/brand	Factors		
	Quality	Sensitivity and mildness	Brand glamor
It is a trustworthy brand	0.736	0.214	-0.119
Products fulfill current expectations towards skin care	0.689	0.365	-0.071
Products perform better than those of other brands	0.619	0.367	0.080
Products are of high quality	0.612	0.287	-0.008
Products offer good value for money	0.610	0.044	0.026
Products contain highly effective ingredients	0.530	0.544	-0.010
Products are suitable for sensitive skin	0.208	0.783	-0.024
This brand offers mild skin care products	0.305	0.768	0.084
Products rely on the latest scientific findings	0.141	0.661	0.354
Products are highly appropriate for skin	0.472	0.620	-0.045
It is a modern brand	0.023	0.037	0.858
This brand is highly advertised	-0.034	-0.118	0.824
This brand is for demanding women who give importance to their appearance	-0.019	0.250	0.705
Products have a pleasant fragrance	0.467	0.098	0.326

Netherlands

Requirements towards a product/brand	Factors			
	Quality	Brand glamor	Sensitivity and mildness	Pleasant fragrance
Products contain highly effective ingredients	0.745	0.103	0.257	0.008
Products are of high quality	0.700	-0.070	0.209	0.178
Products offer good value for money	0.672	-0.151	-0.018	0.333
Products perform better than those of other brands	0.653	0.240	0.047	-0.148
Products fulfill current expectations towards skin care	0.555	0.240	0.384	-0.020
It is a trustworthy brand	0.536	0.140	0.171	0.394
It is a modern brand	-0.001	0.867	0.044	0.086
This brand is highly advertised	-0.031	0.854	0.008	0.037
This brand is for demanding women who give importance to their appearance	0.225	0.705	0.060	0.089
Products are suitable for sensitive skin	0.048	0.009	0.815	0.062
This brand offers mild skin care products	0.201	0.020	0.736	0.144
Products are highly appropriate for skin	0.403	-0.056	0.542	0.372
Products rely on the latest scientific findings	0.303	0.391	0.538	-0.245
Products have a pleasant fragrance	0.100	0.178	0.119	0.837

Spain

Requirements towards a product/brand	Factors		
	Quality and mildness	Brand glamor	Suitability for sensitive skin
This brand offers mild skin care products	0.758	-0.028	0.089
Products fulfill current expectations towards skin care	0.753	0.176	-0.080
Products are highly appropriate for skin	0.741	-0.027	0.246
It is a trustworthy brand	0.739	0.161	-0.049
Products contain highly effective ingredients	0.694	0.187	0.257
Products offer good value for money	0.660	-0.094	0.188
Products are of high quality	0.634	0.159	0.247
Products have a pleasant fragrance	0.611	0.206	0.224
It is a modern brand	0.042	0.792	0.207
This brand is highly advertised	-0.120	0.741	0.138
This brand is for demanding women who give importance to their appearance	0.134	0.729	0.156
Products perform better than those of other brands	0.372	0.650	-0.217
Products rely on the latest scientific findings	0.317	0.511	0.525
Products are suitable for sensitive skin	0.278	0.232	0.779

Switzerland

Requirements towards a product/brand	Factors		
	Quality	Brand glamor	Sensitivity and mildness
Products are of high quality	0.760	0.046	0.190
Products fulfill current expectations towards skin care	0.708	0.117	0.283
Products contain highly effective ingredients	0.680	0.152	0.281
Products offer good value for money	0.635	-0.006	-0.083
It is a trustworthy brand	0.562	0.278	0.210
It is a modern brand	0.051	0.869	-0.014
This brand is highly advertised	-0.052	0.814	-0.029
This brand is for demanding women who give importance to their appearance	0.236	0.745	0.030
Products perform better than those of other brands	0.357	0.565	0.078
Products are suitable for sensitive skin	0.118	0.047	0.886
This brand offers mild skin care products	0.160	0.063	0.834
Products are highly appropriate for skin	0.382	-0.074	0.697
Products rely on the latest scientific findings	0.464	0.435	0.264
Products have a pleasant fragrance	0.325	0.182	0.152

Russia

Requirements towards a product/brand	Factors		
	Quality	Sensitivity and mildness	Brand glamor
Products are of high quality	0.743	0.126	-0.038
Products fulfill current expectations towards skin care	0.669	0.260	0.013
It is a trustworthy brand	0.645	0.168	0.225
Products offer good value for money	0.603	0.095	-0.024
Products contain highly effective ingredients	0.594	0.308	0.220
Products perform better than those of other brands	0.583	0.295	0.171
Products are suitable for sensitive skin	0.146	0.782	0.067
This brand offers mild skin care products	0.255	0.711	0.130
Products are highly appropriate for skin	0.312	0.688	0.017
Products have a pleasant fragrance	0.156	0.504	0.145
This brand is highly advertised	0.013	0.012	0.848
It is a modern brand	0.033	0.145	0.845
Products rely on the latest scientific findings	0.218	0.311	0.578
This brand is for demanding women who give importance to their appearance	0.151	0.481	0.354

Denmark

Requirements towards a product/brand	Factors		
	Sensitivity and mildness	Brand glamor and progressive ness	Quality
Products are suitable for sensitive skin	0.908	0.054	0.064
This brand offers mild skin care products	0.895	0.035	0.105
Products are highly appropriate for skin	0.865	0.008	0.222
It is a modern brand	-0.073	0.770	0.020
This brand is highly advertised	0.004	0.714	-0.134
This brand is for demanding women who give importance to their appearance	0.010	0.696	0.240
Products rely on the latest scientific findings	0.231	0.610	0.341
Products fulfill current expectations towards skin care	0.214	0.540	0.420
Products contain highly effective ingredients	0.179	0.523	0.456
Products have a pleasant fragrance	0.045	0.122	0.756
Products offer good value for money	0.086	-0.017	0.632
Products are of high quality	0.477	0.123	0.580
Products perform better than those of other brands	0.192	0.302	0.493
It is a trustworthy brand	0.418	0.365	0.287

Norway

Requirements towards a product/brand	Factors		
	Quality	Sensitivity and mildness	Brand glamor
Products are of high quality	0.732	0.336	0.029
Products fulfill current expectations towards skin care	0.715	0.102	0.308
Products perform better than those of other brands	0.705	0.005	0.281
It is a trustworthy brand	0.680	0.161	0.183
Products contain highly effective ingredients	0.672	0.243	0.262
Products offer good value for money	0.539	0.237	0.029
Products rely on the latest scientific findings	0.517	0.190	0.533
Products are highly appropriate for skin	0.508	0.676	-0.006
Products are suitable for sensitive skin	0.168	0.882	0.068
This brand offers mild skin care products	0.210	0.852	0.152
This brand is highly advertised	-0.033	0.066	0.814
It is a modern brand	0.177	0.031	0.782
This brand is for demanding women who give importance to their appearance	0.286	0.028	0.685
Products have a pleasant fragrance	0.468	0.316	-0.039

Argentina

Requirements towards a product/brand	Factors		
	Mildness and effectiveness	Brand glamor	Quality and value
Products are highly appropriate for skin	0.735	-0.053	0.013
Products fulfill current expectations towards skin care	0.695	0.035	0.204
Products contain highly effective ingredients	0.690	0.150	0.010
It is a trustworthy brand	0.631	0.094	0.329
Products are suitable for sensitive skin	0.603	0.110	0.121
Products rely on the latest scientific findings	0.584	0.238	-0.117
This brand offers mild skin care products	0.521	0.200	0.240
Products perform better than those of other brands	0.513	0.357	-0.068
It is a modern brand	-0.001	0.801	-0.004
This brand is highly advertised.	0.045	0.798	0.047
This brand is for demanding women who give importance to their appearance	0.235	0.602	-0.091
Products have a pleasant fragrance	0.182	0.542	0.145
Products offer good value for money	-0.041	0.061	0.831
Products are of high quality	0.360	-0.040	0.620

Paraguay

Requirements towards a product/brand	Factors			
	Quality	Product excellence	Brand popularity	Sensitivity and mildness
Products are of high quality	0.801	0.144	0.080	0.042
It is a trustworthy brand	0.786	0.118	0.017	0.060
Products offer good value for money	0.597	-0.084	0.215	0.100
Products fulfill current expectations towards skin care	0.509	0.327	0.060	0.304
Products are highly appropriate for skin	0.004	0.729	0.107	0.240
Products rely on the latest scientific findings	0.088	0.660	0.221	-0.128
This brand is for demanding women who give importance to their appearance	0.054	0.522	0.454	0.063
This brand is highly advertised	0.073	0.141	0.834	-0.019
It is a modern brand	0.100	0.288	0.755	0.194
Products are suitable for sensitive skin	0.117	0.060	-0.037	0.766
This brand offers mild skin care products	0.123	0.273	0.222	0.713
Products have a pleasant fragrance	0.164	-0.069	0.470	0.472
Products contain highly effective ingredients	0.443	0.422	-0.234	0.211
Products perform better than those of other brands	0.296	0.493	0.058	0.195

Venezuela

Requirements towards a product/brand	Factors		
	Quality and mildness	Product excellence	Brand glamor
It is a trustworthy brand	0.757	0.243	-0.034
Products are of high quality	0.732	0.239	-0.012
Products fulfill current expectations towards skin care	0.730	0.263	-0.033
This brand offers mild skin care products	0.678	0.109	0.280
Products are suitable for sensitive skin	0.663	0.221	0.193
Products have a pleasant fragrance	0.535	0.090	0.311
Products offer good value for money	0.532	0.096	0.113
Products rely on the latest scientific findings	0.218	0.731	0.134
Products perform better than those of other brands	0.062	0.693	0.293
Products contain highly effective ingredients	0.313	0.635	0.059
Products are highly appropriate for skin	0.392	0.535	0.064
It is a modern brand	0.149	0.117	0.848
This brand is highly advertised	0.062	0.140	0.833
This brand is for demanding women who give importance to their appearance	0.153	0.410	0.509

Appendix A-2: Increases in Values of Error Sum of Squares (the Last Ten Fusion Steps)

South Africa

Step	Increase in the error sum of squares
# 800 (2 clusters are being combined to 1)	481.1
# 799 (3 clusters are being combined to 2)	357.5
# 798 (4 clusters are being combined to 3)	352.2
# 797 (5 clusters are being combined to 4)	175.9
# 796 (6 clusters are being combined to 5)	85.0
# 795 (7 clusters are being combined to 6)	67.1
# 794 (8 clusters are being combined to 7)	65.3
# 793 (9 clusters are being combined to 8)	53.9
# 792 (10 clusters are being combined to 9)	53.0
# 791 (11 clusters are being combined to 10)	47.5

