Opportunity Identification and Exploitation:
A Case Study of Three Swiss-Based Software Companies

D I S S E R T A T I O N
of the University of St. Gallen
Graduate School of Business Administration,
Economics, Law and Social Sciences (HSG)
to obtain the title of
Doctor of Business Administration

submitted by

Matthäus Urwyler
from
Aarwangen (Bern)

Approved on the application of

Prof. Georg F. von Krogh, PhD
and
Prof. Chris Steyaert, PhD

Dissertation no. 3183

(Difo-Druck GmbH, Bamberg 2006)
The University of St. Gallen, Graduate School of Business Administration, Economics, Law and Social Sciences (HSG) hereby consents to the printing of the present dissertation, without hereby expressing any opinion on the views herein expressed.

St. Gallen, January 17, 2006

The President:

Prof. Ernst Mohr, PhD
# Table of Contents

Table of Contents.............................................................................................................i  
List of Figures.............................................................................................................. vii  
List of Tables .............................................................................................................. viii  
List of Abbreviations ................................................................................................. x  
Abstract.................................................................................................................. xii  
Key Words.................................................................................................................. xiii  
Acknowledgments ...................................................................................................... xiv  

1 Introduction............................................................................................1  
1.1 Entrepreneurial Opportunity Research ............................................................1  
1.2 Open Issues and Research Objectives .............................................................2  
1.3 Research Strategy and Method ........................................................................4  
1.4 Dissertation Outline .........................................................................................5  

2 Literature Review and Theoretical Foundations.................................7  
2.1 Entrepreneurship: Its Development and Approaches .................................7  
2.1.1 A Short Historical Overview......................................................................7  
2.1.2 Different Disciplines in Entrepreneurship Research.................................9  
2.1.3 Different Levels of Analysis in Entrepreneurship Research......................11  
2.1.4 Towards a Generally Accepted Definition of Entrepreneurship .............13  
2.2 The Role of Opportunities in Entrepreneurship Research......................18  
2.2.1 The Nature of Opportunities ....................................................................18  
2.2.2 Recent Theoretical Works in Opportunity Identification and Exploitation .................................................................................................................................................19  
2.2.3 Recent Empirical Works in Opportunity Identification and Exploitation .................................................................................................................................................22
2.3 Conclusion .....................................................................................................26

3 Methodology ...................................................................................................28

3.1 Research Strategy and Method ......................................................................28

3.1.1 The Case Study Approach ......................................................................28

3.1.2 Grounded Theory ..................................................................................29

3.1.3 Participatory Research as a Method of Increasing the Validity of Qualitative Research ..............................................................................30

3.2 Case Design and Case Selection ......................................................................31

3.2.1 The Case Design ..................................................................................31

3.2.2 The Selection of the Cases .....................................................................32

3.2.3 A Short Presentation of the Three Main Cases under Investigation .........34

3.3 Data Collection ............................................................................................36

3.3.1 Interviews and Documents as the Primary Source of Data .................36

3.3.2 Data Collection through Participatory Workshops and Meetings .........37

3.3.3 Secondary Data Sources .......................................................................38

3.3.4 Key Categories and Constructs Examined throughout the Study ...........38

3.4 Data Analysis and Theorizing ......................................................................40

3.4.1 The Coding of the Data .........................................................................40

3.4.2 The Replication Approach of Multiple Case Studies ............................41

3.4.3 Reaching Closure ..................................................................................42

3.5 Increasing the Validity and Reliability of the Case Study Method .............42

4 Prior Knowledge and Business Opportunities .............................................45

4.1 Theoretical Background .............................................................................46

4.1.1 The Importance of Prior Market Knowledge ........................................47

4.1.2 The Importance of Prior Knowledge of How to Serve Markets ..........48

4.1.3 The Importance of Prior Knowledge of Customer Problems ...............49

4.1.4 Shane’s Conceptual Model of Prior Knowledge ..................................50

4.1.5 Some Open Issues ................................................................................52
4.2 Empirical Findings ..........................................................................................53
  4.2.1 The Prehistory of the Companies ............................................................53
  4.2.2 The Founding of the Firms .....................................................................54
  4.2.3 The First Projects ...................................................................................56
  4.2.4 The Technological Background ............................................................58
4.3 Discussion .......................................................................................................63
  4.3.1 Limited Prior Knowledge ......................................................................64
    4.3.1.1 Limited Prior Market Knowledge ..................................................64
    4.3.1.2 Limited Prior Knowledge of How to Serve Markets ....................68
    4.3.1.3 Limited Prior Knowledge about Customer Problems ...................72
  4.3.2 Alternative Conceptual Models ...............................................................74
    4.3.2.1 Basic Elements .............................................................................74
    4.3.2.2 Alternative Causal Chains ............................................................78
    4.3.2.3 The Possibility of Multiple Sequencing .......................................83
  4.3.3 Additional Considerations .......................................................................86
    4.3.3.1 The Impact of the University Context .........................................87
    4.3.3.2 Involved Persons ..........................................................................88
    4.3.3.3 Interest, Intention and Volition ......................................................90
4.4 Conclusion ......................................................................................................92

5 Information and Knowledge Asymmetries – The Entrepreneurial Process and the Creation of Business Opportunities .........................96
  5.1 Theoretical Background .............................................................................97
    5.1.1 The Dispersion of Knowledge and Information .................................97
      5.1.1.1 Hayek and the Positive Characteristics of Dispersed Knowledge....97
      5.1.1.2 Akerlof and the Drawbacks of Asymmetric Information ..............98
    5.1.2 Its Consequences for Entrepreneurial Opportunities .......................99
      5.1.2.1 Asymmetric Information, Market Failures, and the Inversion of the Argument .........................................................100
      5.1.2.2 Asymmetries and the Discovery of Entrepreneurial Opportunities .....101
      5.1.2.3 Asymmetries, Opportunity Exploitation and a Theory of the Firm .....103
5.1.3 Some Open Issues ....................................................................................104

5.2 Empirical Findings.......................................................................................105

5.2.1 The Software Market for Individualized Solutions: The Dispersion of
Information and Knowledge ........................................................................106

5.2.1.1 Software Industry Sectors and Individualized Software Solutions ......106

5.2.1.2 The Market for Individualized Software Solutions and
Information Asymmetries .....................................................................112

5.2.1.3 The Market for Individualized Software Solutions and
Knowledge Asymmetries ....................................................................118

5.2.2 Asymmetric Information and Knowledge and the Entrepreneurial
Process of Opportunity Discovery and Exploitation ...............................125

5.2.2.1 The Starting Point of an Entrepreneurial Opportunity
Process Framework ............................................................................125

5.2.2.2 Four Entrepreneurial Opportunity Processes ...............................127

5.2.2.3 Four Entrepreneurial Opportunity Processes and
Characteristics to Consider ..................................................................144

5.2.3 Three Firm Specific Project Examples ....................................................147

5.3 Discussion....................................................................................................151

5.3.1 The Co-Evolution of the Entrepreneurial Process and
Customer and Market Knowledge ............................................................152

5.3.2 Entrepreneurial Opportunity Identification and Exploitation as an
Iterative and Ongoing Process ................................................................154

5.3.3 Asymmetric Information and Knowledge and Its Consequences ..........157

5.4 Conclusion ...................................................................................................161

6 Entrepreneurial Opportunities and the Role of the Individual,
the Firm and the Environment ....................................................................164

6.1 Theoretical Background ............................................................................165

6.1.1 Technological Invention in the Individual-Opportunity Nexus ..........165

6.1.2 Beyond the Individual-Opportunity Nexus (I):
The Impact of the Environment ................................................................166

6.1.3 Beyond the Individual-Opportunity Nexus (II):
The Consideration of the Firm Level .......................................................169
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1.4</td>
<td>Some Open Issues</td>
<td>171</td>
</tr>
<tr>
<td>6.2</td>
<td>Empirical Findings</td>
<td>171</td>
</tr>
<tr>
<td>6.2.1</td>
<td>Economic Change in the Software Industry</td>
<td>172</td>
</tr>
<tr>
<td>6.2.1.1</td>
<td>From Up- to Downturn in the Software Industry (1994-2004)</td>
<td>172</td>
</tr>
<tr>
<td>6.2.1.2</td>
<td>The Economic Change from the Software Companies’ Perspective</td>
<td>175</td>
</tr>
<tr>
<td>6.2.2</td>
<td>Changed Economic Context and Its Impact on Technology, Innovation and Firms’ Economic Efficiency</td>
<td>181</td>
</tr>
<tr>
<td>6.2.2.1</td>
<td>Technological Innovation during the Economic Upturn (1996-2000)</td>
<td>181</td>
</tr>
<tr>
<td>6.2.2.2</td>
<td>Technological Innovation during the Economic Downturn (2001 and Beyond)</td>
<td>182</td>
</tr>
<tr>
<td>6.2.2.3</td>
<td>Software Companies’ Economic Efficiency under Changed Economic Conditions and Internal Measures</td>
<td>183</td>
</tr>
<tr>
<td>6.2.2.4</td>
<td>The Reuse of Software Code and Its Impact on Production Efficiency and Innovative Software Solutions</td>
<td>185</td>
</tr>
<tr>
<td>6.2.3</td>
<td>Firm Specific External Reaction Patterns</td>
<td>186</td>
</tr>
<tr>
<td>6.2.3.1</td>
<td>Changed Economic Environment and Triggered Search Processes</td>
<td>186</td>
</tr>
<tr>
<td>6.2.3.2</td>
<td>Concentrating on Established Markets or Moving into New Fields</td>
<td>187</td>
</tr>
<tr>
<td>6.2.3.3</td>
<td>Firm Specific Explanations</td>
<td>190</td>
</tr>
<tr>
<td>6.3</td>
<td>Discussion</td>
<td>194</td>
</tr>
<tr>
<td>6.3.1</td>
<td>The Impact of a Changed Economic Context on Entrepreneurial Opportunities</td>
<td>194</td>
</tr>
<tr>
<td>6.3.2</td>
<td>Firm Specific Impact on Entrepreneurial Opportunities</td>
<td>196</td>
</tr>
<tr>
<td>6.3.3</td>
<td>A Multi-Level Model of Entrepreneurial Opportunity Research</td>
<td>198</td>
</tr>
<tr>
<td>6.4</td>
<td>Conclusion</td>
<td>200</td>
</tr>
<tr>
<td>7</td>
<td>Conclusion</td>
<td>203</td>
</tr>
<tr>
<td>7.1</td>
<td>Summary of Results</td>
<td>203</td>
</tr>
<tr>
<td>7.2</td>
<td>Contributions</td>
<td>206</td>
</tr>
<tr>
<td>7.3</td>
<td>Limitations</td>
<td>207</td>
</tr>
<tr>
<td>7.4</td>
<td>Practical Implications and Future Outlook</td>
<td>208</td>
</tr>
</tbody>
</table>
References ........................................................................................................ 212

Appendices ........................................................................................................ 223

Appendix A ....................................................................................................... 223
Appendix B ....................................................................................................... 224
Appendix C ....................................................................................................... 225
Appendix D ....................................................................................................... 226
Appendix E ....................................................................................................... 227
Appendix F ....................................................................................................... 228
Appendix G ....................................................................................................... 229
Appendix H ....................................................................................................... 230

Curriculum Vitae ............................................................................................... 231
List of Figures

Figure 1: The case study method .................................................................................42
Figure 2: A conceptual model of prior knowledge.......................................................51
Figure 3: Alternative causal chain A ............................................................................78
Figure 4: Alternative causal chain B ............................................................................80
Figure 5: Vertical asymmetric information and knowledge and four
          key processes .............................................................................................127
Figure 6: Reciprocal and unilateral learning ..............................................................140
Figure 7: Western European IT market investments..................................................173
Figure 8: A multi-level model of entrepreneurial opportunity research .................199
List of Tables

Table 1: Contributions of disciplines to entrepreneurship .................................................................9
Table 2: A comparison of levels of analysis in three leading entrepreneurship journals .......................................................................................................................12
Table 3: Selected definitions of entrepreneurship .............................................................................17
Table 4: Recent theoretical works in opportunity identification and exploitation research .................................................................................................................................22
Table 5: Recent empirical works in opportunity identification and exploitation research .................................................................................................................................26
Table 6: Key figures about complementary company cases ........................................................................34
Table 7: Statements illustrating the thoughts and activities at the very beginning ........................................63
Table 8: Potential fields of activity for software firms ...........................................................................66
Table 9: Limited prior market knowledge ..............................................................................................68
Table 10: Limited knowledge how to serve markets ..............................................................................72
Table 11: Limited prior knowledge about customer problems ...............................................................74
Table 12: A comparison of the conceptual models ..................................................................................86
Table 13: Sectors in the software industry ..............................................................................................107
Table 14: Professional services in the software industry ........................................................................108
Table 15: Statements representing different forms of asymmetric information ....................................118
Table 16: Statements related to asymmetric knowledge ........................................................................124
Table 17: Company statements to the four entrepreneurial opportunity processes ..................................144
Table 18: Categories of asymmetric information and knowledge and their consequences ............................160
Table 19: Firm-specific statements in respect of the economic downturn.................180
Table 20: Firm-specific diversification patterns.........................................................190
List ofAbbreviations

3DP™ Three Dimensional Printing Technology
ASP Application Service Provider
CAD Computer Aided Design
CEO Chief Executive Officer
CHF Swiss Franc (currency)
COO Chief Operation Officer
CRM Customer Relationship Management
CTO Chief Technology Officer
DBMS Data Base Management Systems
EAI Enterprise Application Integration
EDP Electronic Data Processing
e.g. for example
EITO European Information Technology Observatory
ERP Enterprise Resource Planning
etc. et cetera
ETH Swiss Federal Institute of Technology, Zurich
FDA Food and Drug Administration
GDP Gross Domestic Product
GPA Agreement on Government Procurement
GUI Graphical User Interface
HTML Hypertext Markup Language
ICT Information and Communication Technology
i.e. that is
IP Internet Protocol
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>IT</td>
<td>Information Technology</td>
</tr>
<tr>
<td>KOF</td>
<td>Konjunkturforschungsstelle der ETH Zürich</td>
</tr>
<tr>
<td>MIT</td>
<td>Massachusetts Institute of Technology</td>
</tr>
<tr>
<td>PDA</td>
<td>Personal Digital Assistant</td>
</tr>
<tr>
<td>PhD</td>
<td>Doctor of Philosophy</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>Research and Development</td>
</tr>
<tr>
<td>RISE</td>
<td>Research Center for Innovation, Strategy and Entrepreneurship</td>
</tr>
<tr>
<td>SMB</td>
<td>Small and Medium-Sized Businesses</td>
</tr>
<tr>
<td>SME</td>
<td>Small and Medium-Sized Enterprises</td>
</tr>
<tr>
<td>UMTS</td>
<td>Universal Mobile Telecommunications System</td>
</tr>
<tr>
<td>WAP</td>
<td>Wireless Application Protocol</td>
</tr>
<tr>
<td>WTO</td>
<td>World Trade Organization</td>
</tr>
<tr>
<td>XP</td>
<td>Extreme Programming</td>
</tr>
</tbody>
</table>
Abstract

In recent years, opportunity identification and exploitation has gained increased attention in entrepreneurial research. This study evaluates the role of prior knowledge, the dispersion of information and knowledge, and the impact of environmental and firm-specific factors in the entrepreneurial process of opportunity identification and exploitation. Overall, these topics are mainly examined through in-depth case studies of three Swiss-based software companies for individualized large-scale software solutions.

In particular, the empirical findings show that prior knowledge of markets, of how to serve those markets, and of customer problems existed only to a limited extent when the three software companies were founded, but that the companies mainly identified and exploited their project opportunities through search activities, deep customer interaction and reciprocal learning.

Furthermore, this study gives a more detailed categorization of the role of dispersed knowledge in the entrepreneurial process of opportunity identification and exploitation. It shows that asymmetric information and knowledge can be categorized along three main dimensions resulting in vertical, horizontal and longitudinal information and knowledge asymmetries in the entrepreneurial process.

In addition, this work provides a comprehensive view of how the software companies reduce vertical information and knowledge asymmetries in the entrepreneurial process. In essence, the study analyzes the different activities the software companies undertook to identify opportunities and further shows different decision factors in the evaluation of opportunities beside pure economic considerations. It stresses the importance of opening up and acquiring the identified opportunities in a high-tech service business, and shows the significance of learning and knowledge combination in the realization of the identified software project opportunities.

Finally, this dissertation expands the individual-opportunity nexus as the key relationship in entrepreneurial opportunity research, by showing the impact of the economic environment and firm-level considerations. Furthermore, the impact of motivational factors and the role of the location of nearby universities in the identification and exploitation of entrepreneurial opportunities are discussed.
Key Words

Key words: entrepreneurship, entrepreneurial opportunities, prior knowledge, vertical, horizontal and longitudinal asymmetric information and knowledge, entrepreneurial process, environmental and firm-level analysis
Acknowledgments

As a graduate student, I was always a little amused when reading the acknowledgments of all those who had finished their dissertations – to read about the joys and sorrows of the long journeys they traveled when doing their research, and to see the long lists of people who had contributed to the successful completion of their dissertation. It always sounded so dramatic to me.

Now, the moment has come when I find myself writing these lines, and it is only now that I begin to truly understand my colleagues. Even though acknowledgments often have a dramatic tone – as, perhaps, do mine – what I write in the following lines is deeply felt. Without the support of those listed below I would not be where I am today. Maybe I myself will provide some amusement for students who read these lines, but I suppose they might understand me when they finish their own dissertation.

First of all, I would like to thank my referent and co-referent, Georg von Krogh and Chris Steyaert. I am indebted to them for their support, help, encouragement, and patience, and for the insights they gave whenever I asked for help and advice. I also want to thank them for giving me the freedom to conduct my research in an area I was highly interested in. Furthermore, I am grateful for Georg von Krogh’s suggestion and encouragement to go to Norway as a visiting scholar. I was very fortunate to have such a committee.

Next, I would like to thank Simon Grand for the interesting discussions and empirical research we conducted together. He was always a source of inspiration and our research sessions were a pleasure, highlighting problems from different perspectives, whether in meetings at the University of St. Gallen or in a café in Zurich. I am also deeply indebted to Simon for putting me in touch with the three software companies that I have mainly researched for this study.

My special thanks go to the companies that have contributed to this dissertation. In particular, I would like to thank Stefan Arn of Adnovum, Patrick Burkhalter and Theodor Graf of Ergon, and Andrej Vekovski of Netcetera. Being out in the field and having the chance to talk with you was always very interesting and provided highly valuable insights for my dissertation.

I would also like to acknowledge the University of St. Gallen, which gave me the opportunity to participate in its doctoral program. I further express my deep gratitude
to Ian MacMillan at the Sol C. Snider Entrepreneurial Research Center at the Wharton School, University of Pennsylvania, and to the people of the Knowledge and Strategy Department at SINTEF in Trondheim, Norway, for accommodating me as a visiting scholar at their institutes; these times were among the most valuable experiences of my life. In addition, I am deeply thankful for the scholarship from the Swiss National Science Foundation, which made it possible for me to study abroad as a visiting scholar. I hope that I will be able to return the benefit of my experiences and knowledge in some way.

I might still be editing my work were it not for the valuable help of Mrs. Angela Bennett and Mrs. Lindsay North, who went over my English writing. Furthermore, I would like to thank Aleksandar Marjanovic for the useful comments he made, having reviewed my dissertation. I am also grateful for all of the comments made by my colleagues from the Research Center for Innovation, Strategy and Entrepreneurship (RISE) at the University of St. Gallen, and by the good PhD friends and colleagues I came to know during my time as a doctoral student.

Lastly, warm thanks go to my parents, Willi and Annemarie Urwyler, and to my whole family, for supporting and encouraging me over the years. Without you, it would have been difficult to achieve this. The final words belong to you, Antje, for all that you have done for me; for your support and encouragement, your smart advice and cleverness. You were always there when I needed a reader, an editor, or just a friend. With all my gratitude and love, Matthäus.

Unterägeri, January 2006 Matthäus Urwyler

---

1 Research Center for Innovation, Strategy and Entrepreneurship at the University of St. Gallen
1 Introduction

1.1 Entrepreneurial Opportunity Research

The field of entrepreneurship research has intensively grown and flourished in recent years. What started as a tiny seed over 20 years ago is now approaching maturity. However, despite the extensive attention this area has received recently, discussions and debates about the core elements of entrepreneurship research are ongoing. One prominent view, suggested by Shane and Venkataraman (Venkataraman 1997; Shane and Venkataraman 2000), which has gained more weight over the last five years, is centered around the examination of entrepreneurial opportunities. Or in the words of the two authors (Shane and Venkataraman 2000: p. 217): “Entrepreneurship is concerned with the discovery and exploitation of profitable opportunities.” In particular, within this stream of research, the focus is on studying how, by whom, and with what effects opportunities are identified, evaluated, and exploited.

Following Shane and Venkataraman’s suggestions, several research activities have been performed in this area. In the last five years, a number of conceptional and theoretical works have been published about the role of entrepreneurial opportunities in entrepreneurship research. In essence, the following theoretical elements have been identified as core factors that impact the process of the identification and exploitation of entrepreneurial opportunities: idiosyncratic knowledge (Shane and Venkataraman 2000; Ardichvili, Cardozo et al. 2003), cognitive properties (Shane and Venkataraman 2000; Baron 2004), information processing and social networks (Kang and Uhlenbruck 2002; West III 2003), personal traits (Krueger and Brazeal 1994), entrepreneurial alertness (Gaglio and Katz 2001; Ardichvili, Cardozo et al. 2003), signal detection (McMullen and Shepherd 2003), entrepreneurial intuition (Zahra 2002), and mindset (McGrath and MacMillan 2000).

After an initial set of theoretical and conceptional publications, several empirical studies have followed, which investigate the role of prior knowledge (Shane 2000; Shepherd and De Tienne 2005), entrepreneurial learning (Ravasi and Turati 2005), pioneering behavior (Schatzel, Kiyak et al. 2005), network alliances (Soh 2003;
Ferriani 2004), risk handling (Mullins and Forlani 2005), and growth aspiration (Wiklund and Shepherd 2003) in the identification and exploitation of entrepreneurial opportunities.

Overall, Shane and Venkataraman, whose theory is rooted in Austrian economics (Hayek 1945; Mises 1949; Kirzner 1973; Menger [1871], 1950), have mentioned, among others, three particular elements that are important when studying the phenomenon of entrepreneurial opportunities.

- Based on Hayek (1945), they argue that information and knowledge are not evenly dispersed among people. No two individuals share identical information and knowledge about the economy, and these differences are suggested to highly influence who identifies and exploits entrepreneurial opportunities (Venkataraman 1997; Shane and Venkataraman 2000).

- Derived from the notion of dispersed knowledge, Shane (2000) sets forth that the entrepreneur’s prior knowledge is an important precondition for opportunity identification and exploitation. In other words, an entrepreneur will only discover and exploit those opportunities that are related to his already existing knowledge.

- Furthermore, Shane and Venkataraman emphasize that the nexus between the individual and the opportunity itself is a key relationship which needs to be studied in order to understand why certain entrepreneurs (and not others) identify and exploit certain opportunities (Venkataraman 1997; Shane and Venkataraman 2000). In essence, researchers must look at the attributes of both the entrepreneur and the opportunity and the relationship between the two, rather than looking at either the attributes of the entrepreneur (e.g. as it is done within personal trait theories) or the attributes of the opportunity. Consequently, they argue that the focus lies primarily on this individual-opportunity nexus and less on environmental antecedents and their consequences of how entrepreneurial opportunities are identified or created.

1.2 Open Issues and Research Objectives

Shane and Venkataraman (Venkataraman 1997; Shane 2000; Shane and Venkataraman 2000) have identified the three above-mentioned essential elements that foster the understanding of how entrepreneurs identify and exploit entrepreneurial opportunities. In the following, I would like to revisit these three elements and present
open issues with regard to prior knowledge, information and knowledge asymmetries, and the individual-opportunity nexus.

First of all, within his model, Shane (2000) illustrates how entrepreneurs identify and exploit entrepreneurial opportunities in new ventures based on their prior knowledge in three specific areas – markets, how to serve these markets, and customer problems. I would like to show that there are also new ventures that deal with new entrepreneurial opportunities without necessarily having profound prior knowledge in these areas. Contrarily, it will be shown that these firms gain their entrepreneurial opportunities based on profound prior technological know-how and competence, and through intense interaction with customers.

Second, Shane and Venkataraman stress the role of dispersed information and knowledge in explaining why certain entrepreneurs and not others identify and exploit certain entrepreneurial opportunities. However, the two authors use the terms ‘asymmetric information’ and ‘asymmetric knowledge’ as synonyms, and it is not clearly specified between whom these information and knowledge asymmetries exist. Consequently, there is scope for a more detailed specification and categorization. Therefore, on the one hand, I would like to present a more comprehensive analysis of the conceptual difference between asymmetric information and knowledge; on the other hand, I analyze more specifically between which parties asymmetric information and knowledge exists and what role these asymmetries play in the identification and exploitation process of entrepreneurial opportunity exploitation and identification.

Third, beside the importance of the individual-opportunity nexus, the question of how other levels of analysis influence the entrepreneurial process of opportunity identification and exploitation is also shown to be of relevance. In particular, I look at the environment and the firm level and their impact on specific entrepreneurial processes.

Therefore, the main objective of this work is to revisit the theoretical foundations of prior knowledge, asymmetric information and knowledge, and the individual-opportunity nexus in the light of empirical data derived from different case studies performed in the software industry. In particular, I analyze three software companies that provide sophisticated, individualized software solutions. The analysis focuses on their prior knowledge of markets and customers during the company foundation phase, on their first projects, and on their technological background. In addition, different forms of asymmetric information and knowledge are analyzed: between
whom they exist, and what role they play in the entrepreneurial process of opportunity identification and exploitation. Finally, the impact of the environmental context and the influence of the firm level on the identification and exploitation of entrepreneurial opportunities are examined.

Overall, this dissertation provides a discussion about the entrepreneurial opportunity research as derived by Shane and Venkataraman, as well as other authors in a similar vein, based on the empirical data collected in the case studies.

1.3 Research Strategy and Method

This work is primarily based on qualitative research. In particular, three company cases in the market for individualized, large-scale software solutions are examined with regard to the three above-mentioned open issues. The market for high-technology, tailor-made software solutions has been identified as a very suitable area for examining entrepreneurial opportunities with regard to these issues for the following reasons. First of all, this market is highly dynamic, therefore software companies are constantly forced to identify and open up new project opportunities. Second, relatively few studies in entrepreneurship and management research have been carried out in the software industry. Third, most studies of entrepreneurial opportunities have been done in manufacturing-based industries rather than in service-based industries.

The case study approach has served as a general methodological setting. Each case was first conducted individually, before a cross-case analysis was accomplished. Interviews were conducted through a stratified sampling procedure. Different people with different functions were interviewed within the companies. Data collection within the three companies lasted from the beginning of 2001 until the end of 2004. The data was analyzed by means of the qualitative grounded theory approach and with the help of a software program for qualitative research. In line with the participatory research approach, findings were presented to the interviewed people in order to validate the results based on their feedback.

Accordingly, this work is based on a phenomenon-oriented perspective, rather than on a particular theoretical perspective, such as transaction cost or resource-based theory; this is because the phenomenon of entrepreneurial opportunities includes a broad range of concepts and dimensions that one single theoretical discipline would not cover. Therefore, whenever a certain phenomenon is explained, different
theoretical perspectives may be involved in order to provide a comprehensive explanation and understanding of the phenomenon of how companies identify and exploit entrepreneurial opportunities.

1.4 Dissertation Outline

Chapter two provides a brief review of current literature in the relevant areas, thereby laying the foundations for subsequent chapters. In the first part, a short introduction to the development of entrepreneurship research and to the different approaches to it is given, by presenting a concise historic overview of the entrepreneur’s role in economic and management research. Furthermore, the different disciplines and levels of analysis that contribute to entrepreneurship research are presented and the recent debates about the core of entrepreneurship research are shown, highlighting the importance of entrepreneurial opportunities as an important element in this respect. In the second part, the particular elements of entrepreneurial opportunity research are established, followed by a review of recent theoretical and empirical contributions to entrepreneurial opportunity identification and exploitation research.

Chapter three describes the research strategy and methods that are used in this study. In essence, it expounds the case study approach as the general research frame, explains grounded theory as the major tool for analyzing the data, and elucidates the benefits of participatory research in data collection and in obtaining feedback from the interviewees. This chapter also explains how the main company cases were selected and gives a brief presentation of them. Finally, I show how the reliability and the different forms of validity of this study could be improved.

Chapter four begins with the theoretical basis of prior knowledge for the following empirical part and discussion. In particular, Shane’s (2000) model of prior knowledge, which is based on the data of eight technological ventures, is introduced; in this model, prior knowledge of markets and customers is a key factor for identifying and exploiting entrepreneurial opportunities. In order to compare Shane’s model with the empirical findings of three software companies for individualized software solutions, I investigate in more detail the prehistory, the firm founding, the first realized projects, and the technological backgrounds of these companies. Based on the theoretical and empirical part, I analyze the role of prior knowledge in the formation process of the three software companies and I present two alternative conceptional models. Lastly,
Chapter 1

additional considerations that play a role in the firm formation process and in the identification and exploitation of entrepreneurial opportunities of the three company cases are briefly discussed.

Chapter five begins with the theoretical foundation of asymmetric information and knowledge. In particular, the seminal works of Hayek (1937, 1945) and Akerlof (1970), and their impact on entrepreneurial opportunity research, are discussed. In the empirical part, different forms of vertical, horizontal and longitudinal asymmetric information and knowledge in the entrepreneurial process are specified and categorized, based on data from the three software companies. In addition, four entrepreneurial processes, which enable to reduce vertical asymmetric information and knowledge, and their characteristics are highlighted. The last part of the discussion shows how the ongoing process of opportunity identification and exploitation co-evolves with market and customer knowledge in close customer interaction.

Chapter six begins with the theoretical foundation of the individual-opportunity nexus and a theoretical investigation that goes beyond it, looking at environmental and firm-level factors that may also play a role in the opportunity identification and exploitation process. The empirical part shows how the three software companies dealt with the changed economic conditions in the software industry after the technology euphoria of the late nineties; in particular, how the innovation level and the number of project opportunities changed, and what kind of internal and external measures were taken in respect of the identification and exploitation of new opportunities. In the subsequent discussion part, the insights of the changed economic context and firm-specific characteristics on entrepreneurial opportunities are discussed. Lastly, based on these insights, a multi-level model for entrepreneurial opportunity research is presented.

In Chapter seven, the major theoretical and practical insights and implications of this study are summarized. I also explain the context in which the findings may be generalized. Finally, the limitations of the present work are discussed and an outlook for future research is provided.
2 Literature Review and Theoretical Foundations

This chapter presents an introduction into entrepreneurship practice and theory. It starts with a short historical overview of entrepreneurship research, illustrates the different disciplines that contribute to it, shows the different levels of analysis conducted by entrepreneurship studies and briefly summarizes the recent debates about the purpose of entrepreneurship research. One issue that has received particular interest in recent discussions is the role of opportunities in entrepreneurial activities. Accordingly, in the second part of this chapter the nature of entrepreneurial opportunities is discussed and an overview of recent theoretical and empirical works is presented.

2.1 Entrepreneurship: Its Development and Approaches

2.1.1 A Short Historical Overview

Interestingly, entrepreneurship as a phenomena and the entrepreneur as a person were first studied by economists. One of these researchers, who considered the entrepreneur and its role in the economy, was Cantillon (1755/1931). In Cantillon’s work, the entrepreneur plays the role of a coordinator by connecting producers with consumers and by making judgments in an environment of uncertainty. By contrast, according to Turgot (1727-1781/1977) the entrepreneur is the result of a capitalist investment decision. Either he lends money, which means that he represents a pure capitalist, or he becomes a producer, which is, in Turgot’s theoretical concept, equivalent to the entrepreneur. On the other hand, Say (1840, 1845) considered the entrepreneur as a key figure in economic life, who understands technological means of production and transfers his knowledge into valuable products (Grebel, Pyka et al. 2001).

With the emergence of neoclassical economics, of which the Walrasian general equilibrium model is the analytical core, the entrepreneur almost disappeared from economic theory, because he seemed to upset the notion of equilibrium conditions. For this reason some scholars also have criticized the neoclassical approach although most of them respected its inherent theoretical value.
Knight (1921) challenged the perfect competition model by introducing his concept of risk and uncertainty. Similarly, Schumpeter (1934) objected to the static view of neoclassical models. He contested the idea that the general state of the economy is in equilibrium, but emphasized constant change that stems from new combinations and waves of creative destruction driven by entrepreneurs. As a consequence, in Schumpeter’s world, the entrepreneur constantly disturbs the economic equilibrium. In the same way, Hayek (1937, 1945, 1948) and Mises (1949), founders of the Austrian School of Economics, also agreed that equilibrium is not a given condition of the economy. Both were interested in the market process, which leads to an equilibrium of the economy. In their view, the entrepreneur is responsible for this process happening. In particular, Hayek (1948) suggested that the market process is driven by individuals who acquire better mutual information about the plans being made by fellow market participants. In Mises’ (1949) opinion, the market process is shaped by the daring, imaginative, and speculative actions of entrepreneurs, who identify opportunities for pure profit in the conditions of market disequilibriums. Kirzner (1985, 1997), a student of Mises, developed his mentor’s work further and introduced the terms “entrepreneurial alertness” and “entrepreneurial discovery”. The idea behind the two concepts is that the entrepreneur is alert to existing opportunities in the market and identifies them by coincidence.

The work of some of these economists has subsequently moved into the field of business management or has been complemented by researchers from this area. Penrose (1959), for instance, studied the impact of the entrepreneur and the productive opportunity on firm growth. However, as Meyer et al. (2002) illustrate, entrepreneurship as an individual field of study only began to emerge in the 1970s and since then has gained importance in academia and in business practice for several reasons. For instance, the research of Birch (1979) highlights entrepreneurship as the engine of growth in the economy. Moreover, Reynolds et al. (1999) show that in 1996, 15% of the firms with the highest growth rates created 94% of all new jobs. In addition, Morris (1998) mentions, beside growth and the creation of employment, five further beneficial aspects of entrepreneurship, namely: the creation of wealth; the creation of enterprises; the creation of innovation; the creation of change; and the creation of value.

---

2 Ludwig von Mises was one of the greatest critics of neoclassical economic theory and propagated a paradigm shift for the entire discipline of economics. Whereas Friedrich A. Hayek expressed unease with certain aspects of modern economics, he viewed his work in large part as a complement to, rather than a substitute for, the neoclassical approach (Caplan, 1999).
As can be seen in the previous paragraphs, different disciplines have contributed to entrepreneurship research. In the next section, the major disciplines and their objectives are presented in more detail.

2.1.2 Different Disciplines in Entrepreneurship Research

During the last fifteen years, the importance of entrepreneurship research has continuously increased and the field has received significant research interest. This can also be seen from the appearance of specialized journals such as the Journal of Business Venturing and the Entrepreneurial Theory and Practice journal and the manifold contributions from different research disciplines. From a broad perspective, there are basically three main disciplines that contribute to entrepreneurship research: economics, management and psychology theory.

According to Stevenson and Jarillo (1990), these three approaches distinguish themselves one from another by having a specific focus towards entrepreneurship research (see Table 1). In particular, the psychology approach is interested in the causes of why entrepreneurs act, analyzing entrepreneurs primarily on the individual level. Management research mainly focuses on the behavior of entrepreneurs and is mainly interested in the question how entrepreneurs act from a firm-level perspective. By contrast, economics concentrates on the effects of entrepreneurs, in particular, on what happens for the whole economic system when they act.

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Psychology</th>
<th>Management</th>
<th>Economics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line of inquiry</td>
<td>Causes</td>
<td>Behavior</td>
<td>Effects</td>
</tr>
<tr>
<td>Main question</td>
<td>Why</td>
<td>How</td>
<td>What</td>
</tr>
<tr>
<td>Main level of investigation</td>
<td>Individual</td>
<td>Firm</td>
<td>Economy</td>
</tr>
</tbody>
</table>

Table 1: Contributions of disciplines to entrepreneurship research

Source: adapted to Stevenson and Jarillo (1990)

In the following, some topics and subjects of the prevailing disciplines are presented, whereby focus is given to some specific topics, without claiming to present a complete overview.
In psychology based studies, two streams of research have gained particular interest, namely trait and cognitive theories. In trait-related studies, researchers are interested in identifying the specific traits of entrepreneurs. The idea behind trait theory is to differentiate entrepreneurs from non-entrepreneurs by comparing differences in their personality. Traits that have been investigated include, for instance, the need for achievement (McClelland 1961), risk-taking propensity (Brockhaus 1980), locus of control (Hull, Bosley et al. 1980), and tolerance of ambiguity (see e.g. Schwenk 1982).

However, trait theory approaches have been criticized for not producing stable outcomes (Gartner 1988, 1989). As a result, the focus has shifted to more cognitive approaches. Among the first cognitive works were those that studied cognitive biases and heuristics in strategic decision making (Busenitz 1992; Busenitz and Barney 1997) and the impact of prior entrepreneurial exposure on the perceptions of new venture feasibility and desirability (Krueger 1993). In general, entrepreneurial cognitive research looks at the positive and negative aspects of entrepreneurial cognition. In particular, it examines entrepreneurial behavior in complicated environments that are characterized by information overload, high uncertainty, or novelty (Mitchell, Busenitz et al. 2002). For instance, the decision to become an entrepreneur may be influenced by several cognitive biases, such as optimistic bias, planning fallacy, or the illusion of control (Baron 2004).

The management approach of entrepreneurship deals with a wide range of topics, and therefore, an encompassing mapping is difficult to depict. In general, topics reach from financing, franchising, growth, innovation, venture creation, learning, strategy formation, up to network, alliance building, and internationalization. Nevertheless, all these approaches have in common that they are centered around the “how” question, which serves as a means for analyzing different issues, such as how entrepreneurs or entrepreneurial firms are financed, how they grow their companies, or how they internationalize. The overall objective is to find out what differentiates successful entrepreneurs and firms from non-successful ones.

In this respect, management researchers need to be able to consistently measure the outcome and success of entrepreneurial behavior. However, there are different opinions about how this should be done and which performance variables should be examined. Therefore, several performance measures for entrepreneurial behavior are used, such as sales growth, profitability and return of investment (McDougall, Robinson et al. 1992; Zahra and Covin 1995; Dess, Lumpkin et al. 1997), number of
employees and growth in employees (see e.g. Brush and Venderwerf 1992), or firm survival (Stearns, Carter et al. 1995; Gartner, Starr et al. 1998; Azoulay and Shane 2001).

Furthermore, management researchers examine firms at different life stages. While some are more interested in the start-up phase or in the creation process of new companies (Low and MacMillan 1988; Sexton and Landström 2000), others examine entrepreneurial behavior in established companies (Burgelman 1983; Pinchot 1985; Zahra, Nielson et al. 1999).