China

Step	Increase in the error sum of squares
# 799 (2 clusters are being combined to 1)	449.9
# 798 (3 clusters are being combined to 2)	329.7
# 797 (4 clusters are being combined to 3)	243.3
# 796 (5 clusters are being combined to 4)	164.8
# 795 (6 clusters are being combined to 5)	155.6
# 794 (7 clusters are being combined to 6)	95.0
# 793 (8 clusters are being combined to 7)	80.9
# 792 (9 clusters are being combined to 8)	67.9
# 791 (10 clusters are being combined to 9)	66.8
# 790 (11 clusters are being combined to 10)	58.9

Hong Kong

Step	Increase in the error sum of squares
# 503 (2 clusters are being combined to 1)	278.2
# 502 (3 clusters are being combined to 2)	210.3
# 501 (4 clusters are being combined to 3)	164.7
# 500 (5 clusters are being combined to 4)	125.8
# 499 (6 clusters are being combined to 5)	87.2
# 498 (7 clusters are being combined to 6)	67.1
# 497 (8 clusters are being combined to 7)	58.9
# 496 (9 clusters are being combined to 8)	43.7
# 495 (10 clusters are being combined to 9)	38.5
# 494 (11 clusters are being combined to 10)	26.2

Indonesia

Step	Increase in the error sum of squares
# 825 (2 clusters are being combined to 1)	452.1
# 824 (3 clusters are being combined to 2)	292.9
# 823 (4 clusters are being combined to 3)	228.8
# 822 (5 clusters are being combined to 4)	180.7
# 821 (6 clusters are being combined to 5)	133.8
# 820 (7 clusters are being combined to 6)	106.7
# 819 (8 clusters are being combined to 7)	94.5
# 818 (9 clusters are being combined to 8)	74.1
# 817 (10 clusters are being combined to 9)	70.5
# 816 (11 clusters are being combined to 10)	65.9

Korea

Step	Increase in the error sum of squares
# 499 (2 clusters are being combined to 1)	278.6
# 498 (3 clusters are being combined to 2)	217.4
# 497 (4 clusters are being combined to 3)	172.0
# 496 (5 clusters are being combined to 4)	114.4
# 495 (6 clusters are being combined to 5)	66.9
# 494 (7 clusters are being combined to 6)	59.5
# 493 (8 clusters are being combined to 7)	52.4
# 492 (9 clusters are being combined to 8)	39.8
# 491 (10 clusters are being combined to 9)	32.2
# 490 (11 clusters are being combined to 10)	31.2

Philippines

Step	Increase in the error sum of squares
# 499 (2 clusters are being combined to 1)	283.2
# 498 (3 clusters are being combined to 2)	262.6
# 497 (4 clusters are being combined to 3)	206.1
# 496 (5 clusters are being combined to 4)	73.7
# 495 (6 clusters are being combined to 5)	72.4
# 494 (7 clusters are being combined to 6)	70.8
# 493 (8 clusters are being combined to 7)	57.9
# 492 (9 clusters are being combined to 8)	38.0
# 491 (10 clusters are being combined to 9)	31.2
# 490 (11 clusters are being combined to 10)	24.4

Taiwan

Step	Increase in the error sum of squares
# 503 (2 clusters are being combined to 1)	333.1
# 502 (3 clusters are being combined to 2)	248.9
# 501 (4 clusters are being combined to 3)	207.9
# 500 (5 clusters are being combined to 4)	94.0
# 499 (6 clusters are being combined to 5)	66.2
# 498 (7 clusters are being combined to 6)	60.0
# 497 (8 clusters are being combined to 7)	43.4
# 496 (9 clusters are being combined to 8)	42.4
# 495 (10 clusters are being combined to 9)	27.9
# 494 (11 clusters are being combined to 10)	23.6

Thailand

Step	Increase in the error sum of squares
# 999 (2 clusters are being combined to 1)	563.0
# 998 (3 clusters are being combined to 2)	454.9
# 997 (4 clusters are being combined to 3)	318.1
# 996 (5 clusters are being combined to 4)	217.9
# 995 (6 clusters are being combined to 5)	162.4
# 994 (7 clusters are being combined to 6)	132.3
# 993 (8 clusters are being combined to 7)	90.5
# 992 (9 clusters are being combined to 8)	81.1
# 991 (10 clusters are being combined to 9)	64.5
# 990 (11 clusters are being combined to 10)	58.6

Australia

Step	Increase in the error sum of squares
# 580 (2 clusters are being combined to 1)	355.4
# 579 (3 clusters are being combined to 2)	297.9
# 578 (4 clusters are being combined to 3)	258.6
# 577 (5 clusters are being combined to 4)	110.0
# 576 (6 clusters are being combined to 5)	61.3
# 575 (7 clusters are being combined to 6)	54.1
# 574 (8 clusters are being combined to 7)	50.3
# 573 (9 clusters are being combined to 8)	40.5
# 572 (10 clusters are being combined to 9)	36.1
# 571 (11 clusters are being combined to 10)	30.2

Belgium

Step	Increase in the error sum of squares
# 371 (2 clusters are being combined to 1)	229.2
# 370 (3 clusters are being combined to 2)	172.2
# 369 (4 clusters are being combined to 3)	157.2
# 368 (5 clusters are being combined to 4)	119.2
# 367 (6 clusters are being combined to 5)	107.8
# 366 (7 clusters are being combined to 6)	58.2
# 365 (8 clusters are being combined to 7)	47.9
# 364 (9 clusters are being combined to 8)	30.2
# 363 (10 clusters are being combined to 9)	28.5
# 362 (11 clusters are being combined to 10)	28.4

Germany

Step	Increase in the error sum of squares
# 1046 (2 clusters are being combined to 1)	570.8
# 1045 (3 clusters are being combined to 2)	557.9
# 1044 (4 clusters are being combined to 3)	417.0
# 1043 (5 clusters are being combined to 4)	168.0
# 1042 (6 clusters are being combined to 5)	161.1
# 1041 (7 clusters are being combined to 6)	108.7
# 1040 (8 clusters are being combined to 7)	100.1
# 1039 (9 clusters are being combined to 8)	85.1
# 1038 (10 clusters are being combined to 9)	60.7
# 1037 (11 clusters are being combined to 10)	53.0

Italy

Step	Increase in the error sum of squares
# 520 (2 clusters are being combined to 1)	290.9
# 519 (3 clusters are being combined to 2)	283.2
# 518 (4 clusters are being combined to 3)	195.2
# 517 (5 clusters are being combined to 4)	81.9
# 516 (6 clusters are being combined to 5)	72.2
# 515 (7 clusters are being combined to 6)	66.4
# 514 (8 clusters are being combined to 7)	55.1
# 513 (9 clusters are being combined to 8)	36.7
# 512 (10 clusters are being combined to 9)	32.1
# 511 (11 clusters are being combined to 10)	27.6

Netherlands

Step	Increase in the error sum of squares
# 490 (2 clusters are being combined to 1)	282.9
# 489 (3 clusters are being combined to 2)	234.2
# 488 (4 clusters are being combined to 3)	196.8
# 487 (5 clusters are being combined to 4)	133.4
# 486 (6 clusters are being combined to 5)	95.7
# 485 (7 clusters are being combined to 6)	72.2
# 484 (8 clusters are being combined to 7)	66.7
# 483 (9 clusters are being combined to 8)	57.9
# 482 (10 clusters are being combined to 9)	49.3
# 481 (11 clusters are being combined to 10)	39.7

Spain

Step	Increase in the error sum of squares
# 754 (2 clusters are being combined to 1)	455.9
# 753 (3 clusters are being combined to 2)	352.0
# 752 (4 clusters are being combined to 3)	236.7
# 751 (5 clusters are being combined to 4)	172.2
# 750 (6 clusters are being combined to 5)	100.5
# 749 (7 clusters are being combined to 6)	86.8
# 748 (8 clusters are being combined to 7)	81.5
# 747 (9 clusters are being combined to 8)	75.4
# 746 (10 clusters are being combined to 9)	73.3
# 745 (11 clusters are being combined to 10)	37.5

Switzerland

Step	Increase in the error sum of squares
# 505 (2 clusters are being combined to 1)	320.6
# 504 (3 clusters are being combined to 2)	266.3
# 503 (4 clusters are being combined to 3)	146.7
# 502 (5 clusters are being combined to 4)	103.4
# 501 (6 clusters are being combined to 5)	69.9
# 500 (7 clusters are being combined to 6)	58.0
# 499 (8 clusters are being combined to 7)	50.8
# 498 (9 clusters are being combined to 8)	47.2
# 497 (10 clusters are being combined to 9)	39.1
# 496 (11 clusters are being combined to 10)	31.7

Russia

Step	Increase in the error sum of squares
# 1199 (2 clusters are being combined to 1)	669.2
# 1198 (3 clusters are being combined to 2)	533.9
# 1197 (4 clusters are being combined to 3)	515.6
# 1196 (5 clusters are being combined to 4)	222.8
# 1195 (6 clusters are being combined to 5)	175.2
# 1194 (7 clusters are being combined to 6)	125.6
# 1193 (8 clusters are being combined to 7)	117.8
# 1192 (9 clusters are being combined to 8)	117.8
# 1191 (10 clusters are being combined to 9)	80.5
# 1190 (11 clusters are being combined to 10)	75.6

Denmark

Step	Increase in the error sum of squares
# 399 (2 clusters are being combined to 1)	240.8
# 398 (3 clusters are being combined to 2)	193.8
# 397 (4 clusters are being combined to 3)	134.5
# 396 (5 clusters are being combined to 4)	79.5
# 395 (6 clusters are being combined to 5)	76.1
# 394 (7 clusters are being combined to 6)	37.4
# 393 (8 clusters are being combined to 7)	36.1
# 392 (9 clusters are being combined to 8)	31.1
# 391 (10 clusters are being combined to 9)	30.1
# 390 (11 clusters are being combined to 10)	26.6

Norway

Step	Increase in the error sum of squares
# 365 (2 clusters are being combined to 1)	227.7
# 364 (3 clusters are being combined to 2)	160.1
# 363 (4 clusters are being combined to 3)	119.8
# 362 (5 clusters are being combined to 4)	111.6
# 361 (6 clusters are being combined to 5)	71.9
# 360 (7 clusters are being combined to 6)	42.1
# 359 (8 clusters are being combined to 7)	34.6
# 358 (9 clusters are being combined to 8)	28.2
# 357 (10 clusters are being combined to 9)	24.9
# 356 (11 clusters are being combined to 10)	23.8

Argentina

Step	Increase in the error sum of squares
# 515 (2 clusters are being combined to 1)	375.3
# 514 (3 clusters are being combined to 2)	287.1
# 513 (4 clusters are being combined to 3)	229.0
# 512 (5 clusters are being combined to 4)	93.3
# 511 (6 clusters are being combined to 5)	49.7
# 510 (7 clusters are being combined to 6)	48.5
# 509 (8 clusters are being combined to 7)	45.6
# 508 (9 clusters are being combined to 8)	33.0
# 507 (10 clusters are being combined to 9)	27.3
# 506 (11 clusters are being combined to 10)	22.1