According to (Stevenson and Jarillo 1990), entrepreneurial economics in general examines the net effects for the overall economic system caused by the actions of the entrepreneur and the role he or she plays in the development of the whole market system. As we have seen in the previous section 2.1.2, there are two predominant explanations in economics about how entrepreneurs influence the whole economic system. One stream argues that entrepreneurs disrupt the market equilibrium by innovation and by creating new entrepreneurial opportunities (Schumpeter 1934; Holcombe 2003). The other stream argues that the entrepreneur is the person who brings the market back to its equilibrium by identifying existing entrepreneurial opportunities (Hayek 1945; von Mises 1949; Kirzner 1973).

The simplified overview of the three main disciplines in entrepreneurship research has indicated that each discipline has its core level of investigation. A more sophisticated view of the different levels of analysis in actual entrepreneurship research is presented in the next sections.

2.1.3 Different Levels of Analysis in Entrepreneurship Research

Based on MacMillan and Low’s (1988) suggestion that entrepreneurship research should deal with the question of new firm creation on different levels of analysis, Davidsson and Wiklund (2001) looked at three leading entrepreneurship journals and studied the levels of analysis that were favored by entrepreneurship researchers and thus prompted the question whether these levels have changed over a time range of ten years (1988-1998). The two authors categorized the different levels of analysis in micro (individual, team, and firm), macro (industry, and region) and mixed level investigations (see Table 2).

---

3 The three journals are of Entrepreneurship Theory & Practice, Journal of Business Venturing and Entrepreneurship and Regional Development.
<table>
<thead>
<tr>
<th>Levels of Analysis</th>
<th>1988/89</th>
<th>1998</th>
<th>Tendency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Micro level</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individual</td>
<td>26.6%</td>
<td>20.6%</td>
<td>✅</td>
</tr>
<tr>
<td>Firm</td>
<td>26.6%</td>
<td>35.5%</td>
<td>✅</td>
</tr>
<tr>
<td>Individual &amp; firm</td>
<td>1.6%</td>
<td>11.1%</td>
<td>✅</td>
</tr>
<tr>
<td><strong>Aggregate levels</strong></td>
<td>21.9%</td>
<td>11.1%</td>
<td>✅</td>
</tr>
<tr>
<td>Industry</td>
<td>7.8%</td>
<td>3.2%</td>
<td>✅</td>
</tr>
<tr>
<td>Region</td>
<td>6.2%</td>
<td>3.2%</td>
<td>◀</td>
</tr>
<tr>
<td><strong>Micro/aggregate mix</strong></td>
<td>12.5%</td>
<td>11.1%</td>
<td>✅</td>
</tr>
<tr>
<td>Others</td>
<td>6.2%</td>
<td>0.0%</td>
<td>✅</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

Table 2: A comparison of levels of analysis in three leading entrepreneurship journals

Source: adapted from Davidsson and Wiklund (2001) / absolute numbers in brackets

Their findings show that entrepreneurship research is dominated by micro level analysis, primarily by individual and firm level studies. Furthermore, the share of micro level analysis has increased over the last ten years and the share of macro studies has decreased. Moreover, whereas studies that focus solely on the individual level had decreased, the overall rate of individual studies has remained stable, due to an increase of studies that have been conducted as mutual investigations into individual and firm level analysis. However, studies of teams as well as mixed studies on the micro/macro level are still rare.
The authors therefore conclude that a positive trend exists towards studies that look at combined levels, such as individual and firm level-analysis. However, studies that combine micro and macro levels have not found the attention they deserve, probably also because data is difficult and costly to collect. It is notable that there are fewer studies in areas where secondary data are missing, such as investigations in projects, teams and clusters.

Given the short historical introduction and the overview of relevant disciplines and levels of analysis in entrepreneurship research, we turn now to the prominent discussions and debates about the fundamentals of entrepreneurship research.

2.1.4 Towards a Generally Accepted Definition of Entrepreneurship

As Steyaert and Hjorth (2003: p. 4) remark: “… what is almost a tradition from the very start in the field of academic entrepreneurship, namely to reflect upon and comment upon its own development.”, there have been temporal discussions about what the heart of entrepreneurship research is or should be.

The interdisciplinary approach of entrepreneurship theory and the different opinions about which levels of analysis in entrepreneurship research should be studied have been a constant source for debates. In particular, two major issues have held the field in its spell for the last two decades. Namely, “what is the role of the entrepreneur in entrepreneurship research?” and second, “what is entrepreneurship research about?”

The first issue has mostly been a debate within the entrepreneurial community and it was basically activated by two articles by Low and MacMillan (1988) and by Gartner (1988). All three authors criticized the “psychological traits” approach to entrepreneurship, because it did not produce stable results over time and it mainly concentrated on the entrepreneur as a person without considering other factors.

Instead of focusing on the entrepreneur as a person, Low and MacMillan (1988) suggested that entrepreneurship research should concentrate on how new enterprises are created and on the consequences for enhancing the economic progress. Likewise, Gartner (1988) suggested that entrepreneurship research should focus on the creation of organizations and on “what the entrepreneur does” and not on “who the entrepreneur is” and he has therefore proposed a behavioral approach as a theoretical background.

Since the articles of Gartner, Low and MacMillan, researchers have taken the recommendations seriously. At least, the number of pure individual level analysis has
decreased in the mid-nineties as Davidsson and Wiklund (2001) have shown. However, the field has seen a considerable expansion in new areas, such as corporate entrepreneurship, macro environmental linkages, and international entrepreneurship. However, the rapid extension of topics and the increasing contributions to entrepreneurship research from other management areas led to a broad debate in the field: The debate about the domain of entrepreneurship research, its legitimacy, and its contribution to management practice (Meyer, Neck et al. 2002).

There have been several criticisms about what is lacking in entrepreneurship research. For instance, Aldrich and Baker (1997) compared management research with entrepreneurship research published from 1990 to 1995. They conclude that entrepreneurship research has only in a limited way progressed toward a coherent paradigm development on what entrepreneurship research is about. They further remark that entrepreneurship studies tend to be less sophisticated in sampling frames, hypothesis development, statistical analysis, and dynamic longitudinal analysis than organizational studies in the more established disciplines. In addition, Ucbasaran, Westhead and Wright (2001) analyzed the wide range of topics in entrepreneurship research. They come to the conclusion that, while individual research projects have focus, the field as a whole does not. The lack of coherent definitions of entrepreneurship and a limited theoretical background has been seen as a threat for the legitimacy and as a limiting factor in progressing in the field so far (for illustration, a selection of entrepreneurship definitions can be found in Table 3, p. 17).

The debate about the domain of entrepreneurship research has led to numerous publications about the state of the field and its future directions (see e.g. Venkataraman 1997; Brazeal and Herbert 1999; Sharma and Chrisman 1999; Zahra, Jennings et al. 1999; Shane and Venkataraman 2000; Alvarez and Busenitz 2001; Bruyat and Julien 2001; Davidsson, Low et al. 2001; Hitt, Ireland et al. 2001; Busenitz, West III et al. 2003; Steyaert and Hjorth 2003). Several suggestions have been made towards how entrepreneurship research could be improved. First, there has been a claim that entrepreneurial research should be more theory driven, taking advantage of progress made in other disciplines and related management fields (Davidsson, Low et al. 2001). Aldrich and Martinez (2001), for instance, show the power of a single theoretical perspective by reviewing the significant progress made during the past decade in applying evolutionary theory to the study of entrepreneurship. Other researchers have claimed that entrepreneurship research has to develop its own distinctness and domain (see e.g. Venkataraman 1997; Shane and
Venkataraman 2000; Gartner 2001), which, however, stand in contrast to those that have suggested a more integrative approach (see e.g. Hitt, Ireland et al. 2001). Furthermore, several frames and key topics of entrepreneurship research have been presented. For instance, Shane and Venkataraman (Venkataraman 1997; Shane and Venkataraman 2000) suggest that entrepreneurship research should seek to understand how entrepreneurial opportunities of future goods and services are discovered, evaluated and exploited. Bruyat and Julien (2001) suggest that entrepreneurship research should study the dialogue between individuals and new value creations, within an ongoing process and within an environment that has specific characteristics. Hitt, Ireland et al. (2001) propose an integration of entrepreneurial thinking (the identification and exploitation of previously unexploited opportunities) and strategic thinking (set of commitments, decisions, and actions, designed and executed to produce competitive advantage and above-average returns), thereby looking at organizational domains such as external networks and alliances, resources and organizational learning, and innovation and internationalization. West (2003) recommends an entrepreneurial framework that is based on information processing, asymmetric knowledge and networks. Finally, Busenitz, West, et al. (2003) argue that entrepreneurship research should focus on the intersections of individuals, opportunities, modes of organizing, and the environment. Thereby, they present four theoretical perspectives they consider as beneficial for entrepreneurship research, namely: decision-making theory, start-up factors of production, temporal dynamics, information processing and network theory.

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schumpeter (1934)</td>
<td>Entrepreneurship is seen as new combinations including the doing of new things or the doing of things that are already being done in a new way. New combinations include (1) introduction of new goods, (2) new method of production (3) opening of a new market (4) new source of supply (5) new organizations.</td>
</tr>
<tr>
<td>Kirzner (1973)</td>
<td>Entrepreneurship is the ability to perceive new opportunities. This recognition and seizing of the opportunity will tend to “correct” the market and bring it back toward equilibrium.</td>
</tr>
<tr>
<td>Casson (1982)</td>
<td>The essence of entrepreneurship is being different – being different because one has a different perception of the situation. It is this that makes the entrepreneur so important.</td>
</tr>
<tr>
<td>Author(s)</td>
<td>Definition</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Drucker (1985)</td>
<td>Entrepreneurship is an act of innovation that involves endowing existing resources with new wealth-producing capacity.</td>
</tr>
<tr>
<td>Stevenson, Roberts and Grousback (1985)</td>
<td>Entrepreneurship is the pursuit of an opportunity without concern for current resources or capabilities.</td>
</tr>
<tr>
<td>Rumelt (1987)</td>
<td>Entrepreneurship is the creation of new business - new business meaning that they do not exactly duplicate existing businesses but have some element of novelty.</td>
</tr>
<tr>
<td>Low and MacMillan (1988)</td>
<td>Entrepreneurship is the creation of new enterprise.</td>
</tr>
<tr>
<td>Gartner (1988)</td>
<td>Entrepreneurship is the creation of organizations, the process by which new organizations come into existence.</td>
</tr>
<tr>
<td>Bygrave (1989a), Bygrave (1989b), Bygrave and Hofer (1991)</td>
<td>An entrepreneurial event involves the creation of a new organization to pursue an opportunity. The entrepreneurial process involves all the functions, activities, and actions associated with the perception of opportunities and the creation of organizations to pursue them.</td>
</tr>
<tr>
<td>Stevenson and Jarillo (1990)</td>
<td>Entrepreneurship is a process by which individuals – either on their own or inside organizations – pursue opportunities without regard to the resources they currently control.</td>
</tr>
<tr>
<td>Amit, Glosten and Muller (1993)</td>
<td>Entrepreneurship can be defined as the process of extracting profits from new, unique, and valuable resources in an uncertain and ambiguous environment.</td>
</tr>
<tr>
<td>Krackhardt (1995)</td>
<td>Entrepreneurship can be seen as a structural and dyadic concept, where the entrepreneur faces the task of discovering which of his relationships are unconstrained and will lead to the greatest entrepreneurial opportunity.</td>
</tr>
<tr>
<td>Lumpkin and Dess (1996)</td>
<td>The essential act of entrepreneurship is new entry. New entry can be accomplished by entering new or established markets with new or existing goods or services. New entry is the act of launching a new venture, whether via a start-up firm, through an existing firm, or via internal corporate venturing.</td>
</tr>
</tbody>
</table>

*Structure is defined here as the characteristics of embedded network ties an entrepreneur has access to.*
Timmons (1999) | Entrepreneurship research is the way of thinking, reasoning and acting that is opportunity obsessed, holistic in approach, and leadership balanced.

Venkataraman (1997) | Entrepreneurship research seeks to understand how opportunities of creating future goods and services are discovered, created, and exploited, by whom, and with what consequences.

Morris (1998) | Entrepreneurship is the process through which individuals and teams create value by bringing together unique packages of resource inputs to exploit opportunities in the environment. It can occur in any organizational context and results in a variety of possible outcomes, including new ventures, products, services, processes, markets, and technologies.

Sharma and Chrisman (1999) | Entrepreneurship encompasses acts of organizational creation, renewal, or innovation that occur within or outside an existing organization.

Hitt, Ireland, Camp and Sexton (2001) | Entrepreneurship is defined as the identification and exploitation of previously unexploited opportunities.

Ireland, Hitt, Camp and Sexton (2001) | Entrepreneurship is a context-dependent social process through which individuals and teams create wealth by bringing together unique packages of resources to exploit marketplace opportunities.

Alvarez and Barney (2002) | Entrepreneurial actions refer to individual-level actions in the creation of the firm, firm-level actions in the pursuit of innovations, and market-level actions in the exploitation of opportunities presented.

Smith and DiGregorio (2002) | We define entrepreneurial actions as any newly fashioned behavior by which firms exploit opportunities that others have not noticed or exploited.

**Table 3: Selected definitions of entrepreneurship**

Overall, as it can be seen from the different suggestions above, entrepreneurial opportunities, among other issues, are considered as an important construct in current and future entrepreneurial research. Therefore, it is worthwhile looking at the opportunity topic and its role in entrepreneurship research in more detail in the upcoming sub-chapter.
2.2 The Role of Opportunities in Entrepreneurship Research

After the brief review of entrepreneurship research in general in the last sub-subchapter, the upcoming sections focus more profoundly on the role of entrepreneurial opportunities. In a first part, the nature of entrepreneurial opportunities is discussed. In a second and third part, recent theoretical and empirical publications are presented.

2.2.1 The Nature of Opportunities

The use and introduction of the opportunity construct is not new, but has some tradition in economics and management research. Generally, the idea of opportunities goes back to Austrian economics. Either entrepreneurs create opportunities (thereby they disequilibrate the market) through innovative actions (Schumpeter 1934), or they discover opportunities by exploiting existing market disequilibriums through idiosyncratic knowledge (Hayek 1945), profit motives (von Mises 1949), or alertness (Kirzner 1973). Although the opportunity term is quite often used in academic publications, it is only rarely defined in a clear way. The few explicit definitions that exist mostly go back to the above mentioned classical works. For instance, Casson (1982) defines opportunities as those situations, in which new goods, services, raw materials and organizational methods can be introduced and sold at a greater price than their cost of production. Timmons (1999) defines opportunities as attractive, durable and timely potential products or services that create or add value. Singh (2000) defines an entrepreneurial opportunity as a feasible, profit-seeking, potential venture that provides an innovative new product or service to the market, improves on an existing product/service, or imitates a profitable product/service in a less-than-saturated market. Finally, Sarasvathy, Dew et al. (2002) define an entrepreneurial opportunity as a set of ideas, beliefs and actions that enable the creation of future goods and services in the absence of current markets for them.

Beside the question of accurate definitions, the sources of entrepreneurial opportunities are of particular interest. Drucker (1985, 1998) was one of the first scholars who dealt with this topic. He mentions seven sources of opportunities, four of them exist within a company or industry (unexpected occurrences, incongruities in demand and supply, process needs, industry and market changes) and three additional sources of opportunities exist outside a company in its social and intellectual environment (demographic changes, changes in perception, new knowledge). Shane and Venkatraman (2000) summarize these seven sources in three main categories:
(1) the creation of new information, as it occurs with the invention of new technologies; (2) the exploitation of market inefficiencies that result from information asymmetry, as occurs across time and geography; and (3) the reaction to shifts in the relative costs and benefits of alternative uses for resources, as occurs with political, regulatory, or demographic changes. A further explanation about the existence (or non-existence) of opportunities is provided by Sarasvathy, Dew et al. (2002), based on neoclassical, Austrian and recent research streams in economics (Buchanan and Vanberg 1991). According to the authors, opportunities are either recognized, discovered or created, depending on the maturity of markets and the degree of information completeness.

A third question addresses why and how certain people and not others identify and exploit entrepreneurial opportunities. Since Shane and Venkataraman (Venkataraman 1997; Shane and Venkataraman 2000) have defined the field of entrepreneurship as the scholarly examination of how, by whom and with what effects opportunities are discovered, evaluated, and exploited, the number of publications that deal with this topic has increased during the last five years. Accordingly, recent theoretical and empirical works are presented in the next two sections.

### 2.2.2 Recent Theoretical Works in Opportunity Identification and Exploitation

One main research stream about opportunity identification and exploitation is based on Austrian economics. The following works are especially based on Hayek’s (1945) notion of dispersed knowledge.

According to Shane and Venkataraman (1997, 2000), people discover opportunities due to idiosyncratic knowledge and specific cognitive properties. The two researchers offer two determinants of how opportunities are evaluated. First, they highlight the nature of the opportunity itself – meaning that entrepreneurs exploit those opportunities for which the expected profit is large enough to compensate for the opportunity costs of other alternatives (Casson 1982). Second, individuals may assess a given entrepreneurial opportunity based on individual differences in personality, experience, perception and optimism. Additionally, they mention two modes of exploitation. In particular, they address the question of when an opportunity is exploited by the institutional arrangement of the firm or when it is exploited via the market.
Eckhardt and Shane (2003) elaborate and extend the opportunity based theory of entrepreneurship. Their starting points are two criticisms of dominant theories of entrepreneurship. First, instead of examining possible stable personal characteristics of entrepreneurs, researchers should rather concentrate on entrepreneurial activities, which stem from episodic information. Second, they question the usefulness of equilibrium theories for entrepreneurship research. Furthermore, they describe several typologies of opportunities, such as opportunities that occur through changes in the value chain, from information asymmetries, or from exogenous shocks in the market.

Dew, Velamuri et al. (2004) propose an entrepreneurial theory of the firm, where dispersed knowledge leads to uncertainty, heterogeneous individual expectations, and new entrepreneurial opportunities. They argue that the different degrees of dispersed knowledge, uncertainty and expectations can explain whether opportunities are exploited by new or by established companies.

Based on Kirzner’s (1973) concept of alertness and on Hayek’s (1945) and Shane’s (2000) concept of dispersed and prior knowledge, Ardichvili, Cardozo et al. (2003) present a comprehensive opportunity model, in which personal traits, prior knowledge and social networks lead to entrepreneurial alertness and finally to entrepreneurial opportunities. In contrast to Shane and Venkataraman (Shane and Venkataraman 2000), the authors stress the development process of entrepreneurial opportunities, in which simple concepts are developed and progressed in a continuous, proactive process up to the formation of a business.

In a similar way, West III (2003) emphasizes the creation aspect of entrepreneurial opportunities. Based on asymmetric information and knowledge combined with information processing and network theory, West illustrates how entrepreneurs continuously transfer asymmetric information into asymmetric knowledge, through deliberate information acquisition and through iterative and reciprocal communication exchanges. The network is thereby a means to increase the information flow and to enhance the probability of identifying opportunities.

Kang and Uhlenbruck (2002) present a process framework of entrepreneurial opportunity exploration and exploitation, by applying a multiple theoretical perspective of social, social-information processing, resource-dependence, transaction cost, and strategy theories, in order to better understand and explain the multidimensional phenomena of entrepreneurial activities.
Moving from an information / knowledge based side of entrepreneurship research to a more cognitive perspective, which has its roots in the works of Kirzner (1973, 1979, 1985), Gaglio and Katz (2001) highlight the importance of entrepreneurial alertness, understood as a distinctive set of perceptual and information-processing skills, in the identification process of entrepreneurial opportunities. The two authors present a cognitive model, hypothesizing that people who have a particular schema of entrepreneurial alertness have a better ability to recognize change in the market, industry and socio-political environments than people who do not have them. Baron (2004) suggests that a cognitive perspective may help to answer central questions in entrepreneurship research. He indicates that the understanding of perceptual processes helps to understand how entrepreneurs recognize opportunities. Furthermore, he mentions regulatory focus and signal detection theory as further means of explanation (see also McMullen and Shepherd 2003). Ward (2004) relates the domains of cognition and creativity, until recently two distinct areas of research, arguing that novel ideas about opportunities stem from existing knowledge that is transferred by cognitive processes, such as conceptual combination and analogical reasoning.

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996 Lumpkin and Dess</td>
<td>The importance of entrepreneurial orientation in order to pursue business opportunities.</td>
</tr>
<tr>
<td>1997, 2000 Venkataraman; Shane and Venkataraman</td>
<td>Entrepreneurship research should be concerned with the identification, evaluation and exploitation of entrepreneurial opportunities.</td>
</tr>
<tr>
<td>1999 Timmons</td>
<td>The role of work experience in opportunity recognition.</td>
</tr>
<tr>
<td>2000 McGrath and MacMillan</td>
<td>The importance of the entrepreneurial mindset in identifying and exploiting entrepreneurial opportunities.</td>
</tr>
<tr>
<td>2001 Gaglio and Katz</td>
<td>Entrepreneurial alertness is the source of opportunity recognition.</td>
</tr>
<tr>
<td>2002 Kang and Uhlenbruck</td>
<td>A multi-theoretical process framework that focuses on the exploration and exploitation of entrepreneurial opportunities as well as on the existence of the entrepreneur.</td>
</tr>
<tr>
<td>2003 Ardichvili, Cardozo and Ray</td>
<td>A theoretical framework that explains opportunity identification with entrepreneurial alertness, prior knowledge, social networks and personality traits.</td>
</tr>
<tr>
<td>2003 Eckhardt and Shane</td>
<td>The importance of examining entrepreneurship through a disequilibrium framework that focuses on the characteristics and existence of entrepreneurial opportunities.</td>
</tr>
</tbody>
</table>
A multi-level frame is presented that focuses on information processing, asymmetric knowledge and networks as prerequisites in order to pursue opportunities.

Perceptual processes, regulatory focus and signal detection theory build the analytical core in order to explain the recognition of entrepreneurial opportunities.

An entrepreneurial theory of the firm that is based on dispersed knowledge. The dispersion of knowledge, uncertainty and heterogeneous expectations lead to different opportunities which will be exploited in new or existing firms.

Novel ideas about opportunities stem from existing knowledge that is transferred by cognitive processes.

Table 4: Recent theoretical works in opportunity identification and exploitation research

Other researchers have found further factors that influence the identification and exploitation of opportunities. Lumpkin and Dess (1996) highlight the importance of entrepreneurial orientation in order to pursue business opportunities. Additional factors include the importance of work experience (Timmons 1999), entrepreneurial mindset (McGrath and MacMillan 2000), or entrepreneurial intuition and foresight (Zahra 2002). Table 4 provides an overview of recent theoretical works in opportunity identification and exploitation research.

After a period of numerous theoretical works about opportunity identification and recognition, the number of empirical works in this area has recently increased. A more detailed overview is given in the next section.

2.2.3 Recent Empirical Works in Opportunity Identification and Exploitation

Based on existing theoretical works, most empirical papers deal with the role of information, knowledge, network and cognitive issues in the identification and exploitation process of entrepreneurial opportunities.

From a knowledge and information perspective, Shane (2000) shows how a technological invention is used in multiple opportunities, dependent on the entrepreneurs’ prior knowledge of work experience and education. Ravasi and Turati (2005) illustrate the learning process from vaguely defined identified opportunities to their exploitation. Although entrepreneurs often search for solutions to problems that are imperfectly defined, explore new technological applications that are not fully developed, and are often dependent on specialized knowledge from external actors,
entrepreneurs with related prior knowledge and active involvement in the process are better in assessing the commercial return and risks of new opportunities. Shepherd and De Tienne (2005) show that prior knowledge leads to the identification of more opportunities and on top of this to more innovative ones. They also demonstrate that prior knowledge has a moderating role between potential financial rewards and opportunity identification. Financial rewards have a stronger impact on individuals with less prior knowledge than for individuals with more prior knowledge to identify and innovate new opportunities. Cooper, Folta et al. (1995) examine how differently experienced entrepreneurs follow diverse search activities in order to identify new opportunities. Their results indicate that entrepreneurs with no entrepreneurial experience, on average, search for more information than experienced entrepreneurs. However, less experienced entrepreneurs, who venture in very new fields reduced their information gathering activities, whereas experienced entrepreneurs still show about the same intensity, regardless of whether they venture in familiar or unfamiliar domains. Kaish and Gilad (1991) examine differences in information seeking behavior between entrepreneurs and managers. Their findings indicate that entrepreneurs spend more time for information acquisition in their free time and through nonverbal scanning. Entrepreneurs pay special attention to risk cues, whereas managers invest more time in analyzing the economics of opportunities. Additionally, with increased success of opportunities exploited, entrepreneurs tend to reduce their search activities for new opportunities, whereas managers have not shown this tendency. Schatzel, Kiyak et al. (2005) illustrate how pioneering firms identify and pursue opportunities. Their results indicate that pioneering firms are more engaged in information exchange, such as exchanging information with other companies and stakeholders, participating in industry events and scanning activities. Additionally, pioneering firms proactively build competitive equity, in the form of a “high profile” role within their industry, by participating in industry forums, media coverage and management commentaries regarding market trends.

From an information-network perspective, Soh (2003) studies information acquisition about opportunities in networking alliances. He shows that firms improve their product performance by increasing the number of repeated partners and by increasing the centrality position in the network vis-à-vis their competitors in technology collaboration networks. Similarly, Sing, Hill et al. (1999) show the

---

5 Pioneering behavior describes the firm’s strategic posture and measures the degree to which a firm initiates competitive situations and is an early market entrant.
importance of the entrepreneur’s social network in identifying entrepreneurial opportunities.

From a cognitive perspective, Busenitz and Barney (1997) show that there is a difference between entrepreneurs and managers in large organizations with regard to their decision making processes. Entrepreneurs have generally more biases and use more heuristics in their decisions than managers. This can be related to the background that entrepreneurs often act in environments of high uncertainty and ambiguity. The described shortcuts in cognitive processes may help entrepreneurs to seize possible opportunities, for which the window of opportunity is short and for which valid and reliable data is rarely at hand. Keh, Foo et al. (2002) show how “illusion of control” and “the law of small numbers” are related to how entrepreneurs evaluate opportunities. Their results also indicate that risk perception mediates these causations.

Other studies have investigated the role of risks, growth aspirations, technological opportunities and environmental shocks. For instance, Mullins and Forlani (2005) examine different risk elements in entrepreneurs’ decision making with regard to new venture opportunities. They found that entrepreneurs are not so risk seeking as often assumed. In general, they prefer ventures with acceptable risks and high potential gains. However, their decision is influenced by the source of venture funding (own money versus investors’ capital). Wiklund and Shepherd (2003) show how entrepreneurs’ growth aspirations lead to increased firm growth. Moreover, the relationship between growth aspiration and growth is moderated by small business manager’s education and experience and it depends on the amount of new growth opportunities triggered through environmental dynamism. Additionally, Wiklund and Shepherd (2005) show the positive effects of entrepreneurial orientation of small business managers on firm performance, again, the availability of new opportunities and access to financial capital has a moderating influence (see also McCline, Bhat et al. 2000). Shane (2001) examines the effect of technological opportunities on new firm creation. He shows that the probability of the commercialization of new technological opportunities through new firm formation is dependent on the importance, radicalness, and patent scope of the opportunity. Sine and David (2003) show how environmental jolts trigger institutional change, which often results in new entrepreneurial opportunities.

The following table provides an overview of the main recent empirical studies undertaken in the area of entrepreneurial opportunity research.
<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Method / Data Collection</th>
<th>Sample</th>
<th>Statistical Analysis</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kaish and Gilad (1991)</td>
<td>Mail Survey</td>
<td>51 founders and 36 managers</td>
<td>Factor analysis</td>
<td>Entrepreneurs and managers exhibit different search behavior in the identification process of opportunities.</td>
</tr>
<tr>
<td>Cooper, Folta and Woo (1995)</td>
<td>Survey</td>
<td>1.176 individuals</td>
<td>Regression analysis</td>
<td>The study examines the role of entrepreneurs’ experience and applied search routines in order to identify opportunities.</td>
</tr>
<tr>
<td>Busenitz and Barney (1997)</td>
<td>Survey</td>
<td>124 entrepreneurs and 95 managers</td>
<td>Logistic regression analysis</td>
<td>An analysis of the differences in decision-making between entrepreneurs and managers in regard to opportunity pursuing.</td>
</tr>
<tr>
<td>Shane (2000)</td>
<td>Case study, archival data and interviews</td>
<td>Eight new business ventures</td>
<td>Text analysis / pattern matching</td>
<td>The role of prior knowledge as an antecedent in the discovery of opportunities.</td>
</tr>
<tr>
<td>Keh, Foo and Lim (2002)</td>
<td>Survey</td>
<td>77 firms of the top 500 SMEs in Singapore</td>
<td>Regression analysis</td>
<td>An investigation of the cognitive processes of entrepreneurs. Results indicate that illusion of control and belief in the law of small numbers are related to how entrepreneurs evaluate opportunities.</td>
</tr>
<tr>
<td>Choi and Shepherd (2003)</td>
<td>Experiment</td>
<td>55 entrepreneurs who started a venture in different U.S. incubators</td>
<td>Conjoint analysis</td>
<td>An examination of the decisions related to why entrepreneurs start to exploit their business opportunities. The results show that entrepreneurs are more likely to exploit opportunities when they have more knowledge about customer demand, possess more fully developed technologies, have greater managerial capabilities, and enjoy greater stakeholder support.</td>
</tr>
</tbody>
</table>

6 Small and Medium-Sized Enterprises
<table>
<thead>
<tr>
<th>Study Authors</th>
<th>Methodology</th>
<th>Sample</th>
<th>Data Collection Method</th>
<th>Analysis</th>
<th>Research Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wiklund and Shepherd (2003)</td>
<td>Longitudinal data set</td>
<td>326 CEOs’ of small businesses</td>
<td>Hierarchical regression</td>
<td>An examination of growth aspiration and of achieved growth and the moderating role of resources and opportunities.</td>
<td></td>
</tr>
<tr>
<td>Mullins and Forlani (2005)</td>
<td>Mail survey</td>
<td>75 experienced entrepreneurs</td>
<td>Logistic regression</td>
<td>An analysis of the influence of the suitability of entrepreneurs’ skills and their sources of financial funds, the entrepreneurs’ risk propensities and their perception of risk on new venture decision making.</td>
<td></td>
</tr>
<tr>
<td>Ravasi and Turati (2005)</td>
<td>Comparative case study, interviews</td>
<td>Two projects in one company</td>
<td>Grounded theory</td>
<td>Innovation in entrepreneurial ventures rests on self-reinforcing learning cycles that lead entrepreneurs to dedicate increasing resources to the exploration of opportunities.</td>
<td></td>
</tr>
<tr>
<td>Schatzel, Kiyak and Iles (2005)</td>
<td>Survey</td>
<td>265 top executives</td>
<td>Structural equation modeling</td>
<td>An examination of how pioneering firms, through their information exchange practices, identify pioneering opportunities.</td>
<td></td>
</tr>
<tr>
<td>Shepherd and De Tienne (2005)</td>
<td>Experiment</td>
<td>78 MBA students</td>
<td>Hierarchical regression</td>
<td>The study explores the impact of prior knowledge and financial rewards on opportunity identification.</td>
<td></td>
</tr>
</tbody>
</table>

Table 5: Recent empirical works in opportunity identification and exploitation research

2.3 Conclusion

This chapter has provided a short historical overview of the field of entrepreneurship research in general and of the role of entrepreneurial opportunities in particular. Based on the review of the predominant theoretical concepts and recent empirical studies conducted in this area, it was shown that different disciplines contribute to entrepreneurship research and that different levels of analysis are under investigation.

Against this background, this work will investigate more profoundly the phenomenon of opportunity identification and exploitation. Because entrepreneurial activities are a multi-dimensional phenomenon, the focus does not lie on one particular theoretical perspective, nor is the identification and exploitation of opportunities exclusively examined through one specific level of analysis, but rather

---

7 CEO stands for Chief Executive Officer.
the phenomenon is analyzed based on three case studies that show how three software companies identify, evaluate and exploit entrepreneurial opportunities. Consequently, the company cases are examined through different theoretical perspectives and through different levels of analysis. Thereby, a particular objective of this work is to engage in a dialogue with the works of Shane, Venkataraman and with authors who are in line with these two researchers.

Before this dialog is started in Chapter four, five and six, the methodological background of this study is presented in the upcoming chapter.
3 Methodology

After specifying the objectives of this work in the last chapter, this chapter shows how these objectives can be reached methodologically. Therefore, in a first part, the methods that are used in this work are illustrated. The case study approach forms the general frame for this study and, in particular, grounded theory as an important method for analyzing the interviews conducted, and the participatory research approach for increasing the validity and quality of the results is presented. In a second part of this chapter, the case design is explained, with focus on how the underlying research of this work began and how it was conducted. Furthermore, how and why the specific cases were selected is shown, followed by a short presentation of the main company cases. In a third part, the collection of the relevant data is discussed and the sources of the primary and secondary data are disclosed. Furthermore, the key categories and constructs in this study are defined and presented. In addition, it is explained briefly to what extent participatory research can contribute to the collection of relevant data. In the fourth part, the logic of the coding procedure in grounded theory and the logic of the replication approach in case study research are explained. Additionally, the question about when a qualitative study reaches closure is addressed. Finally, in a fifth part, insights and recommendations are presented with regard to how the quality of empirical qualitative studies can be improved.

3.1 Research Strategy and Method

In the present work, three research approaches were used to gather and analyze the data, namely the case study approach, grounded theory and participatory research. These are explained in detail below.

3.1.1 The Case Study Approach

The methodological frame of this study forms the multiple case study approach, which was used to determine the general research design as suggested by Eisenhardt (1989) and Yin (1984). According to Eisenhardt (1989), case study research focuses on the understanding of the dynamics present within individual settings. Different cases are treated as a series of independent experiments that confirm or do not confirm
emerging conceptual insights (Brown and Eisenhardt 1997). Furthermore, case study research may be helpful to find answers for new phenomena and to foster new theory building. With regard to the stage of research and theory building, Yin (1984) argues that case studies can be used in the exploratory phase of an investigation as well as for testing propositions. In particular, he mentions three conditions under which the case study approach is reasonable. First of all, case study research is a good means for dealing with “how” and “why” questions, because these questions are often concerned with issues that need to be traced over time. Second, case studies are preferred when investigations are conducted in contemporary events for which archival data is often rare. Third, the case study approach is useful when researchers have no control over the elements of the investigation, when they cannot manipulate the event as opposed to the case, for example, of laboratory experiments. Finally, a great advantage of case study research is the ability to deal with a full variety of evidence, such as documents, artifacts, interviews, videos and observations, and its flexibility to integrate other research methods (Larsson and Löwendahl 1995).

3.1.2 Grounded Theory

Within the case study approach, grounded theory was chosen and primarily used to analyze the data. Grounded theory (Glaser and Strauss 1967; Strauss 1987; Strauss and Corbin 1996) is a research method in which theory is derived from systematical gathering and analyzing of data throughout the whole research process. In other words, it is a method where data collection, data analysis and theorizing stand in close relationship to each other and where the researcher takes an active role in the interplay of data analysis and theory building. The term “grounded” thereby refers to the fact that the developed theory is grounded in the data at hand.

Hence, grounded theory lays particular emphasize on the procedure for analyzing the data. First of all, the data is analyzed through microscopic examination, meaning, for instance, the detailed, line-by-line examination of a piece of text. Furthermore, the different coding procedures are important tools of the analysis. In essence, relevant concepts are identified, their properties and dimensions determined, and the relationships between the concepts exposed. Finally, notions and insights gained throughout the coding procedures are recorded in memos and diagrams.

The grounded theory method has been developed over the years, because their founders had an interest in developing a methodology that was able to address and include a) the need to get out into the field to discover what is really going on; b) the
understanding of complexity and variability of phenomena and of human action; c) the belief that persons are actors who take an active role in responding to problematic situations; d) the assumption that persons act on the basis of meaning; e) a sensitivity to the evolving and unfolding nature of events; and f) an awareness of the interrelationships among conditions, action, and consequences (just to mention a few of the reasons, for a more detailed overview see Strauss and Corbin (1996: p. 9)).

3.1.3 Participatory Research as a Method of Increasing the Validity of Qualitative Research

Finally, participatory research is another research method that was integrated into the case study approach. Several researchers have suggested involving people from the researched companies in the research process (Whyte 1981; Calori 2000). In particular, the collected and analyzed data is regularly presented to the persons interviewed in order to get their feedback and to incorporate their comments in the further development of theoretical concepts. According to Buechel (2000), participatory research is based on the assumption of interpretative theory building. It is assumed that human understanding and actions are influenced by the interpretation of information and events that the members of the organizations researched have experienced. Thus, these interpretations are then used in the further research process, in particular for further analysis and theory building.

Calori (2000) considers the incorporation of practical knowledge as a useful contribution to theory building, as it can enrich existing mainstream economic and strategic theories. He further argues that participatory research can increase the validity of research studies, because the interviewed persons can actively and critically take part in the research process and contribute to the analysis of data. However, in order to avoid biases, it is important to triangulate data with other interviewees, documents and secondary data.

On the whole, the case study approach was used as the guiding procedure to select the cases, to conduct the research projects, and to organize the data analysis. Grounded theory was mainly used to analyze the interview texts and participatory research was mainly used to increase the validity of the research results.
3.2 Case Design and Case Selection

The case study design is important as it provides the researcher with a “road map” on how to conduct the research process. Additionally, in multiple case study research, the question about which cases to select and why is central. The most important aspects of these two issues are discussed in the following three sections, which end with a short presentation of the main company cases.

3.2.1 The Case Design

The case design was based on and adopted to the suggestions provided by Eisenhardt (Eisenhardt 1989) and (Yin 1984).

Initially, a review of entrepreneurship literature was conducted, with particular focus on how entrepreneurs and entrepreneurial firms identify, evaluate and exploit entrepreneurial opportunities and a first collection of constructs that play a role in this entrepreneurial process was drawn.

Within this initial theoretical frame, the overall objective was to conduct a multiple case study research and to select cases through theoretical sampling in a dynamic high-tech industry. In technology driven industries, the need to continuously recognize and exploit new entrepreneurial opportunities is of particular importance (West III and Meier 1997). Therefore, the software industry was chosen, and in particular, companies that were positioned in the high-tech segment of sophisticated software solutions and services.

First interviews were done with one selected company. Through these initial contacts, further company cases were identified and selected through theoretical sampling. Data gathering was combined with alternating data analysis. At the end, interviews were carried out with nine software companies, out of which three were chosen for the present multiple case study. Each of these three cases was first analyzed independently, and cross-case comparisons followed.

After an initial gathering of data and data analysis, first results for each of these three firms were presented in order to get the firms’ feedbacks. Further data gathering and analysis followed, which ended in a collective workshop with all three companies, in which parts of the research results were presented and further feedback was collected. Further results where discussed with each company individually and lastly,

---

8 Sampling on the basis of emerging concepts, with the aim being to explore the dimensional range or varied conditions along which the properties of concepts vary (Strauss and Corbin 1996: p.73).
the final draft of the work was submitted to the three CEO’s of the company cases for a final feedback.