Paraguay

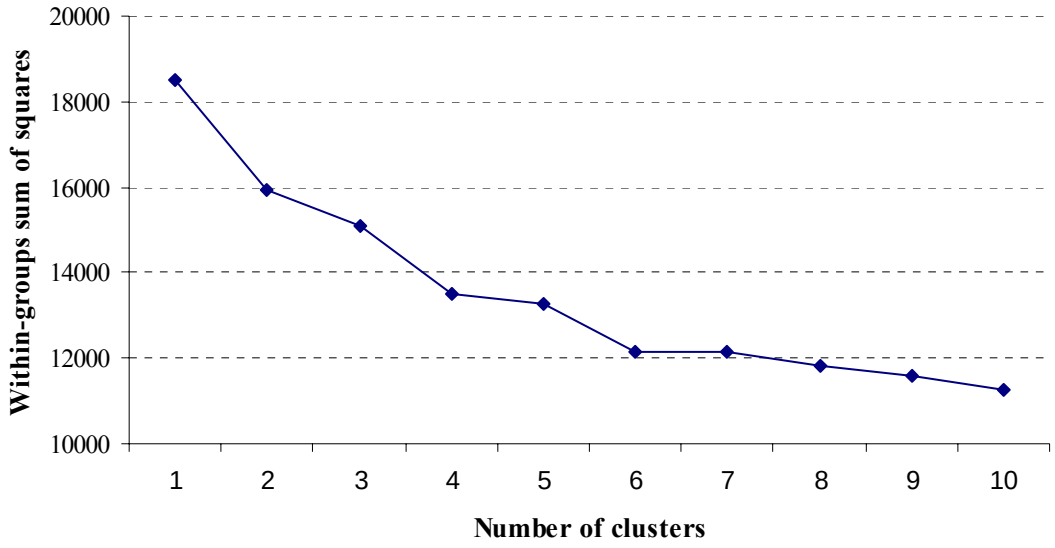
Step	Increase in the error sum of squares
# 401 (2 clusters are being combined to 1)	226.6
# 400 (3 clusters are being combined to 2)	224.3
# 399 (4 clusters are being combined to 3)	194.0
# 398 (5 clusters are being combined to 4)	149.5
# 397 (6 clusters are being combined to 5)	67.8
# 396 (7 clusters are being combined to 6)	67.5
# 395 (8 clusters are being combined to 7)	57.2
# 394 (9 clusters are being combined to 8)	53.4
# 393 (10 clusters are being combined to 9)	34.6
# 392 (11 clusters are being combined to 10)	34.2

Venezuela

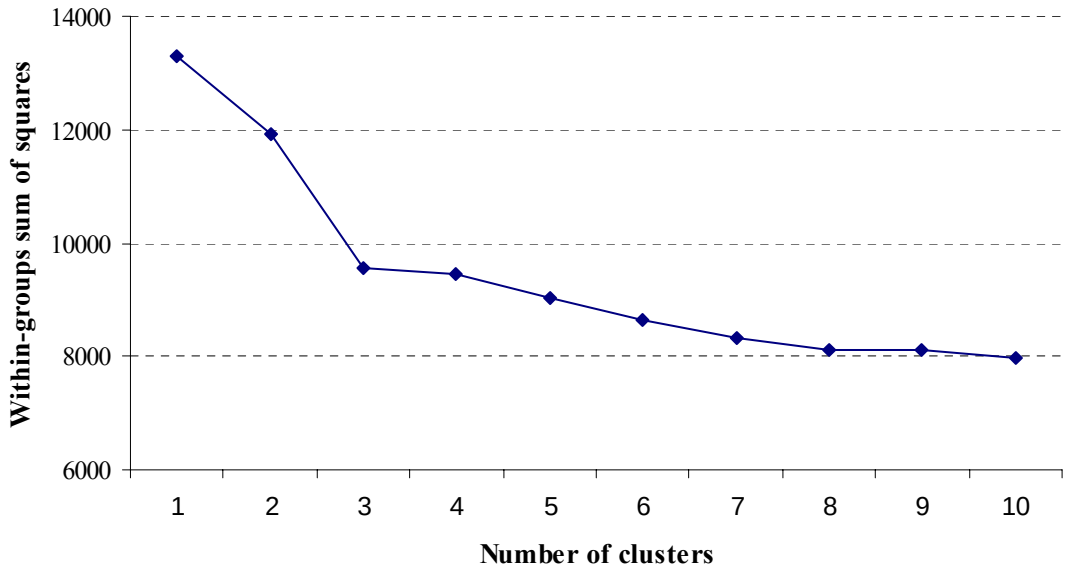
Step	Increase in the error sum of squares
# 799 (2 clusters are being combined to 1)	473.0
# 798 (3 clusters are being combined to 2)	438.6
# 797 (4 clusters are being combined to 3)	348.6
# 796 (5 clusters are being combined to 4)	139.2
# 795 (6 clusters are being combined to 5)	133.9
# 794 (7 clusters are being combined to 6)	81.5
# 793 (8 clusters are being combined to 7)	80.0
# 792 (9 clusters are being combined to 8)	78.2
# 791 (10 clusters are being combined to 9)	50.9
# 790 (11 clusters are being combined to 10)	42.7

Appendix A-3: Values of Within-Groups Sum of Squares Plotted against Corresponding Quantities of Clusters