3.2.2 The Selection of the Cases

In contrast to quantitative forms of research, in which a sample is chosen that represents a representative part of or the whole population (it is therefore called statistical sampling), in qualitative research the aim is to choose cases that replicate or extend an emerging theory. Yin (1984) describes two case selection strategies. Cases may be chosen in such a way that either similar results are achieved as predicted (literal replication), or that results are achieved that are different for predictable reasons (theoretical replication). However, the selection of certain broader samples or populations can also be useful in qualitative research, because it helps to specify the set of entities from which the cases are selected, it controls for certain environmental variation, and it helps to clarify the domain of the findings (Eisenhardt 1989). A formal rule for the selection of cases is given by Pettigrew (1988), suggesting that the cases should be extreme situations and of polar types, in which the event or process is well observable. The adding of new cases can be stopped at a point when theoretical saturation is reached, meaning that only incremental insights are gained from new case material (Glaser and Strauss 1967).

The first company that was selected is Adnovum, which produces sophisticated tailor made, large scale solutions on open standards for corporate companies. The focus on studying companies that carried out sophisticated, complex, individualized software solutions in order to research how firms identify and exploit entrepreneurial opportunities was chosen for several reasons. First, due to industry dynamics and the nature of their business, these companies are constantly forced to search for new project opportunities whenever projects were finished. Second, the realization of individualized software also means that new software “products” are constantly created. Third, the innovation cycles are short and ongoing, and fourth, the companies are constantly forced to be at the forefront with new technological software developments and technological competences in order to not be caught by the rolling wave of standardized software products. Therefore, through theoretical and linear sampling, two further companies, Ergon and Netcetera, which are also active in the market for individualized large scale software solutions, were added to the sample. An additional advantage of choosing the three software companies was that when the first interviews started in April 2001, all three companies were of similar size.
During the interviews, it was realized that the software industry was highly heterogeneous. Among the companies, there existed a rather fixed trichotomy of core activities. While firms, such as Adnovum, Ergon and Netcetera, were focused on the development and realization of tailor-made software projects, other companies focused on the production of standardized software products for the mass-market. And a third category was primarily active in software consulting without being heavily involved in the active development of software. Additionally, there was a high variance in the size of the companies active in the software market, reaching from very small companies, consisting of 1 or 2 persons, up to middle sized companies such as Adnovum, Ergon, and Netcetera with around 60-70 employees in 2000, to big software players that were active internationally. In order to obtain a better understanding of what differentiates the three initially selected companies from the other ones and in order to validate the data of the three cases, six further cases (Alpha, Beta, Gamma, Epsilon, Zeta, and Eta) of different activities, size and age were added. Two of those (Epsilon and Zeta) are active in software consulting, three (Alpha, Beta, and Gamma) build standardized software products and one company (Eta) is a big international player for software development. However, the six company cases were not studied longitudinally such as the other three main cases, but cross-sectionally. Key figures about the six complementary cases can be found in Table 6 (p. 34).
<table>
<thead>
<tr>
<th>Company</th>
<th>Founding year</th>
<th>Number of employees</th>
<th>Main Business Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha</td>
<td>2001</td>
<td>6</td>
<td>Internet based standardized software products for the health sector</td>
</tr>
<tr>
<td>Beta</td>
<td>2000</td>
<td>6</td>
<td>Standardized software components for Enterprise Application Integration (EAI)</td>
</tr>
<tr>
<td>Gamma</td>
<td>1996</td>
<td>15</td>
<td>Visual product selling software products</td>
</tr>
<tr>
<td>Epsilon</td>
<td>2002</td>
<td>3</td>
<td>IT(^9) security consulting</td>
</tr>
<tr>
<td>Zeta</td>
<td>1995</td>
<td>2</td>
<td>Technical consulting in digital communications and signal processing</td>
</tr>
<tr>
<td>Eta</td>
<td>1959</td>
<td>79.000(^{10}) / 700(^{11})</td>
<td>Software development and IT services</td>
</tr>
</tbody>
</table>

Table 6: Key figures about complementary company cases

### 3.2.3 A Short Presentation of the Three Main Cases under Investigation

Adnovum, Ergon and Netcetera are among the leading software companies for highly innovative and sophisticated individualized high-end software solutions in Switzerland. They have successfully carried out several challenging large scale IT projects for a wide range of corporate customers. When the interviews started in 2001, all three companies were primarily active for customers in the financial and telecommunication sector and all three companies have predominantly operated on open standard software platforms, such as Unix and Linux. A brief overview of the background of these companies is given below:

Adnovum Informatik AG was founded in 1988 by 5 students in information technology as a small Zurich-based IT company. The company was founded with the ambition to build a technology driven IT-firm, in which the engineering competence was at the core of the company. Adnovum is specialized in the evaluation, development and integration of secure Web applications and portal solutions. Tailor-
made intranet, internet and extranet solutions are developed in close cooperation with major financial service and telecommunications companies. Adnovum went through several growth stages and employed around 65 employees before the economic downturn in 2000. Nowadays, the number of employees has increased to 107 people. Most software engineers employed by Adnovum have a degree in software engineering from the Swiss Federal Institute of Technology (ETH) in Zurich. The company is organized in several associated companies, two of which are located abroad. One is located in San Mateo, California, and the other one is located in Budapest, Hungary.

Ergon AG was founded in 1984 by a banker and an IT engineer. Ergon is located in Zurich and has created engineering and coaching software projects with client, server and mobile technologies for a wide range of customers. After the initial starting phase, Ergon grew quickly from the mid nineties to a company with 60 employees at the beginning of 2000. Ergon is characterized by several pioneering activities. Amongst others, Ergon was the first Swiss-based authorized Java Center, it realized the first internet banking application in Switzerland and has dealt very early with mobile applications. Nowadays, Ergon has around 70 employees. Over 90 percent of the software engineers have a degree in IT from the Swiss Federal Institute in Zurich. The company is privately owned by the management and its employees.

Netcetera is the youngest of all three companies and was founded in 1996 by a small group of PhDs at the IT institute at the University of Zurich. From the beginning, Netcetera specialized in internet technologies and has been active in this area since, including intranet, extranet, e-commerce and e-payment solutions. Netcetera is further specialized in process engineering, conference and content management software solutions. The company used its IT competence during the internet boom and grew quickly to 70 employees. Netcetera is located in Zurich and has an associated company in Skopje, Macedonia.
3.3 Data Collection

There are many forms of how researchers can collect data. In this sub-chapter, it is shown what the primary and secondary data sources have been for this study. Additionally, the key categories and concepts used in this work are defined and it is shown how participatory research can contribute to the collection of relevant data.

3.3.1 Interviews and Documents as the Primary Source of Data

For the three main software companies, data was collected through interviews, company documents when available, company brochures, and secondary data. The interviews were carried out by means of a stratified sampling technique, in which different people with different functions were interviewed. These included the chairmen of the companies, the CEOs, the CTOs\textsuperscript{12} and COOs\textsuperscript{13}, software engineers and project managers. Overall, 16 persons were interviewed and 25 interviews were conducted across the three cases. In Adnovum, five interviews were conducted with the CEO, one with the COO, one with the CTO, one with a senior software engineer, one with a person from software documentation, and two with project managers. In Ergon, four interviews were held with the CEO, one with the Chairman, one with the CTO, one with a senior software engineer, and one with a further member of the management team. In Netcetera, three interviews were carried out with the CEO, one with the chairman, one with the CTO, and one with a senior project manager. All people have antecedently agreed to take part in the interviews. The interviews were open and semi-structured. They lasted between two and three and a half-hours and were recorded and transcribed. For all three firms, the transcribed interviews added up to 433 pages, containing around 320,000 words. The interviews were conducted by one or two researchers with individual respondents. Specific questions during the data analysis were asked and answered by email. The first interviews were started in April 2001 and were spread at regular intervals until June 2004.

The data collection in the three main cases took place along different time dimensions. In respect to the first research question in Chapter four about the relationship between prior knowledge, entrepreneurial opportunities and firm founding, retrospective data was gathered through interviews and documents. In order

\textsuperscript{12} Chief Technology Officer

\textsuperscript{13} Chief Operation Officer
to reduce possible biases, several people, who were involved in the start-up of the companies, were interviewed. These different sources, together with documents, were then used for data triangulation. With regard to the second research question in Chapter five about the different forms of asymmetric information and knowledge and the entrepreneurial opportunity process, retrospective data and real time observations (longitudinal, more than two points in time) were collected. Finally, with regard to the third research question in Chapter six about the influence of the economic and firm specific context on entrepreneurial opportunities and their innovation level, data was gathered retrospectively and longitudinally (real time observations) over a time horizon of three years.

The data collection for the six supplementary company cases took place during 2001 and 2003 and consisted of retrospective and cross-sectional data. Ten people were interviewed in eleven interview sessions. The interviews lasted between one and a half and three hours. All persons have antecedently agreed to take part in the interviews. Out of the eleven interviews, nine were recorded and transcribed, consisting of 130 pages (80,000 words) of transcribed data. Two interviews were not taped, but notes were taken by the interviewer.

3.3.2 Data Collection through Participatory Workshops and Meetings

Data was also collected in participatory workshops that took place at the companies’ premises or at the University of St. Gallen. In a first round in December 2001, workshops took place for each firm separately, where first results were presented and discussed at each company’s location. At the first workshop with Adnovum, five persons took part, consisting of the CEO, the CTO, the chairman and two researchers. The workshop lasted two and a half hours. In the workshop with Netcetera, eight people participated, consisting of the management team of Netcetera, its chairman and two researchers. The workshop lasted two hours. Finally, in the initial workshop with Ergon, around 40 people participated, consisting of the management team, most of the employees, and two researchers. The workshop lasted over three hours. In a second round in April 2004, a workshop was organized in Zurich with all CEOs of the companies and with three researchers of the University of St. Gallen. Comparative results of the first and second empirical chapter of this dissertation were presented and discussed. The workshop lasted three hours followed by a communal dinner. The three CEOs were then met one month later in individual meetings in order to verify and discuss conceptional parts of the second and third
empirical chapter. A final workshop took place at the University of St. Gallen in June 2005, where parts of the finalized empirical chapters were presented and discussed. Lastly, before the dissertation was submitted, it was sent to the CEOs of all firms for final feedback.

### 3.3.3 Secondary Data Sources

Secondary data was collected in respect of the software industry and the economic context. Data about the software industry was mainly collected through reports from specialized consulting companies, software associations, newspaper and media reports, and the Swiss Federal Office of Statistics. The Swiss Federal Office of Statistics also played a major role in gathering data about the economic context in Switzerland from 1996 until 2004.

### 3.3.4 Key Categories and Constructs Examined throughout the Study

The major categories, constructs and their dimensions, which where investigated during this study, are defined in the following. Some of them were already specified at the outset of the research setting, others where determined during the data analysis.

**Entrepreneurial opportunity**: In analogy to Shane and Venkataraman (2000), entrepreneurial opportunities are understood as those situations in which new, innovative goods and services are introduced to the market. In particular, entrepreneurial opportunities for the three software companies generally consist of project opportunities, in which new sophisticated tailor-made software products are produced for one specific customer and for problems, where no standardized solutions exist yet. In addition, entrepreneurial opportunities in the context of individualized software projects are further defined through their degree of technological innovativeness, in which new technologies, new technological procedures, or new combinations of already existing software components are used (see also Shepherd and De Tienne 2005).

**Entrepreneurial process**: Again, similar to Shane and Venkataraman (2000), the examined entrepreneurial process in this study consists of four mayor sub-processes. The first process is based on the conjecture, the finding out and the recognition of potential opportunities. A second sub-process is formed through the evaluation of the identified opportunities and of the involved customers. A third process comprises the opening up of potential and existing customers for which new entrepreneurial
opportunities can be carried out. A forth sub-process is composed of the execution of the entrepreneurial opportunity. This forth sub-process is particularly characterized through knowledge combination and reciprocal learning between the software companies and their customers. All four sub-processes contribute to the reduction of vertical asymmetric information and knowledge.

Asymmetric information: Asymmetric information in an economic context describes a situation in which one party has more information about economic transactions and actions than other parties. In this work, three major forms of asymmetric information are examined. First, vertical asymmetric information describes a situation where there exists an imbalance of information between software companies and potential customers. Second, horizontal asymmetric information describes an imbalance of information among competitors. Finally, longitudinal asymmetric information represents a situation in which neither software companies nor customers or other economic agents possess accurate information about certain future outcomes. This information has still to be produced in the future or it may already exist, but does not subsist in a form that is reliable, easily accessible or easily to interpret by economic agents.

Asymmetric knowledge: Asymmetric knowledge relates to situations where one party has more knowledge in a particular domain than other parties. In analogy to asymmetric information, three major forms are examined more closely, namely, vertical, horizontal and longitudinal asymmetric knowledge, whereas vertical asymmetric knowledge refers to an imbalance of knowledge between a software company and its customers; horizontal asymmetric knowledge refers to an imbalance in knowledge among competitors; and longitudinal asymmetric knowledge relates to situations in which no market player possesses accurate knowledge about certain aspects of technological and economic issues at a certain time. Therefore, specific knowledge is missing, inconsistent or contradictory and has still to be produced in the future.

The impact of the environment: The impact of the environment on the entrepreneurial process is measured in this study by the changing economic and technological context. In particular, the change of the economic and technological context between 1996 and 2004 and its consequences on how the examined software companies identify and exploit entrepreneurial opportunities is investigated.
The impact of the firm-level: Beside the impact of the environment, firm-specific characteristics and reasoning are examined in the context of why the three studied software companies moved in different directions and areas after the changed economic contexts. Several of these firm specific dimensions are explained in Section 6.2.3.

Furthermore, several other concepts and constructs used in this work, such as technological know-how, job related business know-how, the recognition of the commercial potential, firm founding, search for areas of application, and first projects are explained in the chapters and sections where the concepts and constructs are used.

3.4 Data Analysis and Theorizing

A very important part of every research is how the researchers arrive at new insights. This sub-chapter shows how the data were coded and analyzed and along which lines the whole research procedure took place.

3.4.1 The Coding of the Data

Grounded theory (Glaser and Strauss 1967) was the underlying method for analyzing the data. The transcribed interviews and documents were coded with respect to the main categories of interest, their properties, and their dimensions. Coding describes the analytical process through which data are fractured, conceptualized, and integrated in theoretical statements, models or frameworks. By coding the text, interesting questions arose and first provisional answers were given about interesting categories and their relationships. Certain core categories, which form the central elements of the present study, such as opportunity, information, and knowledge, were already known before the analysis started. Those were derived from the overall target of this study, which mainly lies in a dialogue about Shane and Venkataraman’s (Venkataraman 1997; Shane and Venkataraman 2000) findings. However, through the coding procedures a deeper understanding evolved about these categories and new categories were revealed, such as firm specific characteristics. Theoretical ideas about certain relationships were captured in memos or by writing comments directly into the text. The analysis of the data was a highly iterative process, going back and forth between data collection, coding, and memoing such as described by Strauss (1987). Therefore, empirical data collection and adjustments of theoretical conceptions almost occurred simultaneously. Again, the participatory research approach helped to test
certain propositions and in mutual meetings certain relationships between categories and constructs could be worked out. It was also a useful means to increase the validity of the findings.

The whole data analysis of coding, text search, linking and memoing was done with the help of QSR N5, a computer program for qualitative data analysis. QSR N5 is a toolkit designed for coding text documents and for analyzing and exploring within that coding. Furthermore, it helps to restore, structure, link and search for certain codes. It is also possible to query certain relationships between categories. Each coded text is specified through the time and place of the collected data, through the person who made the statement, and through the source of the relevant document.

3.4.2 The Replication Approach of Multiple Case Studies

For each analysis of the empirical chapters, the replication logic of multiple case studies was applied (Yin 1984; Eisenhardt 1989; Miles and Hubermann 1994). Every single company case was first analyzed independently from the other ones and only afterwards a cross case analysis was carried out. The underlying process is summarized in Figure 1 on the next page. In the within-case analysis, for each company upcoming notions, important categories, and first conceptional ideas were recorded with the help of the QSR N5 software and were written down in an individual case report. Although differences and similarities between the company cases were observed during the coding process, a deep comparison between the cases did not occur until the cross-case analysis (according to the “Prepare, Collect & Analyze” and “Analyze & Conduct” phase in Figure 1). For this reason, we also first organized individual workshops for each of the three companies before, in a second round, a comparative analysis was performed and results were presented in collective workshops. The QSR N5 software was again very helpful in making the cross-case analysis, because codes could easily be compared between the company cases.
3.4.3 Reaching Closure

Each single case was reviewed several times, theoretical concepts were refined, the level of abstraction was raised. The same iterations have been performed for the cross-case analysis. After each of the three empirical chapters in this work has been initially drafted, it was laid aside for a certain time and then reviewed again. Following this procedure, each chapter was reworked three times with temporal breaks between the reviews. Finally, the question was posed about when to stop the iterative process of data analysis. The answer is given by theoretical saturation (Eisenhardt 1989). As soon as the incremental improvements of the data analysis became minimal, the process of data analysis was stopped, and the main work was reviewed on a general level to draw conclusions about the findings.

3.5 Increasing the Validity and Reliability of the Case Study Method

Yin (1984) proposes four criteria against which to judge the quality of any empirical social research - grouped in validity (construct, internal, external) and reliability tests.
**Methodology**

*Construct validity* implies establishing correct operational measures for the concept being studied. This test is especially problematic in qualitative research, because there researchers generally attach less value to the operational measures. Additionally, certain constructs and categories have a subjective note, especially in interviews. However, construct validity can be improved by carefully describing the used constructs and categories (Chandler and Lyon 2001). Moreover, Yin (1984) suggests using multiple sources of evidence to build a sound chain of evidence, and finally, to have the work reviewed by the key informants. In this work, construct validity was addressed by giving careful descriptions and explanations of the core constructs and categories. Furthermore, the multiple case setting increased the sources of evidence for the core constructs. Finally, the work was distributed to the CEOs of the companies for review.

*Internal validity* measures whether causal relationships (inferences) are correctly identified. Therefore, this test is only meaningful for explanatory studies or studies that establish causal relationships. Yin (1984) suggests three techniques for how internal validity can be increased. The first one consists of “pattern-matching”, in which researchers make predictions about causations and try to confirm the prediction with accurate empirical data. The other two techniques he suggests are careful explanation-building and time-series analysis. The alternative models presented in Chapter 4 are not to be understood as real causal models but only as a description of how the three software companies were founded over the course of time. However, causations are established in Chapter 6, examining the impact of the economic and firm specific context on entrepreneurial opportunities. The internal validity in this case was increased by involving multiple respondents about the claimed causations.

*External validity* verifies to what extent study findings can be generalized. The lack of generalization is one of the most frequent criticisms of case study designs. However, this criticism is often misleading, because case study research does not *per se* claim to produce statistical results which can be generalized across a large population, but it relies on analytical generalization, meaning that identified results in a certain context contribute to a broader theory. Nevertheless, one means to improve external validity is the use of multiple cases, which allow for replication of the findings. Furthermore, Eisenhardt (1989) recommends the inclusion of literature with similar findings, also from other scientific fields if possible, in order to strengthen the credibility of generalization. But he also recommends the examination of literature that conflicts with the evolving theory, for two reasons. First, not doing so reduces the
confidence in the findings. Second, conflicting theories lead to the question of why these conflicts occur and their inclusion can therefore point to the limits of generalization of the author and the rival theory.

Finally, reliability controls whether a later investigator, who follows exactly the same procedures as the initial researcher, comes to the same findings and conclusions. To ensure reliability, it is necessary to document and describe carefully how the case studies were conducted. Additionally, the data material that was used for the cases should be archived. In order to increase the reliability of the results, I tried to outline the methodological background, the case design, the selection of the cases and the cases themselves, the collection and analysis of the data in such a way that the reader has an understanding how this research was done. Additionally, I archived all collected and analyzed data, as well as the coded data in QSR N5.
4 Prior Knowledge and Business Opportunities

Prior knowledge is often quoted both by academics and practitioners to be an important factor in order to recognize new entrepreneurial opportunities.\textsuperscript{14} Shane (2000) has presented an insightful conceptual model of opportunity recognition, emphasizing important aspects of how entrepreneurs recognize opportunities based on prior customer and market knowledge. However, without questioning the important impact such prior knowledge can have on opportunity identification, there are also alternative cases, in which entrepreneurs cannot revert back to prior knowledge of customers and markets. Common examples for such cases are university spin-offs, where academics try to turn their research results into a business or companies founded by young people who have just finished their university or education. In all of these cases experience in markets and with customers is only very limited or even non-existent. Nevertheless, sufficient successful examples show that they can find entrepreneurial opportunities as well. It is therefore of interest to analyze such cases in more detail in order to understand potential additional factors that enable entrepreneurial opportunity identification if prior knowledge as described by Shane is not, or only to a very limited extent, available.

Therefore, in this chapter the implications of Shane’s model will be compared with the empirical findings of three Swiss based software companies and results will be discussed in light of potential additional factors that impact the identification of entrepreneurial opportunities. In order to enable a comparison, the three companies were chosen based on the availability of data about their start-up phase and due to their technological background, because the cases presented by Shane are technology driven start-ups as well. In particular, he examines how technological innovations create new entrepreneurial opportunities, presenting several examples of start-ups that recognized multiple opportunities from one single technological innovation.

In general, the structure of this and the following two chapters (Chapter 5 and 6) consists of three parts. In a first part, the theoretical framework is derived, in the second part, the empirical results of the three software companies are presented, and

\textsuperscript{14} Prior knowledge refers to knowledge people have already possessed before they recognize an entrepreneurial opportunity.
in the final part, based on the comparison between the theoretical and empirical part, certain identified differences are discussed in detail. Consequently, in the first part of this chapter, Shane’s model is revisited and discussed in detail, with the aim of setting the theoretical framework and understanding for the subsequent discussion. In particular, the role of prior knowledge in recognizing entrepreneurial opportunities is elucidated. The second part consists of an empirical analysis based on the cases of the software firms. The main focus is on how they got started, how they gained their first projects and an illustration of their technological background is given. In particular, several aspects such as the prehistory, the founding of the firm, the first projects and the technological background are examined in depth in order to obtain a better understanding of the business formation process. The third part encompasses a discussion which links the theoretical and the empirical part. It is a deeper investigation of how much prior market and customer knowledge the cases examined possessed at their outset and what other elements played a role in the business formation and opportunity identification process. It will be shown that the three software firms only had a limited amount of prior knowledge about customers and markets at their outset, but that their technological competence stood at the core and enabled them to gain new customers. Based on these insights two alternative models are suggested. Finally, further facets are discussed, which are not considered in the models due to conceptual parsimony but which nevertheless play a significant role in the firm formation process. The role of the university context, the function of the entrepreneur and behavioral aspects are highlighted.

4.1 Theoretical Background

Technological changes and development are sources of new entrepreneurial opportunities that unfold by applying new technologies to different areas. However, before these new technologies can be utilized, these entrepreneurial opportunities of exploitation must first be discovered (Shane 2000).

In this respect, Shane (2000: p. 451f.) asks the question, why some entrepreneurial opportunities are discovered by certain people and not by others? One main argument is that people possess idiosyncratic information. According to Shane, this information can stem from various sources such as life and work experience, education or even blind luck. According to this concept, people then recognize those opportunities that are related to information they already possess. This type of information is called by
Shane prior information or prior knowledge. Prior information and prior knowledge are synonyms in Shane’s understanding.

One key characteristic of prior information and knowledge is that they are more a stock than a flow dimension. This stock of prior knowledge influences the entrepreneur’s ability to interpret, comprehend and apply new information. Consequently, if the same piece of new information is given to several entrepreneurs it is likely that they will discover different entrepreneurial opportunities, based on their different stock of prior knowledge.

According to Shane (2000: p. 452), there are three major dimensions of prior knowledge which trigger the discovery of new entrepreneurial opportunities, namely prior knowledge of markets, prior knowledge of ways to serve markets, and prior knowledge of customer problems.

4.1.1 The Importance of Prior Market Knowledge

The combination of existing market knowledge and new information can lead to novel insights and to the discovery of entrepreneurial opportunities. A person with prior market knowledge can easier evaluate the potential of new technologies in an existing market than a person without it. Important prior market knowledge may consist of information about suppliers, manufactures, customers, marketing and funding aspects.

Shane (2000) illustrates his claims on the basis of eight cases where different entrepreneurs use a new technology invented at the Massachusetts Institute of Technology (MIT) to found firms and exploit opportunities in different areas. This new technology, which is called three-dimensional printing technology (3DP\textsuperscript{TM})\textsuperscript{15}, enables the efficient production of three dimensional components made up of powder components very efficiently. Shane’ cases illustrate that the same technology is applied eight times differently depending on the entrepreneurs’ prior knowledge of markets and customers.

One founder, for example, enters into a specific market because of his prior work experience as a supplier for the car industry. He learned on his previous job that car manufactures make thousands of models and prototypes of metal parts. He therefore

\textsuperscript{15} The three-dimensional printing (3DP\textsuperscript{TM}) process is a patented manufacturing technology, invented at MIT in 1989 by four faculty and doctoral students under the lead of Professor Ely Sachs.
uses the new 3DP technology to make ceramic molds directly from a CAD\textsuperscript{16} model using a special powder and binder without the need for the usual wax castings which makes the whole process much more efficient.

Complementary new information about a technology and prior knowledge about specific markets can therefore culminate in new entrepreneurial opportunities. Shane (2000: p. 452) summarizes the relationship between prior market knowledge and entrepreneurial opportunities in the following proposition:

Proposition 1: People’s prior knowledge about markets will influence their discovery of which market to enter to exploit a new technology.

4.1.2 The Importance of Prior Knowledge of How to Serve Markets

“New information about technology might be complementary with prior information about ways to serve markets, leading to the discovery of the entrepreneurial opportunity to require prior information about these processes”. What does Shane (2000: p. 452) mean by this sentence? He suggests that if an entrepreneur gets new information about a technology and if this information is related to his existing knowledge of how to serve specific markets, the entrepreneur’s ability to recognize an opportunity in a new technology might be enhanced.

Shane defines the outcome of the newly discovered entrepreneurial opportunity in rather broad terms and does not specify very precisely what he means with the expression “to serve markets”. Instead he cites several examples showing in which respect prior knowledge of how to serve markets and new technologies can be used to create new products or services. One possibility might be that the production process changes, a new method of distribution is introduced, new sources of supply are generated or more generally speaking, new ways of organizing are found. This indicates that in Shane’s considerations serving the market includes not only sales and marketing activities, but production processes as well.

Shane also bases his claims on a study by Aldrich and Wiedenmayer (1993) in which they show that entrepreneurs use their prior work experience when they establish their own firms. Forms of new organizations, product and service lines are related to the organizational units in which they previously worked.

\textsuperscript{16} Abbreviation for Computer Aided Design. CAD is a software program used to design plans and help engineers with different design projects.
As an illustration, one entrepreneur of Shane’s examined start-ups began to produce pills with a superior microstructure. Thanks to his former experience in the pharmaceutical industry, he has a neat understanding of how markets are served that depend on governmental approval, such as that from the American Food and Drug Administration (FDA). He knows especially which materials the FDA would accept in order to produce his drugs with the 3DP\textsuperscript{TM} machine.

The relationship between a new technology and prior knowledge of how to serve markets are summarized in Shane’s following proposition:

*Proposition 2: People’s prior knowledge about how to serve markets will influence their discovery of how to use a new technology to serve a market.*

### 4.1.3 The Importance of Prior Knowledge of Customer Problems

New information about a technology that is related to prior knowledge about a customer problem might help the discovery of new entrepreneurial opportunities. Without knowing a specific problem, it is not necessarily straightforward to recognize possible application areas of a new technology. Having prior knowledge of customers’ problems makes it easier for entrepreneurs to evaluate and identify the usefulness of new technologies. However, the help from customers in this process is often limited because they sometimes have difficulty themselves to clearly articulate their problems or their needs for not-yet-developed solutions (von Hippel 1994).

Entrepreneurs often found firms based on customer problems they learned about in their previous employment. Often, the former employer could not, or did not want to deal with that specific customer problem, or he dealt with it but not well. This could provide the opportunity for the entrepreneur to start his own business.

Utilizing new technologies to meet customers’ needs may contribute to increased speed and lowered costs. For example, Shane (2000: p. 463) describes a case, where a company is founded to manufacture a fast, inexpensive, office compatible machine to make three-dimensional concept models for engineering and architectural design by using the new 3DP\textsuperscript{TM} technology. The machine is 20 times faster than any other procedure and uses less expensive materials. The efficiency gain could be obtained due to the prior knowledge of one founder, because in his work he often dealt with the ingredients of computers and printers and due to his education in materials science.

The relationship between a new technology and prior knowledge of customer problems is summarized in Shane’s following proposition:
Proposition 3: People’s prior knowledge of customer problems will influence their discovery of products and services to exploit a new technology

4.1.4 Shane’s Conceptual Model of Prior Knowledge

The influence of prior knowledge on opportunity recognition as suggested by Shane (2000) is summarized in Figure 2. The model describes the relationship discussed above between technology and opportunity recognition. Prior knowledge about markets, about how to serve markets and about customer problems moderates this relationship. The moderation effect is nothing else than an interaction effect in multi regression and causal analysis models (see Allison 1999; McClendon 2002). The moderation effect indicates that the effect of one variable depends on the level of another variable. In the context of Shane’s model this means that the effect of technological invention on opportunity recognition depends on the level of prior knowledge. The more prior knowledge an entrepreneur has the more likely it is that he recognizes entrepreneurial opportunities when a technological invention has occurred preliminarily.

The model also illustrates that prior knowledge moderates the relationship between opportunity recognition and how the entrepreneur chooses to exploit the opportunity. Interestingly, Shane does not say a lot about this issue, but the meaning is again, that the effect of opportunity recognition on how the opportunity is exploited depends on the level of prior knowledge. What does this mean? Shane does not intensively elaborate on it. However, a concise description of what an approach to exploitation could mean can be read in two previous papers (Venkataraman 1997; Shane and Venkataraman 2000).

---

17 For example, suppose we want to measure the side effect of a drug’s dosage. We might expect that the effect of the dosage might depend on the level of another variable, for example gender. Given the same dosage, the side-effects may be different for men and woman. Therefore, we can say that gender moderates the relationship between dosage and side-effects.
In the latter paper, Shane and Venkataraman describe two major institutional arrangements for the exploitation of entrepreneurial opportunities. On the one hand, the exploitation of the opportunity can be realized by the creation of new firms, which is a form of hierarchical organizing. On the other hand, the opportunity can be exploited by selling the perceived opportunity to existing institutions, which is consistent with the law of markets. In his fundamental paper of the distinctive domain of entrepreneurship research, Venkataraman (1997) sketches the meaning of these two different modes in more detail. For example, he elaborates about different institutional forms, such as the creation of new firms, franchise or license arrangement, joint ventures or simple contractual arrangements.\footnote{According to Venkataraman (1997), three broad categories of theories deal with the question of how to exploit opportunities. One category focuses on cost aspects, such as transaction and agency cost theories. One emphasizes speed and market power, such as theories of strategic behavior. The last category highlights appropriability, such as the resource and capability view of the firm. Venkataraman suggests a more integrated view of these broad categories for entrepreneurship research, because in reality, the exploitation of opportunities is often a trade-off between costs, speed and the protection of knowledge.}

Figure 2: A conceptual model of prior knowledge
4.1.5 Some Open Issues

Although the insights of Shane’s model are very valuable, there are some open issues I would like to address.

First of all, Shane’s previously discussed model is closely related with firm foundation, as his eight examined cases in his study indicate (Shane 2000). Even though in his and Venkataraman’s layout of an entrepreneurial framework, they expound that their interest is broader than just firm creation (Shane and Venkataraman 2000: p. 219). However, the question is raised to what extent Shane’s model can be generalized. How far can his conceptual model be applied as a general model to young companies that deal with technological innovation and entrepreneurial opportunities? In order to get some clarity with regard to this question, I empirically examine how three software firms come into existence and how they dealt at the outset with entrepreneurial opportunities. I especially highlight their prehistory, the founding process, the acquisition of the first software projects and their technological background in more detail.

Second, the existence of prior knowledge in respect of markets, how to serve markets, and customer problems is revisited. Shane assumes that this specific prior knowledge is an important prerequisite in order to recognize entrepreneurial opportunities in a business context. Shane (2000: p. 449) states that “any given entrepreneur will discover only those opportunities related to his or her prior knowledge” and therefore “entrepreneurs can and will discover these opportunities without searching for them”. The question is posed of how rigidly these statements have to be accepted. Can, for example, opportunity identification and entrepreneurship still be possible, if this kind of prior knowledge is not fully at hand at the outset? The next sub-chapters and sections will deal with these open issues.

---

19 Based on Shane and Venkataraman’s (2000) definition of entrepreneurship “we define the field of entrepreneurship as the scholarly examination of how, by whom, and with what effects opportunities to create future goods and services are discovered, evaluated and exploited”. 
4.2 Empirical Findings

Beside the analysis of the prehistory of each software company, further examinations are done in respect of the founding of the companies, in respect of how the companies gain their first projects and customers and in respect of their technological background and understanding.

4.2.1 The Prehistory of the Companies

In this section, the prehistory of each of the three company cases is presented. The objective of this analysis is to understand the starting position of each company and also to get an understanding of the background and motives of the people involved before firm formation. Each firm’s prehistory is discussed in alphabetical order, starting with Adnovum. Statements relating to the prehistory of the three companies can be found in Table 7 at the end of section 4.2.

Adnovum: The founder of Adnovum, Stefan Arn\textsuperscript{20}, started his career with an apprenticeship as a laboratory assistant in a large Swiss pharmaceutical company. He gained his first minor experiences with software programming by dealing with equipment for gas chromatograms. During the four years he worked as a laboratory assistant, he realizes that being employed for a big company is not what he is aiming for. Therefore, he decided to obtain qualifications by returning to his studies. After finishing, he decided to study computer science at the ETH in Zurich. His studies advanced rapidly and at the end of the second semester, he was asked by the Institute of Agriculture to code a software program that controls a photometry process in order to measure the starch of potatoes. During the summer holidays he accomplished this task and earned his first money by software programming.

Ergon: After finishing secondary school, Theodor Graf\textsuperscript{21} made an apprenticeship in a bank and became a bond trader. Beside his job he attends evening school for adults. There he gets to know to Christian Juon, who was his young EDP\textsuperscript{22}-teacher. Christian Juon himself learned typesetting, studied evening classes as well and graduated with distinction in IT at the ETH. During the EDP classes, Theodor Graf recognizes Christian Juon’s IT-competence just by comparing the difference between what is

\textsuperscript{20} CEO Adnovum
\textsuperscript{21} Mr. Graf is the current CFO and Chairman of Ergon.
\textsuperscript{22} EDP means electronic data processing.
done in the banking IT-context and what would theoretically be possible. This gap leads him to the idea of starting a company.

**Netcetera:** The prehistory of Netcetera begins at the University of Zurich, at the IT Institute in the early nineties. Beside their dissertations, PhD students are also responsible for the maintenance of the IT-network. The institute still pursues local IT-solutions. The PhD students decided to integrate the systems, also using internet technologies. As a consequence, several web-applications are developed between 1992 and 1994. For example, they setup the first web-server at the university and they create an internet based administration tool. Although the internet is a common topic at the institute, the internet is still a new technology to the Swiss public. In 1994, one of the PhD students, Andrej Vckovski\(^{23}\), attended some academic conferences in the United States. He is astonished and impressed about the extent to which the internet is already used in daily commercial activities in the United States.\(^{24}\) On television and radio channels, for example, advertisements are broadcast and are underlaid with web-addresses\(^{25}\). Before his journeys to the United States, Andrej Vckovski has thought that the internet mainly applied in the scientific world. After coming back, the American experience is discussed among the PhD colleagues and they start to believe in the commercial potential of the internet. They conclude that they should do something similar, using the abilities they have acquired at the university.

### 4.2.2 The Founding of the Firms

After the prehistory, this section focuses on the formation process of the companies. The main focus is laid on how the decision to establish a company and who is involved in the formation process. Statements referring to the founding of the firms can again be found in Table 7 at the end of section 4.2.

**Adnovum:** At the end of the second year at university, Stefan Arn has some time left and he begins to work as a student apprentice in several local software firms. The firms he saw are not really in accordance with his notion of a software engineering company. He realizes that the software development process is very dominated by

---

\(^{23}\) Mr. Vckovski is the current CEO of Netcetera.

\(^{24}\) Just to mention a few examples: in 1992 the World Bank comes on-line. In 1993 InterNIC provides specific Internet services, such as public information regarding internet domain name registration. Also the US White House, the United Nations come on-line and the first shopping malls arrive on the Internet (source: http://www.zakon.org/robert/internet/timeline/).

\(^{25}\) Using the Internet, a web address leads the user to a specific homepage. Well known web addresses are for example: http://www.google.com or http://www.amazon.com.
other functions such as sale, marketing and finance. The creator of the software, the software engineer, is very often marginalized. Hence, Stefan Arn decides to start his own software firm in which software engineering should be at the core. On a warm summer evening he invites four of his colleagues from the ETH for dinner to his place and he convinces them to start a company. In summer 1988, Adnovum is founded. With the money earned from the ‘potato’ project, Stefan Arn buys the first computers for the company.

At the very beginning, Adnovum is located at Stefan Arn’s home. But shortly after incorporation, they move to a small flat in the city of Zurich. While they attend classes at the university during the day, they work for the company at night. During the fifth and sixth semester, Stefan Arn has to do an industry internship. He starts to work in the IT department of a bigger company. There he gets to know Matthias Loepfe, who has recently completed his studies as an electro engineer at the technical college of Rapperswil. They spend a lot of time together and discuss about software engineering problems. Stefan Arn realizes how talented his working colleague is. Hence, he tells him about the newly founded company and asks him if he would like to join. Matthias Loepfe agrees and quits his former job, although Adnovum does not pay any wages to anybody initially. Everything which is earned during the first year is invested in new computer equipment.

**Ergon:** As a bond trader, Theodor Graf knows how arduous it is to collect and compare specific bond related information. For example, when a customer wants to sort and compare bonds by ratings, profitability, maturity and so on, it was, at that time, necessary to make print-outs on paper and collect the information manually. As a consequence, Theodor Graf had the idea to write a computer program, called ‘bondfinder’, which finds and sorts bonds by certain criteria and prints out summary information. He presents a software specification to his employer who is interested in the program and is willing to pay 70’000 CHF. Thereupon, Theodor Graf suggests to his EDP teacher, Christian Juon, starting their own company and implementing the project within it. After thinking about it for an hour, Christian Juon agrees. Ergo, Ergon is started in 1984. Theodor Graf is responsible for the commercial side, Christian Juon for the technological side. While Theodor Graf works during the day in

---

26 Matthias Loepfe was CTO of Adnovum.
27 Rapperswil is a small and picturesque town at the northern end of Lake Zurich.
28 At that time a complete Sun computer workstation costs around 80’000 CHF.
29 Swiss Franc (currency)
Chapter 4

the bank, he attends school and works for Ergon in the evening. Christian Juon stops working as a teacher and fully concentrates on Ergon. After a while, Theodor Graf completes evening school and starts studying business administration and IT at the University of Zurich. During the first year of Ergon, as at Adnovum, all the earnings are reinvested in the company.