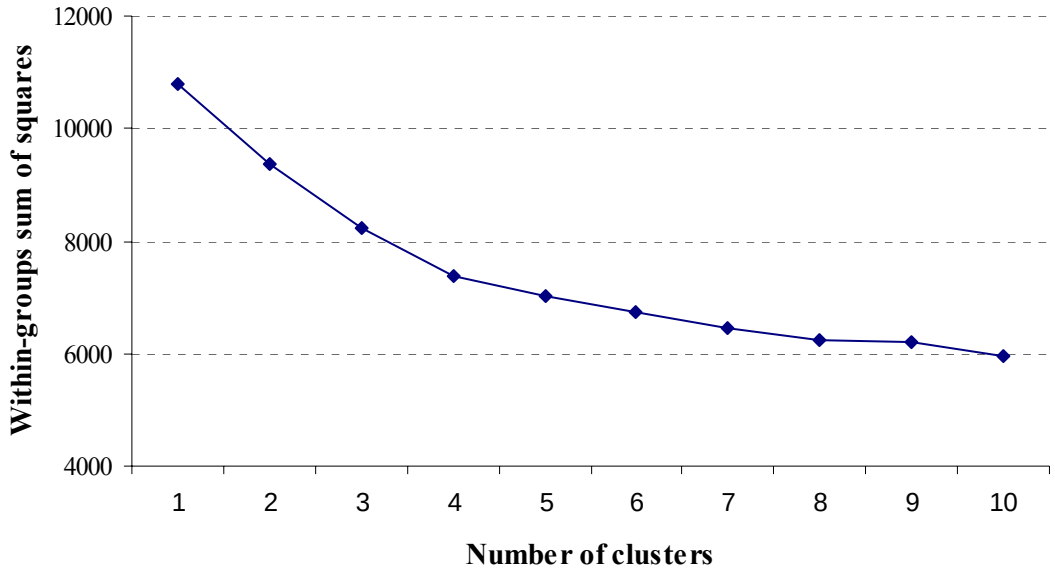
South Africa



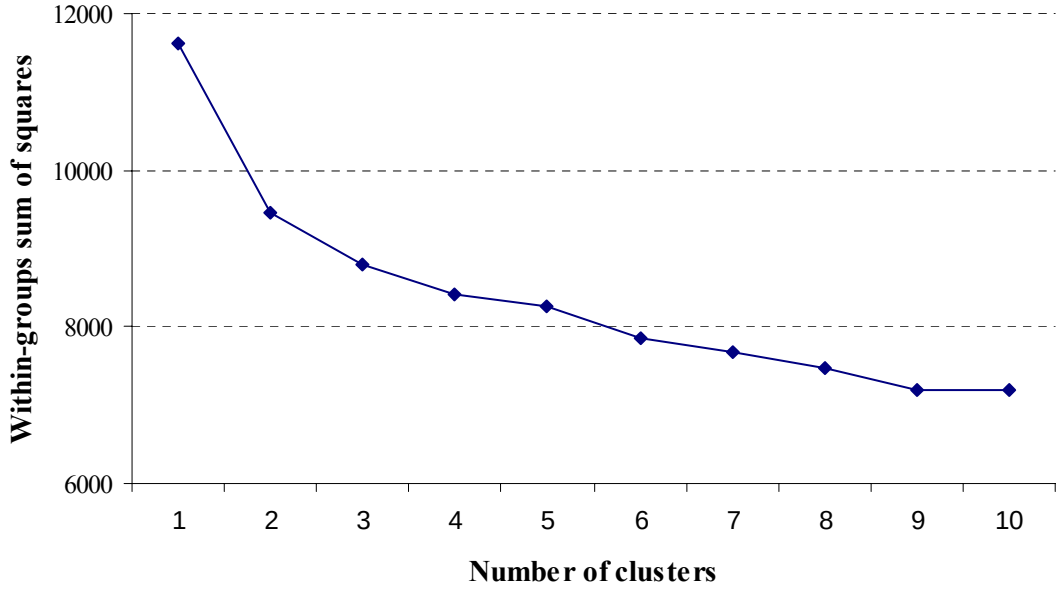
China



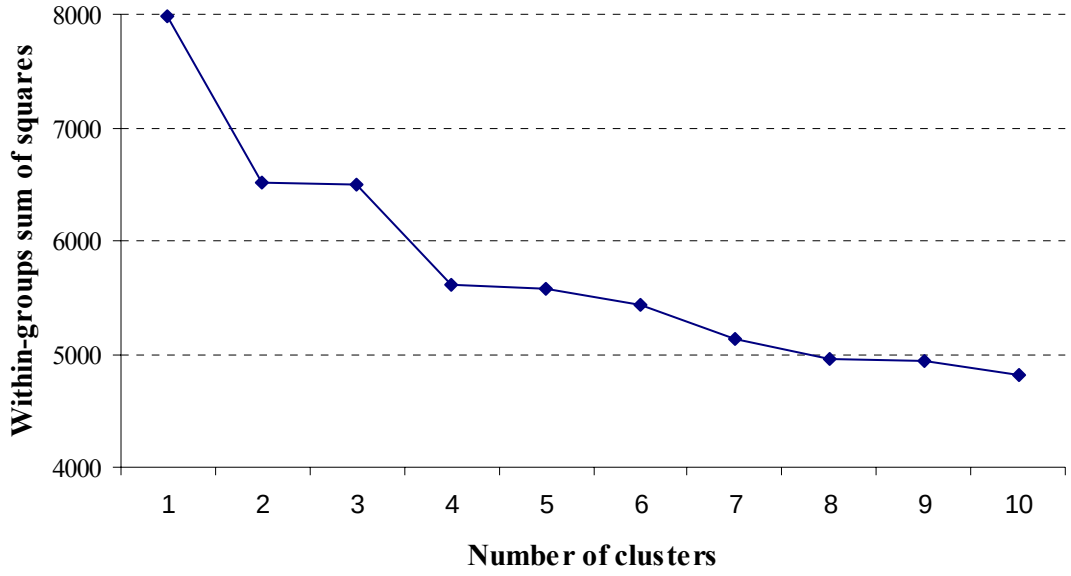
Hong Kong



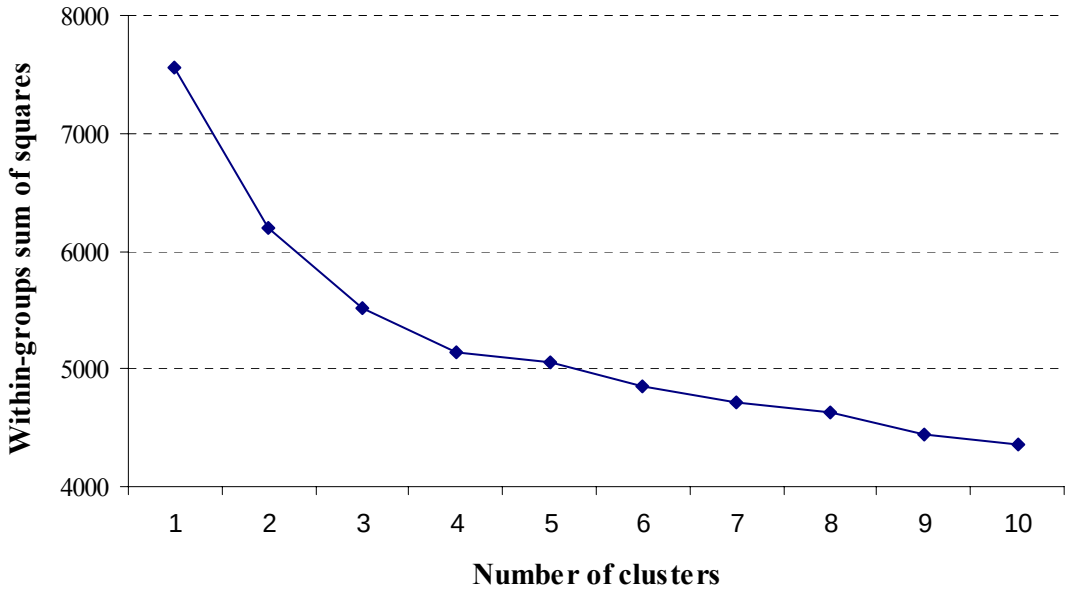
Indonesia



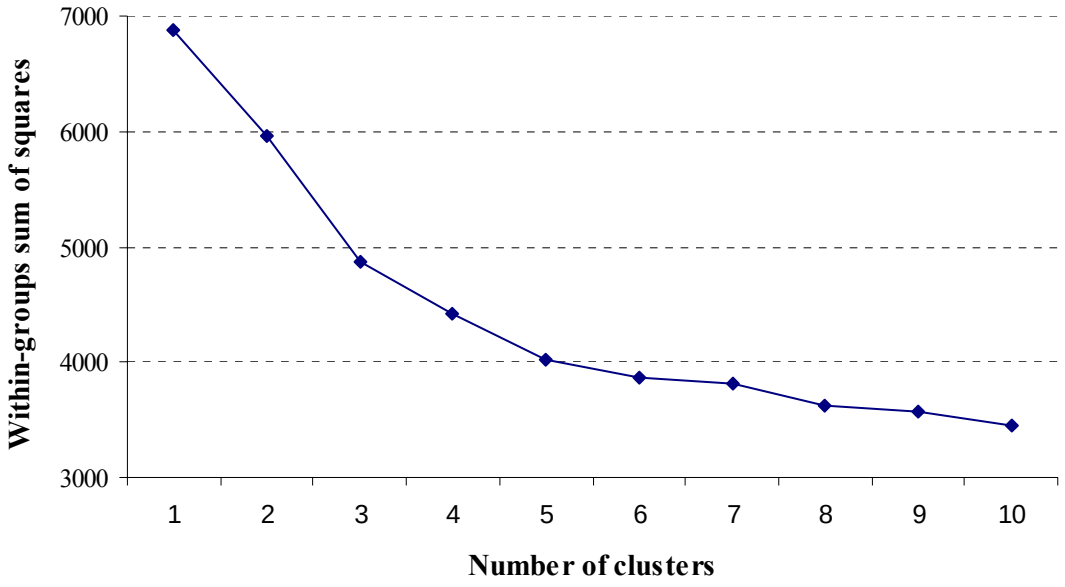
Korea



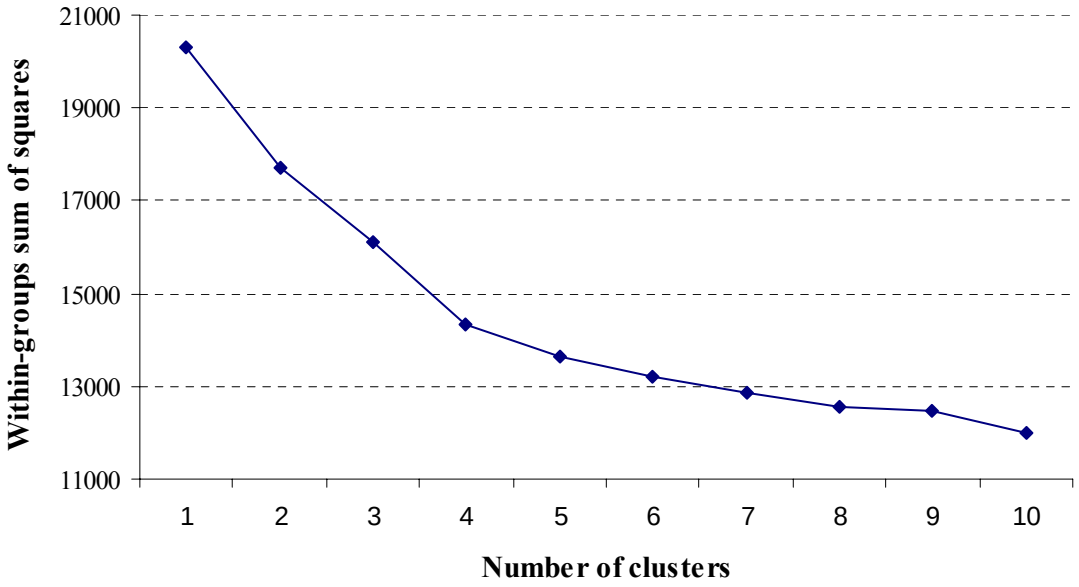
Philippines



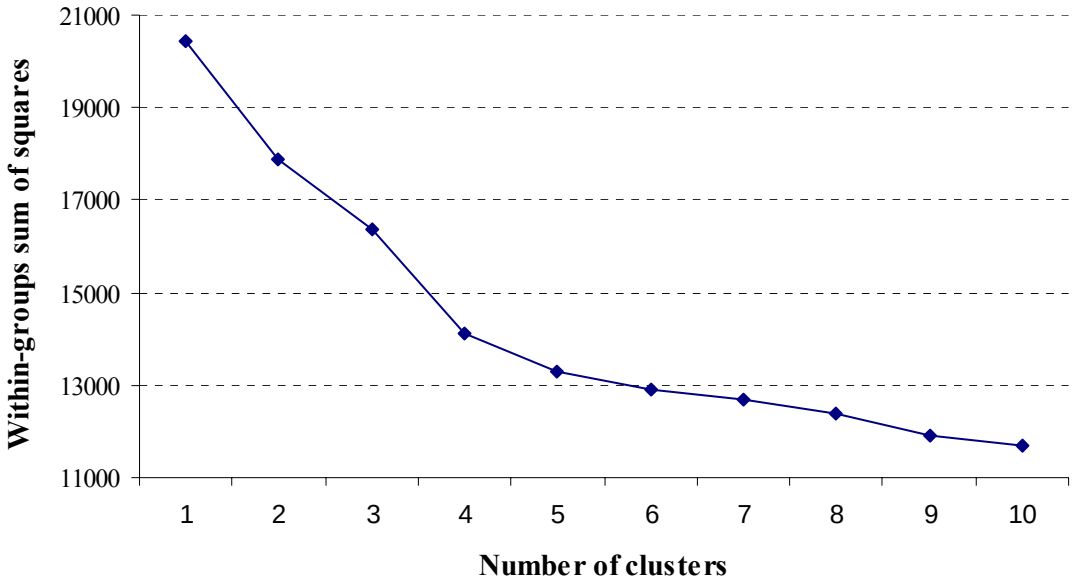
Taiwan