Netcetera: One of the PhD assistants works part-time in the IT-department of a big Swiss bank. He becomes aware that the bank plans to organize a seminar for its managers concerning the novel internet technology and is therefore looking for knowledgeable speakers who can organize the seminar. As a consequence, the small group of PhD students applies and obtains the organization of the seminar. This, in essence, forms the kick-off for Netcetera in 1995, although not yet as an incorporation, but as a simple business partnership. Shortly after the acceptance for the seminar, the five colleagues are asked by three leading multinational IT and computer companies to technologically setup an internet cafe at Orbit, the biggest annual computer fair in Switzerland. People with the necessary competences in that area were at that time still hard to find – even in big multinational technology firms. At the Orbit fair, the five colleagues use their mandate also to present themselves by distributing their first brochures. Afterwards, they start to concentrate their activities more and more on the company and in early 1996, Netcetera is transformed from a partnership into an incorporated company.

4.2.3 The First Projects

As we will see in Chapter 5 in more detail, it is often very difficult for young firms to find their first customers. This section describes how the three software companies gain their first projects and customers. The succeeding passages serve as an illustration of how and which entrepreneurial opportunities are acquired and pursued by the three companies at their outset. The cases are again treated in alphabetical order. Statements illustrating the acquisition of the first projects can also be found in Table 7 (p. 62).

Adnovum: At the beginning, the question about potential target clients for Adnovum was open. Stefan Arn knew several people in the graphical industry, such as advertising agencies and typesetters. In the mid-eighties, the graphical industry was growing. People working there are unconventional and are disposed to give a chance to a young company, with little or no reputation. However, the first orders are not big software engineering projects, but mainly hard- and software installations, training
and smaller software projects, such as a work order or time recording application. For instance, Adnovum installed Macintosh computers in more than sixty advertising agencies and typesetter enterprises. Although Adnovum intends to pursue interesting software engineering projects as its core activity, the installation and training orders are accepted to generate a positive cash flow for the company. Besides, Stefan Arn is keen to increase the percentage of pure software engineering projects.

*Ergon:* As already mentioned, Ergon’s first project was the ‘bondfinder’. After this initial project, several smaller projects were acquired. Then, Theodor Graf gets to know Patrick Burkhalter, who also studied IT at the University of Zurich. During two lectures, Patrick Burkhalter suggests to Theodor Graf their writing a semester assignment together. Patrick Burkhalter has established a contact to a middle sized commercial firm for raw-materials. The company suffers from an obsolete salary accounting system and is therefore looking for a new one. At that time the number of companies that can provide a standardized program was still only very limited. SAP already existed, but focused mostly on bigger enterprises. Firms such as Abacus, Sesam, and Dialogik are just about to be or have not yet been founded. Therefore, the raw material company decides to build an individualized solution together with Ergon. While Patrick Burkhalter takes care of the coding part, Theodor Graf deals with the software specification and its legal aspects. In less than half a year the software is finished and accredited by SUVA. After the project was finished, Patrick Burkhalter continued to work for Ergon in addition to his studies.

*Netcetera:* After the bank seminar for managers and the technical operation of the internet café at the Orbit fair, Netcetera was looking for a reference project, in which they could prove their IT competence and demonstrate what the internet is and what its possibilities were. There is still an extensive need for explanations. Therefore, they were looking for a show case that was understandable for everybody. They came up with the idea of an online pizza ordering system, where people made their orders via

---

30 After three years of developing time, SAP Corporation introduces its personnel management system in 1986 and one year later, SAP broadens its products for mid-sized companies with yearly revenues between 30 and 200 million DM.
31 www.abacus.ch
32 www.sesam.ch
33 www.dialogik.ch
34 SUVA is the most important carrier of obligatory accident insurance in Switzerland. Suva insures over 1.8 million employees in over 100,000 companies against occupational and non-occupational accidents as well as against work-related illnesses. Suva also provides services such as the verification of salary management systems.
the internet. Consequently, several pizza couriers were contacted and finally an interested owner of a small pizza chain was found in 1995\textsuperscript{35} As the skepticism for the Internet was still high at that time, Netcetera offered the courier the whole project for free. Within two months of completion of the project a substantial percentage of the pizza courier’s revenue was already being generated via the internet.

Working at Orbit, together with the pizza courier project had some impact on the following activities of Netcetera. First, they were asked by one of the three big IT firms from the Orbit fair to install firewalls\textsuperscript{36} based on a contractual arrangement. During 1996, Netcetera installs several firewalls for different customers. Second, the online ordering for the pizza courier generated a positive feedback in the market and Netcetera immediately received several smaller web-based projects, for example, for a car importer.

Soon afterwards, Netcetera becomes aware of a bank that is interested in creating a web-based customer interface. The bank plans a comprehensive marketing campaign for young people, which includes brochures, placards, flyers and also an internet based market appearance. Netcetera competed for the internet project together with other firms and finally won the contract which is a big success for the young company. At that time, banks are considered as extremely conservative in placing orders with young firms.

### 4.2.4 The Technological Background

In Shane’s (2000) framework technological change is analyzed in relation to a specific technological invention, namely the “Three Dimensional Printing Technology”. In order to get a better understanding of the technologies used by the three software firms, why they decided for certain technologies, and in which general technological settings they steered at the beginning of their existence, the technological background is described in the next sections. Our three cases are described according to their age, starting with Ergon, because technological change is time dependent.

\textsuperscript{35} The pizza chain is the market leader in Switzerland today. The chain is located in more than 10 cities and agglomerations.

\textsuperscript{36} A firewall is a software utility and/or hardware device that limits outside network access to a computer or local network. Firewalls are commonly a great step for helping prevent un-authorized access to a company or home network.
Prior Knowledge and Business Opportunities

Ergon: The founders and the very first employees of Ergon knew Unix\textsuperscript{37} from the university (ETH) in the mid eighties. Unix was still a very new IT-technology in the business world at that time. Nevertheless, the people of Ergon were fascinated by its open system character\textsuperscript{38}. Unix was considered as an attractive system for software engineering. It provided new possibilities, which were not available with other systems. The decision of Ergon to work with Unix was not driven by the question of whether there existed a market for Unix-based solutions, but rather by the technological qualities and advantages of Unix. They supported Unix because they believed in these qualities and they hoped that they would be able to convince some customers about those and therefore to create Unix-based projects.

However, in the beginning it proved to be rather challenging for Ergon to find these customers. It was difficult to convince potential customers to implement a Unix-based solution due to its newness. The following anecdote illustrates this. Ergon has the chance to speak with the head of the IT department of a large Swiss bank. After five minutes, the presentation is finished and they are standing again outside in the corridor of the IT-head’s office. He has just told them that they should forget Unix, because it is not a safe system and therefore, it would never be used in the bank. Today, the bank uses more than one thousand Unix-based servers\textsuperscript{39}. Of course, these experiences also triggered doubts for Ergon on whether they were still on the right track. But they were still convinced about the qualities of Unix and if they could find some customers they decide to stick to it.

Adnovum had a preference for the Unix operating system as well. Stefan Arn had encountered Unix at different occasions. He heard about it from colleagues at the

\textsuperscript{37}The UNIX computer operating system (Unix is not an acronym) was developed by some of the members of the Multics team at the Bell Labs starting in the late 1960's. The same team also helped creating the C programming language. The UNIX system today, however, is the not just the work of a couple of programmers. Many other organizations (e.g. Sun Microsystems), institutes and various other individuals contributed significant additions to the system we know today (see also http://www.bell-labs.com/history/unix/#).

\textsuperscript{38}The term open system is used to describe a system or technology that is not proprietary to one company and describes a system or technology which can be accessed and modified by all users. Therefore, open systems increase the user’s flexibility.

\textsuperscript{39}A server is a computer connected to a network that other computers may or may not access. Unlike other computers on a network, a server is a dedicated computer setup for one or more purposes. For example, a user may set up a server to authenticate and allow or prohibit users from accessing a network, and/or a server may be set up to manage print jobs, and/or host a website. Because servers commonly serve a high need they often are running all day and night, and when they fail it commonly causes the network users or company significant problems. Some server failures can cause a company and its employees to come to a complete halt in their work until the servers are reactivated again. Because of their important role servers are commonly high-end computers and are set up to be fault tolerant.
university and the ETH was buying Sun computers around the time he attended the university. One colleague also lent him a SUN computer, which was worth a small fortune at that time. Hence, Stefan Arn had the opportunity to ‘hack’ around and to become familiar with Unix. Based on these first experiences he concludes that Unix was a highly performing operation system, with professional tools and fun to use. In 1988, when Adnovum was founded, Stefan Arn decides rather independently that they work on Unix-based Sun computers. Moreover, Adnovum informally made a rule to develop software only on Unix-based Sun computers. Similar to Ergon, Adnovum did not decide to use Unix as a result of commercial considerations. The decision was based on technological stance and confidence, paired with a pinch of prejudice, fortunately aiming in the right direction. However, at that time, it was also a bold choice, because Unix was not yet established in the market and the future market development, especially with regard to the emergence of market standards, was still uncertain.

*Netcetera* was founded almost ten years later than Adnovum and Ergon, at a time when the internet was shaped. Due to their early internet activities and related research performed at the university, the founders built up knowledge with these new technologies. Based on this knowledge, Netcetera aimed at higher-skilled projects in this area, such as dynamic web-pages, e-commerce or e-business. Similar to Ergon and Adnovum, Netcetera’s intent was to predominantly pursue only those projects which required sophisticated software coding.

In the early nineties, Unix had become the dominant internet platform and was mainly distributed by Sun Microsystems, which had a proactive strategy to place their computers at universities. IBM, Microsoft and Apple had not been able to provide a truly competitive product at the time and Linux, a frequently used open source platform nowadays, had just been initiated and introduced by Linus Torwald in 1991.42

---

40 Sun Microsystems uses the Unix-based operating system Solaris.

41 As Richard Stallman, the initiator of the GNU project, points it out: “The use of ‘hacker’ to mean ‘security breaker’ is a confusion on the part of the mass media. We hackers refuse to recognize that meaning, and continue using the word to mean, ‘Someone who loves to program and enjoys being clever about it’” (see: www.gnu.org/gnu/thegnuproject.html).

42 Linux is a free Operating System developed by Linus Torvald and further elaborated by a number of developers throughout the world. Linux was first introduced in 1991. Its kernel runs on numerous different platforms. Linux is a freely available multitasking and multi-user operating system. From the outset, Linux was placed under General Public License (GPL). The system can be distributed, used and expanded free of charge. In this way, developers have access to all the source codes, thus being able to integrate new functions easily or to find and eliminate programming bugs quickly.
Therefore, it appeared as a logical consequence that Netcetera uses Unix for their software developing activities.

Based on Unix and the characteristics of the internet, Netcetera focused from the beginning on open solutions in which technological standards and protocols were disclosed and are not based on proprietary products or standards. This had the advantage that standards were transparent and accessible, which decreased the dependence on suppliers.

However, when Netcetera was founded in 1995, the internet boom has not started yet and there is still a great need for explanations. This was combined not only with technological discussions but also people from the business side had to acquire a better understanding of the new technology to be able to understand the potential of it in their business. Furthermore, as later developments showed, the introduction of the internet also resulted in a drastic re-definition and re-structuring of certain business areas. Therefore, Netcetera also became involved in business development activities. The essence of the internet, its possibilities, had to be explained to customers and interested parties. The internet as a new medium had to be imparted.

Statements relating to the prehistory, the foundation, the first projects and the technological background of the three software companies are summarized in the following table below.

<table>
<thead>
<tr>
<th></th>
<th>Adnovum</th>
<th>Ergon</th>
<th>Netcetera</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prehistory</td>
<td>“Before I started to study I had learnt to be a chemical laboratory assistant in a big pharmaceutical company. I didn’t want to go to university. I wanted to do something practical. I learnt then in an apprenticeship of three</td>
<td>“Beside my job on the bank, I attended evening classes for adults and at that time I got to know to an IT crack. He was my EDP teacher. I realized then the differences in IT competences between the people where I had worked and the</td>
<td>“Before we founded the firm, we carried out small web-applications at the university of Zurich as research assistants for one or two years. That was a very new thing at the time.” (Andrej Vckovski, CEO)</td>
</tr>
</tbody>
</table>

43 Sometimes referred to as an access method, a protocol is a standard used to define a method of exchanging data over a computer network such as local area networks, Internet, Intranet, etc. Each protocol has its own method of how data is formatted when sent and what to do with it once received, how that data is compressed and/or how to check for errors in data. A well known protocol is the Internet Protocol (IP). The IP is an address of a computer or other network device on a network. For example the number "273.45.93.10" is an example of such an address. These addresses are similar to an address used for a house and help data to reach its appropriate location on a network.

44 Proprietary software is copyrighted software that prohibits the redistribution or modification of its program. Legal information about a program can generally be found in the license agreement.
years and one additional year that I am not compatible working in large enterprises and I realized it would be good to study. I decided then to study IT, after I had thought carefully about it.” (Stefan Arn, CEO)

“Competence I found here. And I also saw the difference between what was practiced and what were possible. And I started to think that due to these differences there must be a business possibility.” (Theodor Graf, Chairman)

“In 1994, the internet started to become known. Suddenly, you could read about it in the media. In the same year I also visited some academic conferences in the USA and I was extremely impressed that you could watch or listen to commercials and at the end you were advised to visit the companies’ web page.” (Andrej Vckovski, CEO)

“During the second year of the ETH, I had quite a lot of time available and I made use of it and had a look at several software firms. But I realized soon that they didn’t do it as I envisaged it. The bigger the company the worse the software engineering process. This was not my vision. So I started to think about how to found my own software engineering company. Then on a nice summer evening I had invited four colleagues form the university for dinner and I persuaded them to take part.” (Stefan Arn, CEO)

“After an EDP class I went to my teacher and put a specification for a bond managing application on his table and said: I do the commercial part, you do the technical part and here is our first contract. After one hour he came back to me and he agreed.” Based on that we founded the company together.” (Theodor Graf, Chairman)

“It is amazing, there existed firms with web appearances and applications and I have always thought that this was only done at research institutes. After recognizing this we thought that this is a topic where we want to do something as well and which has a commercial potential.” (Andrej Vckovski, CEO)

“We then held a management seminar for a big Swiss bank. They were looking for people who understood the internet and who could do a workshop. We applied for it and got it. This was basically the moment we founded the company.” (Andrej Vckovski, CEO)

“The company basically took shape, because nobody got a salary. Everybody simply invested his time and what we earned was reinvested.” (Stefan Arn, CEO)

“The company developed stepwise at

“The name of the contemporary CEO is Patrick Burkhalter. I got

“From my own activities, I knew what a bond trader needed. At my bank I acquired the very first project for Ergon.” (Theodor Graf, Chairman)

“What we were looking for at that time was a reference project in which we could demonstrate what a dynamic web-page or e-commerce was. Because most of the people didn’t yet understand it at the time. We thought then that a pizza courier would
that time. We focused on the graphical industry. The reason was quite simple. I knew many people in that industry. And we provided services for them. That went so far, that we installed Macintosh computers, trained people and beside we wrote small software applications.” (Stefan Arn, CEO)

Technological background

“Unix at the beginning was a pure prejudice. I was just fascinated by it. That’s all. It is the famous blind man who hits sometimes the mark. I just stumbled across it and realized ‘okay, that’s good, I like it’.” (Stefan Arn, CEO)

“That was clear for us, we chose Unix for interest. Unix came up at that time at the university and the ETH here in Zurich. It was an interesting system for programming, it offered new possibilities and it was less a market consideration. In the sense that we were not interested that Unix would at some time be big in the market, but more in the sense ‘Unix interests us, we want to focus on it and we will find projects, hopefully’.” (Theodor Graf, Chairman)

“Unix was really a coincidence. And with time you got into it piece by piece without thinking about whether there was a market for it, or whether you could sell the parts. That was not what you were interested in, no, but you could code really good stuff with it.” (Stefan Arn, CEO)

“When we started, the internet had just come into people’s awareness. However, only a few had a concrete notion about the internet. We had our know-how from the university and we had the feeling that this know-how was convertible in the market place.” (Joachim Hagger, CTO)

“The web-page of the pizza courier, where you could place your orders, created a little stir and shortly thereafter a bank wanted to do something on the web. We presented at the bank with among other competitors and we could demonstrate credibly that we understand what we were talking about.” (Andrei Vckovski, CEO)

<table>
<thead>
<tr>
<th>Table 7: Statements illustrating the thoughts and activities at the very beginning</th>
</tr>
</thead>
</table>

4.3 Discussion

Based on the theoretical specification in the first part of this chapter and after the examination of the prehistory, the founding of the firms, the first projects and the
theoretical background in the second part, we come now to a discussion of some particular issues in the third part.

In the following sections, the limited prior knowledge of markets, how to serve markets and of the customer problems of the software firms at their outset are discussed. Based on this examination and based on the empirical material an extended model is presented in the following. Finally, further considerations concerning the extended model in regard to the creation of the companies and the identification of entrepreneurial opportunities are proposed, in particular, the impact of the university context, the impact of the persons involved and the influence of some motivational factors, such as interest, intention and volition are examined.

4.3.1 Limited Prior Knowledge

In this section the cases of the three software companies are discussed in respect of Shane’s concept of prior knowledge about customers and markets. In particular, there is an examination of what extent this prior knowledge existed at the outset of their genesis and to what extent it led to the recognition of entrepreneurial opportunities.

4.3.1.1 Limited Prior Market Knowledge

Before starting to discuss aspects of market knowledge, the meaning of the word ‘market’ will be more closely defined. A market in its original meaning is a place where goods or services are exchanged for a certain price between different parties, such as suppliers, manufacturers, and customers. The amount, quality and goods and services are interchanged are further market characteristics. Some markets are more homogenous, especially markets for commodities such as grain, petrol, or electricity. Other markets are more heterogeneous, with a wide variety of differentiated products, such as jewelry and fashion.

The software market is another example for a very heterogeneous market. The segregation of the software market is a complex task as it encompasses various different dimensions. Basically, there is no such a thing as one software market, but rather a market with many submarkets that allow companies to offer different activities that require different skills and competences. Given the wide range of the industry, software firms can contribute their skills to different activities, beside using the hardware, they can develop software for the infrastructure of IT systems, they can produce specific applications for private or business use, and they can provide several
services. Table 8 (p. 66) represents an incomplete extract of fields of applications to what software firms can contribute. All these listed areas represent different markets with specific market knowledge about suppliers, customers, partners, negotiation procedures, prices, and terms of delivery.

The analysis of the three software firms indicates that they possessed only limited prior market knowledge gained through experience at the very beginning of their existence. For Adnovum, most people were still at university or had just finished it and therefore had had only limited opportunities to gain knowledge in a market environment. At Ergon, Theodor Graf had experience in the banking environment, however, as a trader he had only limited knowledge on how the software market for banking software worked. At Netcetera, some founders had already worked before for a while in other software companies. Two of them had founded a small software company for medicinal software beside their activities at the university. However, when they decided to found Netcetera, they had only limited market knowledge for individualized internet software projects. Additionally, the market for internet applications was only emerging at that time.