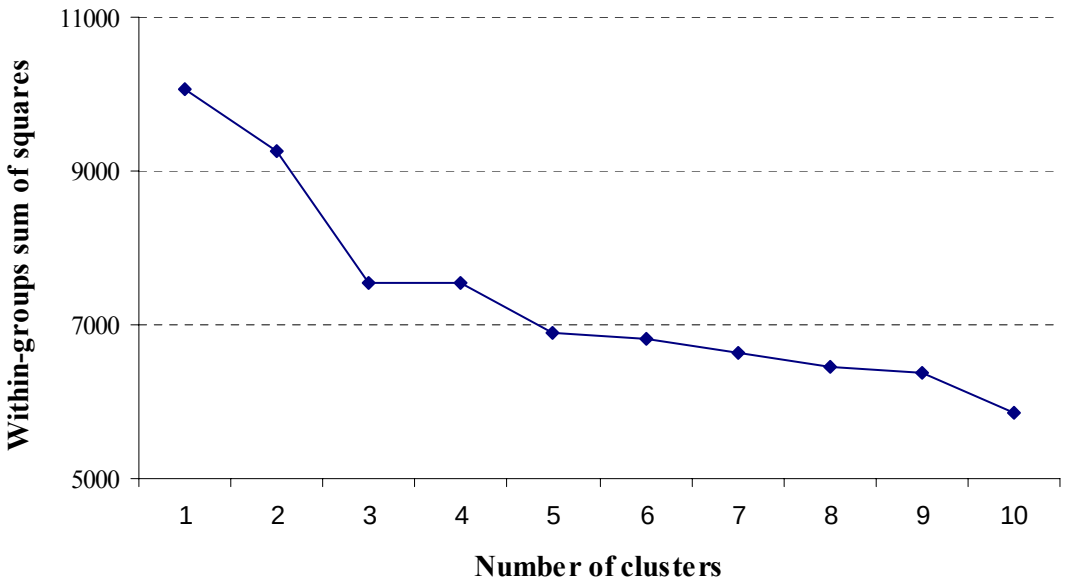
Thailand



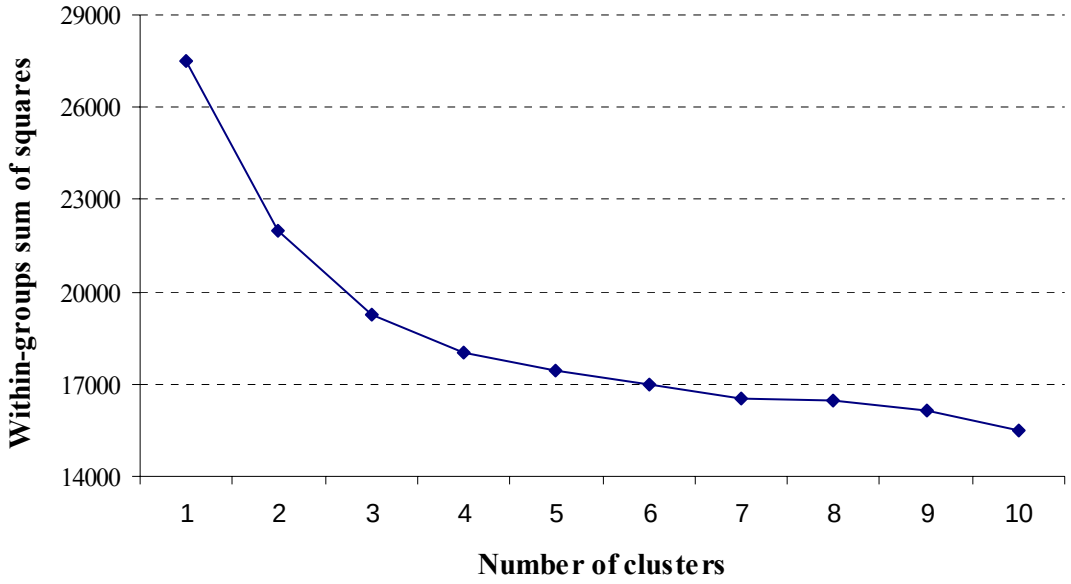
Australia



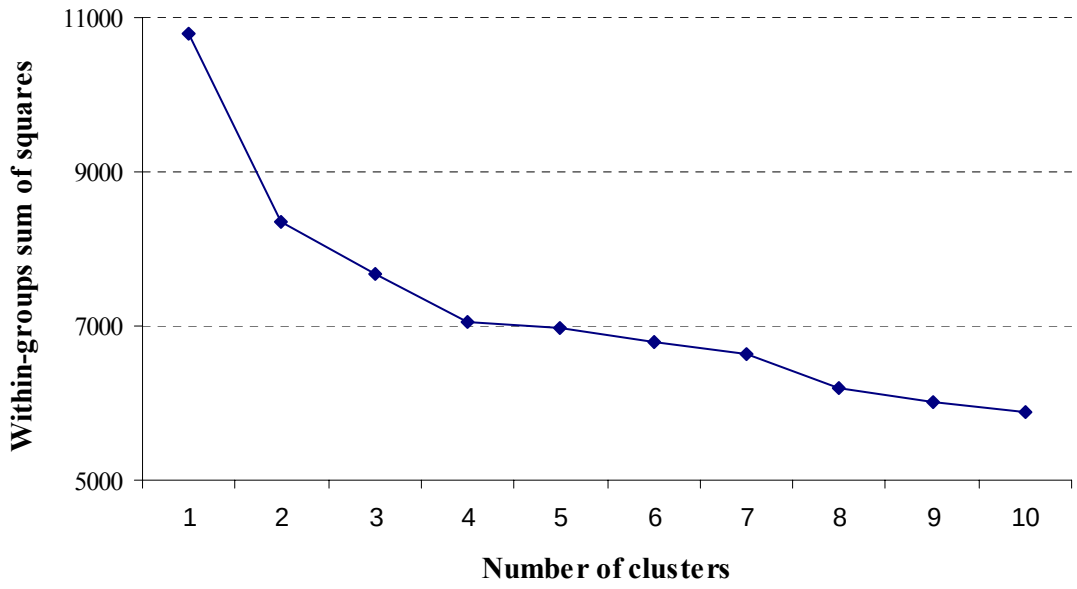
Belgium



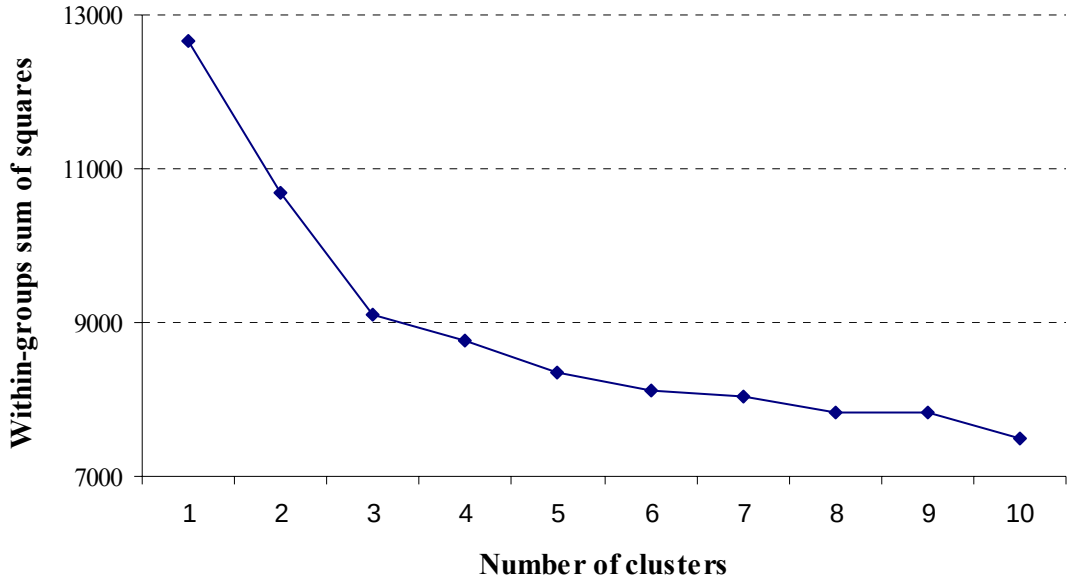
Germany



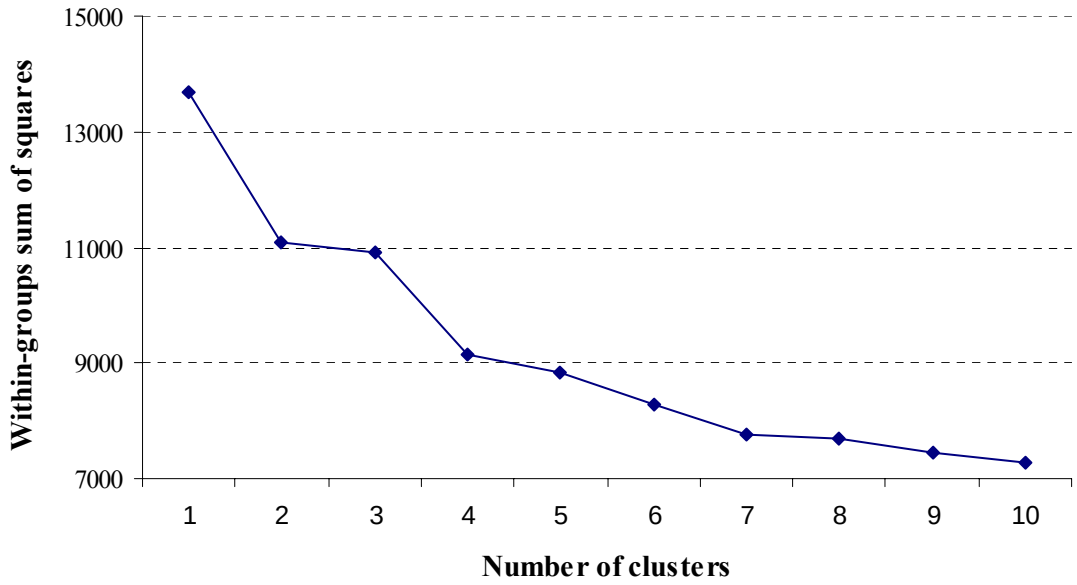
Italy



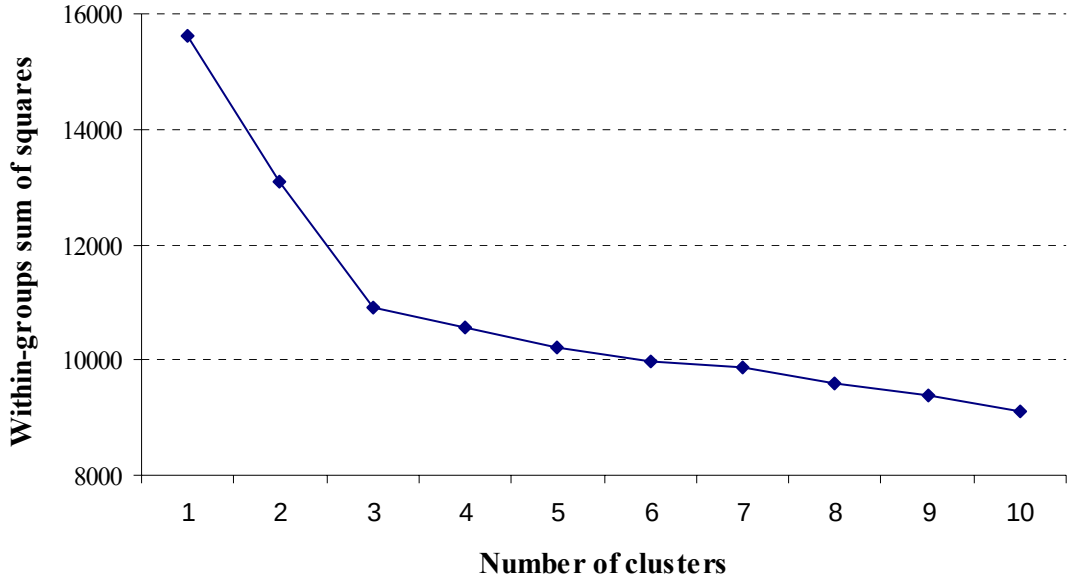
Netherlands



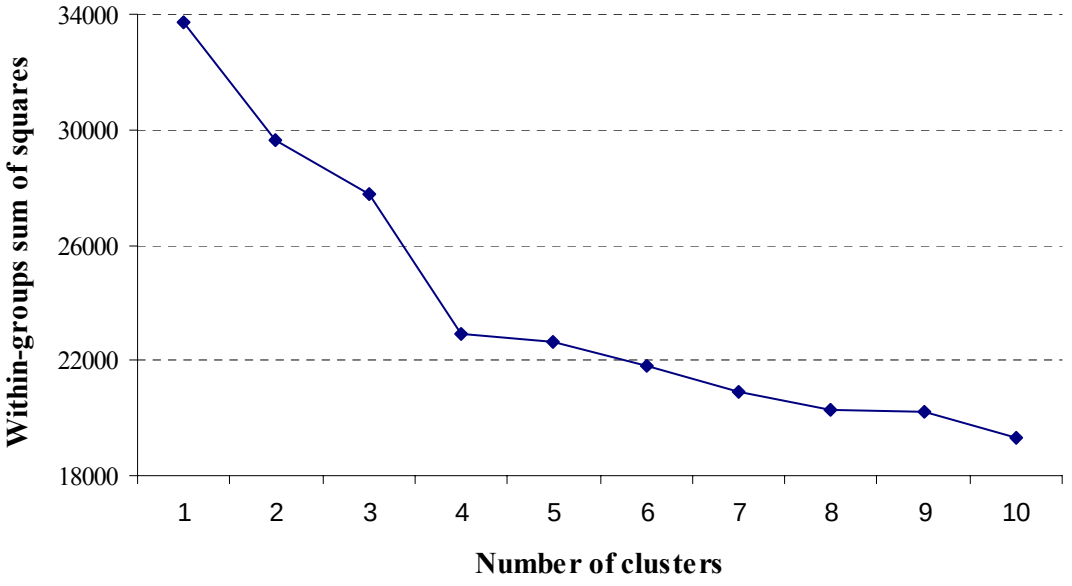
Spain



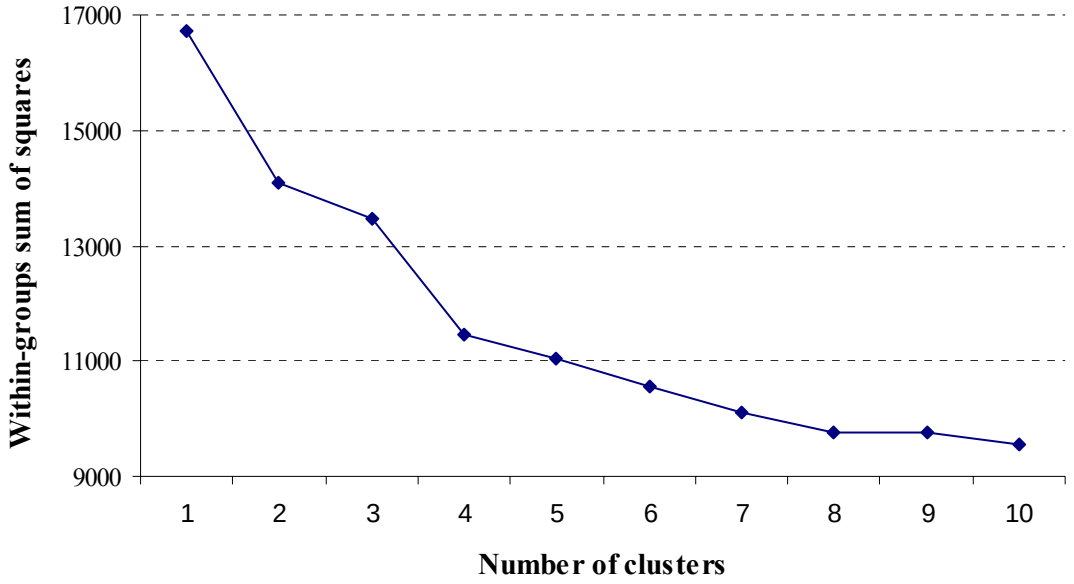
Switzerland



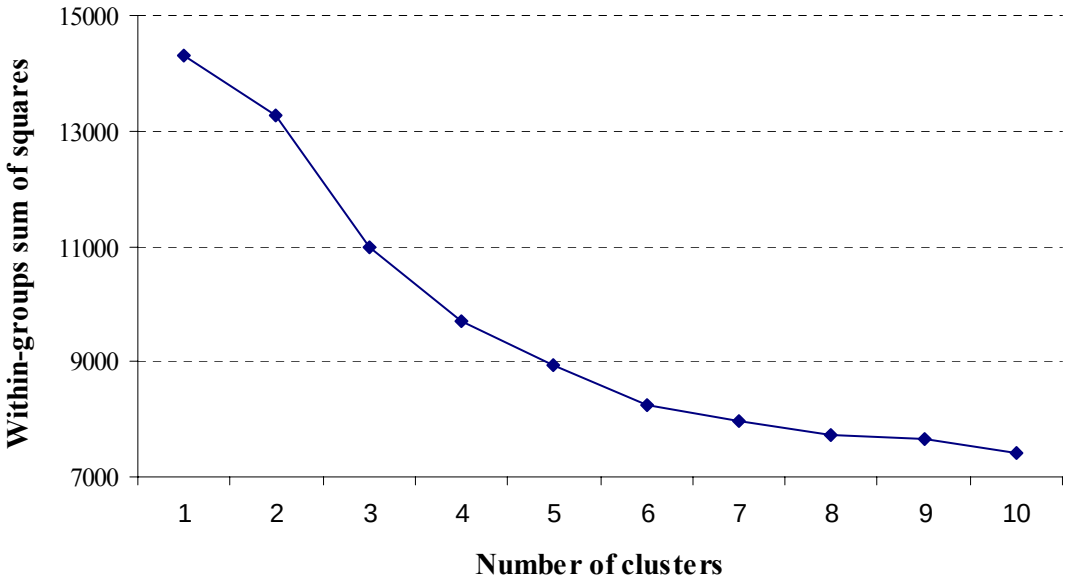
Russia



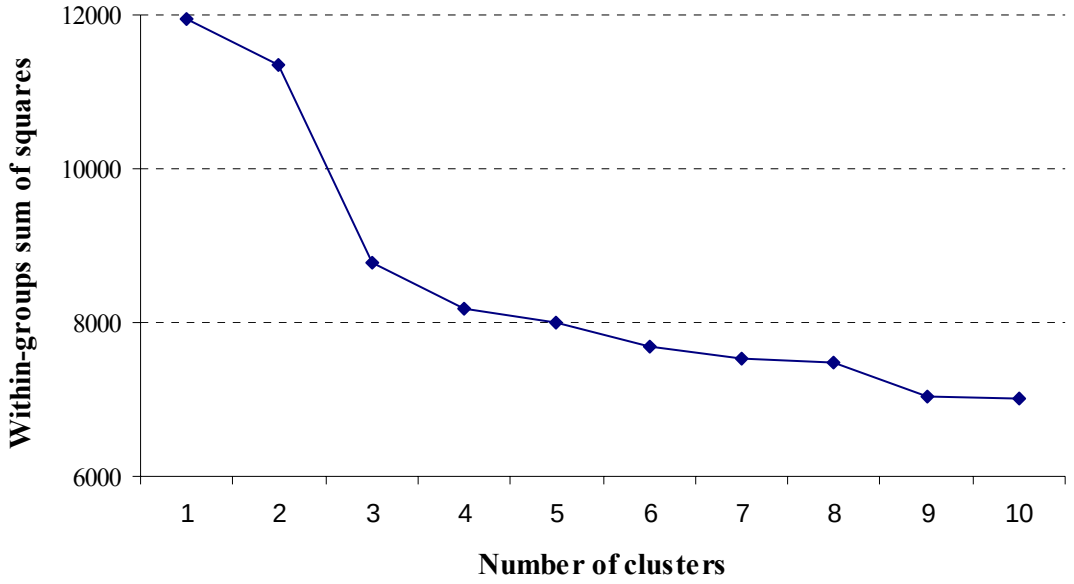
Denmark



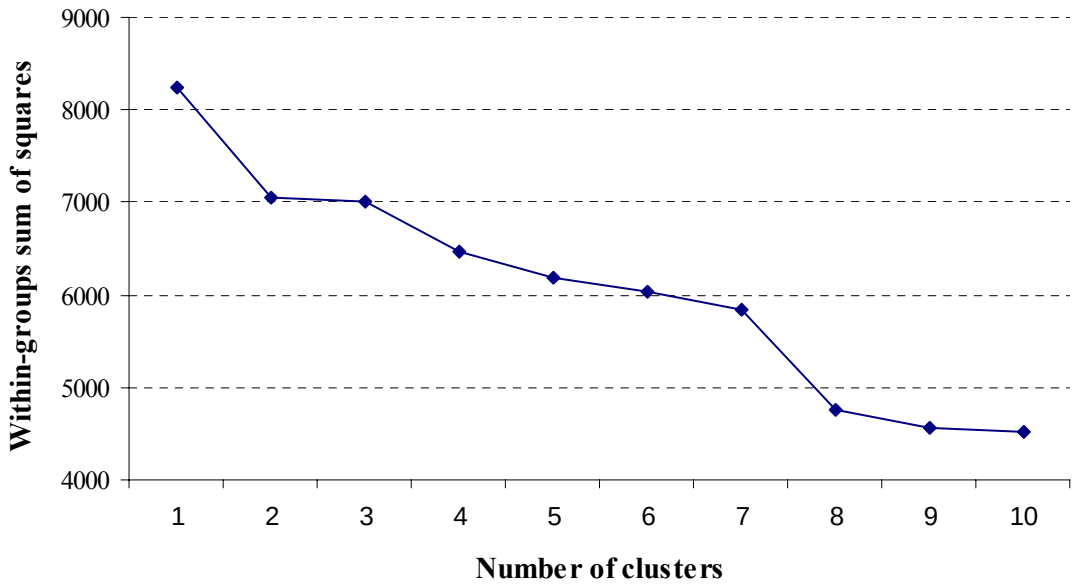
Norway



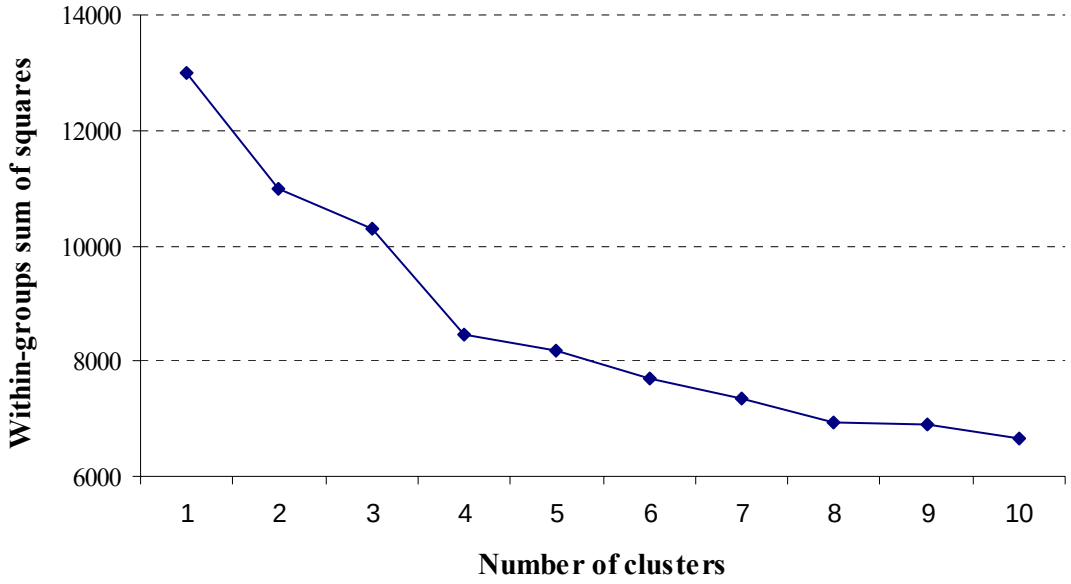
Argentina



Paraguay



Venezuela


14000
12000
10000
8000
6000
Within-groups sum of squares
1
2
3
4
5
6
7
8
9
10
Number of clusters

Appendix A-4: Cluster Names and Sizes

South Africa

The Ward's method

Clusters	#1 Brand glamor driven mainstream	#2 Rationalists	#3 Moderate level of mildness from a popular and modern brand	#4 Highly demanding	#5 Good quality at a fair price	Total Sample
Number of respondents	301	119	62	197	122	801
% of total sample	38%	15%	8%	25%	15%	100%

The K-means method

Clusters	#1 Highly demanding	#2 Good quality at a fair price	#3 Rationalists	#4 Moderate level of mildness from a popular and modern brand	Total Sample
Number of respondents	413	122	157	109	801
% of total sample	52%	15%	20%	14%	100%

SOM

Clusters	#1 Good quality at a fair price	#2 Moderate level of mildness from a popular and modern brand	#3 Rationalists	#4 Brand glamor driven mainstream	#5 Highly demanding	Total Sample
Number of respondents	125	193	197	171	115	801
% of total sample	16%	24%	25%	21%	14%	100%

China

The Ward's method

Clusters	#1 Moderate level of mildness from a popular and modern brand	#2 Rationalists	#3 Highly demanding	#4 Quality and good value for money from a strong brand	Total Sample
Number of respondents	204	280	230	86	800
% of total sample	26%	35%	29%	11%	100%

The K-means method

Clusters	#1 Moderate level of mildness from a popular and modern brand	#2 Highly demanding	#3 Good quality at a fair price	#4 Rationalists	Total Sample
Number of respondents	164	390	119	127	800
% of total sample	21%	49%	15%	16%	100%

SOM

Clusters	#1 Good quality at a fair price	#2 Rationalists	#3 Moderate level of mildness from a popular and modern brand	#4 Brand glamor driven mainstream	#5 Highly demanding	#6 Rational demanding	Total Sample
Number of respondents	87	92	157	206	203	55	800
% of total sample	11%	12%	20%	26%	25%	7%	100%

Hong Kong

The Ward's method

Clusters	#1 Brand glamor driven mainstream	#2 Rationalists	#3 Good quality at a fair price	#4 Uninvolved	#5 Highly demanding	#6 Sensitivity and mildness driven	Total Sample
Number of respondents	175	141	49	34	44	61	504
% of total sample	35%	28%	10%	7%	9%	12%	100%

The K-means method

Clusters	#1 Highly demanding	#2 Rationalists	#3 Good quality at a fair price	#4 Only brand attractiveness driven (very little skin care involved)	Total Sample
Number of respondents	129	132	88	155	504
% of total sample	26%	26%	17%	31%	100%

SOM

Clusters	#1 Highly demanding	#2 Rational demanding	#3 Brand glamor driven mainstream	#4 Only brand attractiveness driven (very little skin care involved)	#5 Rationalists	#6 Uninvolved	#7 Good quality at a fair price	Total Sample
Number of respondents	84	46	66	109	93	49	57	504
% of total sample	17%	9%	13%	22%	18%	10%	11%	100%

Indonesia

The Ward's method

Clusters	#1 Moderate level of mildness from a popular and modern brand	#2 Brand glamor driven mainstream	#3 Quality and good value for money from a strong brand	#4 Rationalists	Total Sample
Number of respondents	108	284	74	360	826
% of total sample	13%	34%	9%	44%	100%

The K-means method

Clusters	#1 Quality and good value for money from a strong brand	#2 Highly demanding	#3 Sensitivity and mildness driven	#4 Rationalists	Total Sample
Number of respondents	184	335	142	165	826
% of total sample	22%	41%	17%	20%	100%

SOM

Clusters	#1 Rational demanding	#2 Highly demanding	#3 Quality and good value for money from a strong brand	#4 Brand glamor driven mainstream	#5 Rationalists	#6 Sensitivity and mildness driven	Total Sample
Number of respondents	97	104	86	204	155	180	826
% of total sample	12%	13%	10%	25%	19%	22%	100%

Korea

The Ward's method

Clusters	#1 Rationalists	#2 Brand glamor driven mainstream	#3 Only brand attractiveness driven (very little skin care involved)	#4 Good quality at a fair price	Total Sample
Number of respondents	205	176	85	34	500
% of total sample	41%	35%	17%	7%	100%

The K-means method

Clusters	#1 Rationalists	#2 Good quality at a fair price	#3 Only brand attractiveness driven (very little skin care involved)	#4 Highly demanding	Total Sample
Number of respondents	115	58	91	236	500
% of total sample	23%	12%	18%	47%	100%

SOM

Clusters	#1 Only brand attractiveness driven (very little skin care involved)	#2 Good quality at a fair price	#3 Brand glamor driven mainstream	#4 Rationalists	#5 Rational demanding	#6 Highly demanding	Total Sample
Number of respondents	77	70	76	69	129	79	500
% of total sample	15%	14%	15%	14%	26%	16%	100%

Philippines

The Ward's method

Clusters	#1 Highly demanding	#2 Rationalists	#3 Sensitivity and mildness driven	#4 Brand glamor driven mainstream	#5 Good quality at a fair price	Total Sample
Number of respondents	143	124	71	60	102	500
% of total sample	29%	25%	14%	12%	20%	100%

The K-means method

Clusters	#1 Sensitivity and mildness driven	#2 Good quality at a fair price	#3 Rationalists	#4 Highly demanding	Total Sample
Number of respondents	76	107	91	226	500
% of total sample	15%	21%	18%	45%	100%

SOM

Clusters	#1 Highly demanding	#2 Brand glamor driven mainstream	#3 Rationalists	#4 Good quality at a fair price	#5 Sensitivity and mildness driven	Total Sample
Number of respondents	148	104	130	75	43	500
% of total sample	30%	21%	26%	15%	9%	100%

Taiwan

The Ward's method

Clusters	#1 Only brand attractiveness driven (very little skin care involved)	#2 Highly demanding	#3 Good quality at a fair price	#4 Rationalists	#5 Moderate level of mildness from a popular and modern brand	Total Sample
Number of respondents	62	178	97	55	112	504
% of total sample	12%	35%	19%	11%	22%	100%

The K-means method

Clusters	#1 Only brand attractiveness driven (very little skin care involved)	#2 Highly demanding	#3 Rational demanding	#4 Moderate level of mildness from a popular and modern brand	#5 Good quality at a fair price	Total Sample
Number of respondents	133	124	57	127	63	504
% of total sample	26%	25%	11%	25%	13%	100%

SOM

Clusters	#1 Highly demanding	#2 Rational demanding	#3 Good quality at a fair price	#4 Only brand attractiveness driven (very little skin care involved)	#5 Sensitivity and mildness driven	Total Sample
Number of respondents	115	69	109	103	108	504
% of total sample	23%	14%	22%	20%	21%	100%

Thailand

The Ward's method

Clusters	#1 Moderate level of mildness from a popular and modern brand	#2 Highly demanding	#3 Quality and good value for money from a strong brand	#4 Only brand attractiveness driven (very little skin care involved)	#5 Rationalists	Total Sample
Number of respondents	223	299	220	65	193	1000
% of total sample	22%	30%	22%	7%	19%	100%

The K-means method

Clusters	#1 Highly demanding	#2 Quality and good value for money from a strong brand	#3 Only brand attractiveness driven (very little skin care involved)	#4 Moderate level of mildness from a popular and modern brand	#5 Rationalists	Total Sample
Number of respondents	380	146	85	134	255	1000
% of total sample	38%	15%	9%	13%	26%	100%

SOM

Clusters	#1 Rationalists	#2 Uninvolved	#3 Quality and good value for money from a strong brand	#4 Rational demanding	#5 Moderate level of mildness from a popular and modern brand	#6 Brand glamor driven mainstream	Total Sample
Number of respondents	121	144	117	233	137	248	1000
% of total sample	12%	14%	12%	23%	14%	25%	100%

Australia

The Ward's method

Clusters	#1 Sensitivity and mildness driven	#2 Highly demanding	#3 Good quality at a fair price	#4 Rationalists	#5 Only brand attractiveness driven (very little skin care involved)	Total Sample
Number of respondents	109	190	93	114	75	581
% of total sample	19%	33%	16%	20%	13%	100%

The K-means method

Clusters	#1 Sensitivity and mildness driven	#2 Highly demanding	#3 Good quality at a fair price	#4 Only brand attractiveness driven (very little skin care involved)	#5 Rationalists	Total Sample
Number of respondents	102	168	89	61	161	581
% of total sample	18%	29%	15%	10%	28%	100%

SOM

Clusters	#1 Sensitivity and mildness driven	#2 Only brand attractiveness driven (very little skin care involved)	#3 Good quality at a fair price	#4 Rationalists	#5 Highly demanding	Total Sample
Number of respondents	85	94	87	132	183	581
% of total sample	15%	16%	15%	23%	31%	100%

Belgium

The Ward's method

Clusters	#1 Only brand attractiveness driven (very little skin care involved)	#2 Highly demanding	#3 Sensitivity and mildness driven	#4 Rationalists	#5 Good quality at a fair price	Total Sample
Number of respondents	45	170	32	32	93	372
% of total sample	12%	46%	9%	9%	25%	100%

The K-means method

Clusters	#1 Rationalists	#2 Highly demanding	#3 Sensitivity and mildness driven	#4 Only brand attractiveness driven (very little skin care involved)	Total Sample
Number of respondents	53	183	58	78	372
% of total sample	14%	49%	16%	21%	100%

SOM

Clusters	#1 Brand glamor driven mainstream	#2 Highly demanding	#3 Rational demanding	#4 Sensitivity and mildness driven	#5 Rationalists	#6 Good quality at a fair price	#7 Only brand attractiveness driven (very little skin care involved)	Total Sample
Number of respondents	34	72	75	36	66	36	53	372
% of total sample	9%	19%	20%	10%	18%	10%	14%	100%

Germany

The Ward's method

Clusters	#1 Rational demanding	#2 Rationalists	#3 Highly demanding	#4 Quality and good value for money from a strong brand	#5 Only brand attractiveness driven (very little skin care involved)	#6 Sensitivity and mildness driven	Total Sample
Number of respondents	246	117	183	159	193	149	1047
% of total sample	23%	11%	17%	15%	18%	14%	100%

The K-means method

Clusters	#1 Highly demanding	#2 Sensitivity and mildness driven	#3 Quality and good value for money from a strong brand	#4 Rationalists	#5 Only brand attractiveness driven (very little skin care involved)	Total Sample
Number of respondents	384	87	122	223	231	1047
% of total sample	37%	8%	12%	21%	22%	100%

SOM

Clusters	#1 Sensitivity and mildness driven	#2 Rationalists	#3 Only brand attractiveness driven (very little skin care involved)	#4 Quality and good value for money from a strong brand	#5 Highly demanding	#6 Rational demanding	Total Sample
Number of respondents	109	97	245	110	254	232	1047
% of total sample	10%	9%	23%	11%	24%	22%	100%

Italy

The Ward's method

Clusters	#1 Only brand attractiveness driven (very little skin care involved)	#2 Highly demanding	#3 Good quality at a fair price	#4 Rationalists	Total Sample
Number of respondents	147	162	112	100	521
% of total sample	28%	31%	21%	19%	100%

The K-means method

Clusters	#1 Only brand attractiveness driven (very little skin care involved)	#2 Rationalists	#3 Good quality at a fair price	#4 Highly demanding	Total Sample
Number of respondents	109	147	65	200	521
% of total sample	21%	28%	12%	38%	100%

SOM

Clusters	#1 Only brand attractiveness driven (very little skin care involved)	#2 Brand glamor driven mainstream	#3 Rational demanding	#4 Good quality at a fair price	#5 Rationalists	Total Sample
Number of respondents	87	125	83	118	108	521
% of total sample	17%	24%	16%	23%	21%	100%

Netherlands

The Ward's method

Clusters	#1 Highly demanding	#2 Only brand attractiveness driven (very little skin care involved)	#3 Rationalists	#4 Sensitivity and mildness driven	#5 Good quality at a fair price	Total Sample
Number of respondents	138	125	126	54	48	491
% of total sample	28%	25%	26%	11%	10%	100%

The K-means method

Clusters	#1 Rationalists	#2 Good quality at a fair price	#3 Sensitivity and mildness driven	#4 Highly demanding	Total Sample
Number of respondents	143	95	76	177	491
% of total sample	29%	19%	15%	36%	100%

SOM

Clusters	#1 Highly demanding	#2 Rational demanding	#3 Only brand attractiveness driven (very little skin care involved)	#4 Good quality at a fair price	#5 Sensitivity and mildness driven	#6 Rationalists	Total Sample
Number of respondents	93	113	70	43	97	75	491
% of total sample	19%	23%	14%	9%	20%	15%	100%

Spain

The Ward's method

Clusters	#1 Uninvolved	#2 Rationalists	#3 Brand glamor driven mainstream	#4 Highly demanding	#5 Good quality at a fair price	Total Sample
Number of respondents	117	135	204	241	58	755
% of total sample	15%	18%	27%	32%	8%	100%

The K-means method

Clusters	#1 Only brand attractiveness driven (very little skin care involved)	#2 Rationalists	#3 Highly demanding	#4 Good quality at a fair price	Total Sample
Number of respondents	186	161	344	64	755
% of total sample	25%	21%	46%	8%	100%

SOM

Clusters	#1 Rational demanding	#2 Highly demanding	#3 Good quality at a fair price	#4 Brand glamor driven mainstream	#5 Rationalists	#6 Uninvolved	#7 Only brand attractiveness driven (very little skin care involved)	Total Sample
Number of respondents	180	110	117	140	87	62	59	755
% of total sample	24%	15%	15%	19%	12%	8%	8%	100%

Switzerland

The Ward's method

Clusters	#1 Highly demanding	#2 Rationalists	#3 Good quality at a fair price	#4 Sensitivity and mildness driven	#5 Only brand attractiveness driven (very little skin care involved)	Total Sample
Number of respondents	221	101	62	62	60	506
% of total sample	44%	20%	12%	12%	12%	100%

The K-means method

Clusters	#1 Only brand attractiveness driven (very little skin care involved)	#2 Rationalists	#3 Good quality at a fair price	#4 Highly demanding	#5 Sensitivity and mildness driven	Total Sample
Number of respondents	59	154	28	204	61	506
% of total sample	12%	30%	6%	40%	12%	100%

SOM

Clusters	#1 Rationalists	#2 Sensitivity and mildness driven	#3 Good quality at a fair price	#4 Only brand attractiveness driven (very little skin care involved)	#5 Rational demanding	#6 Highly demanding	Total Sample
Number of respondents	124	57	54	82	80	109	506
% of total sample	25%	11%	11%	16%	16%	22%	100%

Russia

The Ward's method

Clusters	#1 Rationalists	#2 Highly demanding	#3 Sensitivity and mildness driven	#4 Brand glamor driven mainstream	#5 Good quality at a fair price	Total Sample
Number of respondents	328	443	200	187	42	1200
% of total sample	27%	37%	17%	16%	4%	100%

The K-means method

Clusters	#1 Sensitivity and mildness driven	#2 Good quality at a fair price	#3 Only brand attractiveness driven (very little skin care involved)	#4 Rationalists	#5 Highly demanding	Total Sample
Number of respondents	60	147	107	416	470	1200
% of total sample	5%	12%	9%	35%	39%	100%

SOM

Clusters	#1 Sensitivity and mildness driven	#2 Good quality at a fair price	#3 Rationalists	#4 Brand glamor driven mainstream	#5 Highly demanding	Total Sample
Number of respondents	84	223	412	171	310	1200
% of total sample	7%	19%	34%	14%	26%	100%

Denmark

The Ward's method

Clusters	#1 Sensitivity and mildness driven	#2 Uninvolved	#3 Brand glamor driven mainstream	#4 Rationalists	#5 Highly demanding	Total Sample
Number of respondents	80	63	85	106	66	400
% of total sample	20%	16%	21%	27%	17%	100%

The K-means method

Clusters	#1 Sensitivity and mildness driven	#2 Uninvolved	#3 Rationalists	#4 Brand glamor driven mainstream	Total Sample
Number of respondents	92	68	127	113	400
% of total sample	23%	17%	32%	28%	100%

SOM

Clusters	#1 Sensitivity and mildness driven	#2 Uninvolved	#3 Rationalists	#4 Brand glamor driven mainstream	#5 Highly demanding	Total Sample
Number of respondents	60	74	125	63	78	400
% of total sample	15%	19%	31%	16%	20%	100%

Norway

The Ward's method

Clusters	#1 Rationalists	#2 Only brand attractiveness driven (very little skin care involved)	#3 Good quality at a fair price	#4 Highly demanding	#5 Sensitivity and mildness driven	Total Sample
Number of respondents	148	60	43	56	59	366
% of total sample	40%	16%	12%	15%	16%	100%

The K-means method

Clusters	#1 Rationalists	#2 Good quality at a fair price	#3 Only brand attractiveness driven (very little skin care involved)	#4 Sensitivity and mildness driven	#5 Highly demanding	Total Sample
Number of respondents	106	62	38	60	100	366
% of total sample	29%	17%	10%	16%	27%	100%

SOM

Clusters	#1 Rational demanding	#2 Highly demanding	#3 Rationalists	#4 Good quality at a fair price	#5 Sensitivity and mildness driven	#6 Only brand attractiveness driven (very little skin care involved)	Total Sample
Number of respondents	34	86	97	45	69	35	366
% of total sample	9%	23%	27%	12%	19%	10%	100%

Argentina

The Ward's method

Clusters	#1 Moderate level of mildness from a popular and modern brand	#2 Rationalists	#3 Highly demanding	#4 Only brand attractiveness driven (very little skin care involved)	#5 Good quality at a fair price	Total Sample
Number of respondents	73	111	239	49	44	516
% of total sample	14%	22%	46%	9%	9%	100%

The K-means method

Clusters	#1 Good quality at a fair price	#2 Only brand attractiveness driven (very little skin care involved)	#3 Highly demanding	#4 Moderate level of mildness from a popular and modern brand	#5 Rationalists	Total Sample
Number of respondents	39	45	221	55	156	516
% of total sample	8%	9%	43%	11%	30%	100%

SOM

Clusters	#1 Highly demanding	#2 Brand glamor driven mainstream	#3 Brand attractiveness driven (skin care uninvolved)	#4 Rationalists	#5 Sensitivity and mildness driven	#6 Good quality at a fair price	Total Sample
Number of respondents	111	55	42	173	44	91	516
% of total sample	22%	11%	8%	34%	9%	18%	100%

Paraguay

The Ward's method

Clusters	#1 Sensitivity and mildness driven	#2 Highly demanding	#3 Rationalists	#4 Good quality at a fair price	Total Sample
Number of respondents	29	192	128	53	402
% of total sample	7%	48%	32%	13%	100%

The K-means method

Clusters	#1 Uninvolved	#2 Rationalists	#3 Good quality at a fair price	#4 Highly demanding	Total Sample
Number of respondents	39	125	19	219	402
% of total sample	10%	31%	5%	54%	100%

SOM

Clusters	#1 Highly demanding	#2 Rational demanding	#3 Brand glamor driven mainstream	#4 Sensitivity and mildness driven	#5 Rationalists	#6 Good quality at a fair price	Total Sample
Number of respondents	116	102	63	29	69	23	402
% of total sample	29%	25%	16%	7%	17%	6%	100%

Venezuela

The Ward's method

Clusters	#1 Highly demanding	#2 Quality and good value for money from a strong brand	#3 Rationalists	#4 Only brand attractiveness driven (very little skin care involved)	Total Sample
Number of respondents	368	162	167	103	800
% of total sample	46%	20%	21%	13%	100%

The K-means method

Clusters	#1 Rationalists	#2 Highly demanding	#3 Good quality at a fair price	#4 Only brand attractiveness driven (very little skin care involved)	Total Sample
Number of respondents	154	497	75	74	800
% of total sample	19%	62%	9%	9%	100%

SOM

Clusters	#1 Rationalists	#2 Good quality at a fair price	#3 Only brand attractiveness driven (very little skin care involved)	#4 Rational demanding	#5 Brand glamor driven mainstream	#6 Highly demanding	Total Sample
Number of respondents	130	54	92	159	154	211	800
% of total sample	16%	7%	12%	20%	19%	26%	100%