However, there is another important element with respect to software markets. Prior market knowledge is probably considered as less important than knowledge about technological issues and specific customers. It was not the purpose of the three software firms to focus on a specific market segment, but to pursue demanding software projects, wherever they could be found. The following statements serve as an illustration. Stefan Arn, CEO Adnovum, says for example: “Our paradigm was never a market focus, but an activity focus. […] Our mission is basically to do good software engineering and to be flexible”. Or as Patrick Burkhalter, CEO Ergon, points it out: “We don’t focus on the market. Of course you will have core activities in certain markets, but we don’t say we have to go into this market. What we basically do is we focus on technology”. Also Joachim Hagger’s\footnote{CTO of Netcetera} statement underlines this: “I believe that the objective for Netcetera was not clear from the beginning. We did not go out into a specific market with a clear intention of making this or that. […] What we had were some ideas, we found somehow interesting and we hoped that somebody else would find them interesting as well.”
<table>
<thead>
<tr>
<th>Computing Hardware</th>
<th>Software Infrastructure</th>
<th>Business Applications</th>
<th>IT services</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-end server hardware</td>
<td>Application integration and middleware software</td>
<td>Business intelligence and data warehousing</td>
<td>Hardware maintenance and support</td>
</tr>
<tr>
<td>Mid-range server hardware</td>
<td>Database management software (DBMS)</td>
<td>Knowledge support</td>
<td>Software maintenance and support</td>
</tr>
<tr>
<td>Entry-level server hardware</td>
<td>Enterprise management software</td>
<td>Customer relationship management (CRM)</td>
<td>Consulting services</td>
</tr>
<tr>
<td>Blade server hardware</td>
<td>Operating system software</td>
<td>Enterprise resource planning (ERP)</td>
<td>Development and integration services</td>
</tr>
<tr>
<td>Workstation client hardware</td>
<td>Security software</td>
<td>Project portfolio management</td>
<td>Network and internet services</td>
</tr>
<tr>
<td>Personal computing client hardware</td>
<td></td>
<td>Supply chain management (SCM)</td>
<td>Solution implementation services</td>
</tr>
<tr>
<td>Storage hardware</td>
<td>Engineering and scientific Software</td>
<td></td>
<td>IT outsourcing</td>
</tr>
<tr>
<td>Digital document and imaging hardware</td>
<td></td>
<td>Payments</td>
<td></td>
</tr>
<tr>
<td>Smart cards</td>
<td>Financial services systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mobile</td>
<td>Government systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Healthcare systems</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 8: Potential fields of activity for software companies**

*Source: adapted from Gartner Group (2005)*
Another indicator for the limited market knowledge of the three software firms is that they were inexperienced in pricing their projects in the beginning. Market prices for projects are negotiated bilaterally between suppliers and customers, therefore, only limited information about the pricing of projects exists.

The pricing for individualized software projects is therefore an interesting topic from a microeconomic point of view. It seems that the market is imperfect, because information of prices and costs are hard to get and difficult to determine for both, consumers and producers. Therefore, the extent to which consumer and producer surpluses are achieved is from an *ex ante* perspective hard to say. It also depends on the negotiation power and talent of the respective parties. In general, it is in the interest of a producer to set the price over the marginal costs of a project, but because of incomplete information in the market, he cannot be sure at what level he can set the price. On the other side, a young software company may just be more interested in getting the project than in maximizing profit, for example in order to gain experience, reputation and to employ the firm’s resources. The young company may therefore set the price near or even below the marginal costs. However, marginal costs are not so easy to determine, also for producers themselves. This means that a low price has the risk of leading to an economic loss. From a consumer perspective, a consumer may generally have an interest to obtain a price as low as possible. However, if the consumer sets a price that is too low, it can produce some unfavorable outcomes. In the simplest case, no producer will be willing to provide the service, because the price does not cover marginal costs. If the price is accepted anyway, the consumer will take some further risks, be it because less experienced companies or less economically successful companies (e.g. firms that primarily need contribution margin) are interested in the project (a sort of adverse selection) or because the producer will then have an interest to reduce the scope and the quality of the software.

Experience and an understanding of the target market therefore play very important roles in the pricing of software projects. Young firms lack this experience and therefore often have no concrete idea about the prices that are remunerated when they start. Adnovum, for example, is surprised in the very beginning how much companies are willing to pay for software. Stefan Arn\(^\text{46}\) comments: “We stood tight, when we saw what the companies were willing to pay.” Andrej Vckovski, CEO Netcetera, emphasizes that young firms underestimate prices, not only for strategic reasons in

\(^{46}\) CEO Adnovum
order to get a project as a newcomer, but also because young firm are not experienced
with regard to how projects are priced and they also often underestimate the whole
work load associated with them as well.\textsuperscript{47}

In summary, prior knowledge of markets played only an inferior role in the process
of how the three software companies identified their business opportunities in the very
early stages of their being. The above analysis has shown that their prior market
knowledge is limited in respect to individualized software projects. Key findings are
summarized in Table 9.

<table>
<thead>
<tr>
<th>Prior Market Knowledge about markets for software projects before firm founding.</th>
<th>Adnovum</th>
<th>Ergon</th>
<th>Netcetera</th>
</tr>
</thead>
</table>

- Limited. However, personal contacts to the graphical industry which enables first projects.
- Limited. Knowledgeable about the banking world, gained from work experience as a trader, but limited knowledge about the software market for banks.
- Limited. Some experiences gained within other software firms, but no specific prior knowledge about the internet market. The internet market is still in its infancy.

<table>
<thead>
<tr>
<th>Concentration on specific market segments at the time of firm founding</th>
<th>No. Realization of Unix-based software projects as main objective.</th>
<th>No. Realization of Unix-based software projects as main objective.</th>
<th>No. Project realizations based on internet technologies as main objective.</th>
</tr>
</thead>
</table>


Table 9: Limited prior market knowledge

4.3.1.2 Limited Prior Knowledge of How to Serve Markets

In this section the three software firms are analyzed against the background of Shane’s (2000) discussion on prior knowledge of how to serve markets. How much

\textsuperscript{47} In general it is difficult to calculate the accurate costs for a software project. Experience plays an important role. There also exist approximate methods such as multiplier, analogy, bottom-up methods and so forth, just to mention a few of them. However, pricing models are often inaccurate because of estimating difficulties and are mostly only accurate when combined with sufficient working experience.
Prior knowledge the companies possessed at the beginning of their existence with regard to the production process, distribution and marketing activities, and ways of organizing is examined. These are three main elements Shane mentions as examples of prior knowledge of how to serve markets.

Looking at the production process, it can be said that software projects are typically created by starting with a profound analysis of the customer problem and end with the implementation of the coded software. In many cases further releases are planned and undertaken. In general, a formal software development process consists of an analysis of the customer problem, submission of different proposals to solve the problem, assistance in deciding which solution should be realized, writing of design documents, building of prototypes, coding and testing of the software, documentation, and finally the implementation and testing of the software on the customer’s IT platform.

Considering the three software firms, it is evident that they all have a profound understanding of how to code software. Most company members are graduates in informatics, engineering, or physics. Most of them have gained programming experiences in apprenticeships during their studies and some of them have prior project experience, such as Stefan Arn with the “potato” project or the founders of Nectcetera due to their activities at the university. It can be argued that the companies have comprehensive know-how about how to produce software in respect of coding and theoretical know-how. The university is as an important provider of that knowledge, even though most people in Adnovum and Ergon had not finished their studies at the time when the companies were formed.

However, when looking at the integral production process, it can also be emphasized that practical experience and know-how are still lacking. For example, the university barely teaches their students practically how to manage software projects, how to test, implement and run the developed software at the customer’s site. Students in informatics primarily gain theoretical knowledge. Stefan Arn 48 explained: “...most people speak solely about the coding part when speaking about software development. The coding part gets ninety percent of all attention. But this is only half of the whole software life cycle. There is no single university in the world which teaches you an integrated software production process. This you only learn in projects on the job. What you get from the ETH are people who have a profound theoretical know-how about how to build software. But building the software is only fifty percent of the

48 CEO Adnovum
journey. The other fifty percent are necessary to make the software run.” Or as Andrej Vckovski elucidates: “The university education in informatics is a little bit one-sided, because important aspects such as project management, quality assurance and testing are not taught or only in a limited way.”

Additionally, it is not always clear-cut how the gained knowledge at the universities can be transferred into practical solutions and how the technological know-how can be applied in a valuable form. Joachim Hagger⁴⁹ points it out: “We had our internet experiences at the university, when we worked with the internet. We knew how it basically functioned. All the rest occurred afterwards. We truly learned the advantages of the internet in projects. Before, we already had our assumptions of what could be done. But we only recognized the real value of the internet in the context of real projects.” These statements illustrate that profound knowledge of how to produce software existed when the firms were founded, but this knowledge is not comprehensive and certain aspects are still missing and have to be learned on projects.

With regard to distribution and marketing, in a project-based software business the distribution forms an integral part of the whole software production process, as briefly discussed in the previous section. For individualized software, the distribution is a logical consequence of a customer order, provided that the software development was successful. The software is then released and implemented on the customer’s IT infrastructure, which typically is a highly technical process. Because individualized software projects are in most cases realized for a single customer, project firms do not need a sophisticated distribution network, in contrast to a product company such as Microsoft serving many million customers around the world. However, the distribution of individualized software can still be complex, for example when a software program has to be installed at the customer’s place on several hundred servers and personal computers. In respect of marketing, all three firms primarily consisted of engineers at the beginning and no one had particular experience and interest in marketing. Marketing is not seen as a necessity yet. All the firms were still very small and the sales process is dominated by technological issues which are best marketed in direct customer interactions.

In respect of ways of organizing, sophisticated work flow diagrams, organigrams, formal team meetings are neither used nor institutionalized within these three companies. Projects are rather organized in a very informal way. This often takes

⁴⁹ CTO Netcetera
place during coffee breaks or lunch time. People come together and distribute work due to their available time and competence. Often, very small teams of two to three persons are formed in order to carry out a specific task or part of a project. Decisions concerning the organization of work and the solving of software related issues are not based on formal hierarchy, but primarily on people’s knowledge.

This informal way of organizing is feasible because the companies are still small and consist of only a few people. Furthermore, people of the very beginning often know each other from the time before the companies have been founded. They often come from the same universities and share a similar education. Adnovum and Ergon especially are eager to attract people from the ETH. In addition, geographically work takes place at the same place. In the beginning, the business locations only consisted of one or two rooms. All these factors foster communication and enable an informal way of organizing.

The way work is organized does not stem from prior knowledge about how to organize a software company the best way, or from classes at the university, or from organization literature. Work is organized as a result of what people think fits best, what makes sense and due to their personal preferences. There is some evidence that this informal way of organizing leads to better opportunity identification, as information is distributed rapidly due to open communication and short communication channels.

Regarding opportunity exploitation, there is empirical evidence that informal organizing combined with the small size of the companies increases the efficiency of opportunity exploitation due to increased flexibility. First, people are more flexible to giving an extra-effort, because their professional self conception is more strongly based on what is required at the moment in order to accomplish a task and less on following more formal guidelines and structures. Second, the informal organization does not lead to formal job descriptions, resulting in having the responsibility only for a few, narrow and specific tasks. People rotate and therefore use and broaden their knowledge in different projects. This impedes limiting specialization. Additionally, if a project is under time pressure, resources can easily be shifted by withdrawing it from other projects. Furthermore, the informal way of organizing reduces administrative work and overhead costs. More working hours can be devoted to projects and projects can be realized at lower costs, leading to a cost advantage compared with big established IT-companies. These companies are forced to induce hierarchical and formal organization principles due to their size.
As a conclusion, the profound technical know-how is an important factor in order to gain new software projects and to identify and exploit new entrepreneurial opportunities. This will also be shown in more detail in the sub-sections 4.3.2.1 and 4.3.2.2. However, the three companies have limited experience in handling comprehensive projects at the very beginning. In respect of distribution, marketing and ways of organizing, experience and prior knowledge of all three firms is limited and prior knowledge in this respect only partially helps to recognize new entrepreneurial opportunities. Key findings are summarized in Table 10 below.

<table>
<thead>
<tr>
<th>Production Process</th>
<th>Adnovum</th>
<th>Ergon</th>
<th>Netcetera</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profound technological know-how, but limited experience in project realization with customer interactions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distribution and Marketing</td>
<td>No profound prior distribution and marketing knowledge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ways of Organizing</td>
<td>Informal and non-hierarchical. Some indication that this leads to better information sharing and enhanced opportunity identification.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 10: Limited knowledge how to serve markets**

### 4.3.1.3 Limited Prior Knowledge about Customer Problems

Before they were founded, Adnovum and Nectetera have no particular access to potential customers in order to gain specific knowledge about their IT-problems. Neither is it the case that the founding generation worked at different potential customers before gaining deep insights into firm specific IT problems. Nor are strategic market analyses or business plans conducted in order to gain specific knowledge about customer needs. Joachim Hagger\(^{50}\) explains: “We didn’t go out into the market by doing profound analysis. We weren’t big strategists, in the sense that we would have made market analyses leading us to certain results. A lot was determined by accidental decisions and happening.”

In respect of prior knowledge about customer problems, Ergon differs, because Theodor Graf worked and was experienced as a bond trader at a bank, gaining deep insights into certain work processes in the bank. This enables him to recognize the

\(^{50}\) CTO Nectetera
potential for efficiency improvements, which finally leads to their first project, the “bondfinder”. Thus, Theodor Graf’s employer is Ergon’s first customer. However, after completing the “bondfinder” project, neither an immediate project follows up for the same customer, nor does Ergon try to multiply the same product, although the project is a success. Ergon is looking for further projects with new customers. In general, Ergon does not know customers’ problems in advance. Upcoming projects are widely spread and are not based on specific prior customer knowledge.

One could also argue that prior knowledge about customer problems exist because of work experiences or participation in other software companies. Although people have done apprenticeships or have participated in other software firms, knowledge about specific customer problems, leading to entrepreneurial opportunities or projects in the newly founded companies, is hardly available. The reasons for this are manifold. For example, as a temporary apprentice people are typically not involved in the customer side. Furthermore, the focus of the new firms was often different from their prior experience. Netcetera, for instance, does not concentrate on the market for medicinal software even though two of the people have worked in that area before.

To conclude, Adnovum and Netcetera have no specific prior knowledge about specific customer problems from work experience or customer analysis. Ergon benefits from Theodor Graf’s in-depth trading knowledge coming up with the “bondfinder”. However, following projects are not based on specific prior customer knowledge. In general, prior knowledge of customer problems is not a main driving factor for the identification of new entrepreneurial opportunities at the outset of the three companies. Key findings are summarized in Table 11 (p. 74).

---

51 For example two people of Netcetera have started a company producing medicinal software before.
Chapter 4

4.3.2 Alternative Conceptual Models

It has been shown that prior knowledge in respect of markets, customers, and ways to serve markets does not necessarily lead directly to the recognition of specific business opportunities and to the founding of companies. This section analyzes what other elements led to the foundation of the companies studied. Based on this analysis a temporal model about the creation of the three firms is presented.

4.3.2.1 Basic Elements

In particular, the following elements are presented and analyzed for their impact on opportunity identification: technological and business know-how, the recognition of

<table>
<thead>
<tr>
<th>Prior knowledge of customer problems due to prior work experience within customers leading to new entrepreneurial opportunities</th>
<th>Adnovum</th>
<th>Ergon</th>
<th>Netcetera</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>Yes, however, this applies only for the first project.</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

| Prior knowledge of customer problems due to prior work experience in other software companies leading to new entrepreneurial opportunities | No | No | No |

| Prior knowledge of customer problems due to market analysis leading to new entrepreneurial opportunities | No | No | No |

Table 11: Limited prior knowledge about customer problems
commercial potential, firm foundation, the search for areas of application and the first projects gained.

At the very core of all three cases lies the technological know-how about how to write software. For all three companies, the University of Zurich and the ETH are the main providers of this fundamental know-how. Thirteen out of fifteen persons of the first generation in all three firms have or are in the process of obtaining a degree in engineering from either of those institutions. One person has an engineering degree from a polytechnic school and one person starts a degree in business management with engineering as a subsidiary subject. Thus, the prior knowledge people possess is primarily a profound technological know-how in software related questions such as software methods, technologies and related topics such as interoperability, integration, scalability, reliability and other software performance issues. In this sense, the technological know-how is a broad knowledge base and is wider than just having unique knowledge of a specific technological innovation.

Another element is job related business know-how and job related people know-what. Job related business know-how is defined as a general understanding of how a business works and functions - gained by work experience. Job related business know-how can include market and customer knowledge, but it is more encompassing and includes knowledge about all aspects of company-internal processes, tasks and techniques. Job related people know-what contains the knowledge about people that someone is working with. It encompasses an understanding of the people’s knowledge, their jobs, responsibilities, competences and hierarchical positions. While job related business know-how and people know-what are not the only factors that enable a person to successfully lead a business, they are an important prerequisite in order to do so. In this sense, job related business and people knowledge can be an integral part of managerial know-how which also subsumes managerial skills and techniques such as budgeting, financing, leadership skills, and so forth.

Interestingly, in the entrepreneurship literature quite a lot is written about opportunity recognition, but very little about the recognition of the commercial potential of an entrepreneurial opportunity or activity. Somehow it is assumed that one part is an implicit component of the other. However, this has not always to be the case. As we will see later, firms may recognize the commercial potential of an activity, without having identified a specific entrepreneurial opportunity yet.\(^52\)

\(^52\) Entrepreneurial Opportunity is defined as the creation of new products or services (Venkataraman, 1997).
Furthermore, the commercial potential of an activity is a key element for a successful implementation of such. Therefore, the ability to recognize this potential plays an important role and the analysis of this aspect potentially contributes to a better understanding of the whole opportunity recognition process. Entrepreneurial opportunities and activities are in general risky and uncertain in their outcomes and in many cases it is not possible to determine the accurate cash and cost flows. Nevertheless, before an entrepreneur starts an activity, he might have recognized the commercial potential of this specific activity, and it may just be based on pure belief. Otherwise, as long as he is profit oriented, he would not start.

When the three companies were founded in 1984, 1986 and 1995, it is obvious that earning money with software programming is possible. The existence of many other successful software companies exemplifies this. However, for a single person or a small group of people with limited experience, it is uncertain whether their skills and ideas have a commercial potential when having their own business. Therefore, it is helpful, when preliminary experiences can give some information in this respect, for example by getting a positive feedback, hint or signal (see e.g. McMullen and Shepherd 2003). In our three cases, the recognition of the commercial potential happens through experiences. Experiences can be made through different means, such as acting, by using different senses, by thinking and so forth. The analysis of the three software firms indicates that different modes of how experiences are gained and dealt with play a role in recognizing the commercial potential of an activity. In particular, the commercial potential is recognized by experience through action, by comparing of experiences, and by experience through observations that trigger self reflexive thinking. The different modes will be discussed in more detail in sub-section 4.3.2.2.

Firm founding is a central aspect of entrepreneurship (Low and MacMillan 1988). Shane and Venkataraman (2000) describe two major institutional arrangements that an entrepreneur can chose in order to exploit business opportunities. Either he chooses a market arrangement - by selling the opportunity to a third party - or hierarchy – by creating a new firm. In a later work, Dew, Velamuri and Venkataraman (2004) examine why and when entrepreneurial opportunities are exploited by existing or by new firms. One of their key findings shows that in the absence of markets for entrepreneurial opportunities the outcome is the creation of new firms.

This aspect can also be found in our three cases. The unrealized business opportunity of writing individualized software projects is a service which is hard to sell to a third party. First, this service activity does not produce a standardized product
for the mass market, but is customized to specific, individualized IT-problems and needs. Therefore, only after a project is obtained and through customer interaction more deeply defined, is it known what the ‘end-product’ will be. Second, individualized software engineering is heavily dependent on the involved persons’ knowledge and human capital. One way of selling the idea of a software engineering company for individualized projects would then basically denote to “sell” the software engineers involved, meaning that they are hired by another existing company. Additionally, in our three cases there also exist other non-economic reasons why the mode of firm founding is chosen. For example, the founding of the firm is an opportunity to create their own work place that is congruent with personally preferred values and norms. It is also an opportunity to create an environment where it is possible to choose the people to work with. Likewise, a small informal firm, with a certain life style, flat hierarchical structures, where knowledge is the key decision factor in the software development process, is a very appealing notion for many young software engineers.

An important step in establishing the companies is the search for areas of application. Shane and Venkataraman (Venkataraman 1997; Shane 2000; Shane and Venkataraman 2000), but also other authors (see Sarasvathy, Dew et al. 2002), base their conceptional models on Austrian Economics (Hayek 1945; von Mises 1949; Kirzner 1997). One key premise of this stream of theory implies that opportunities are found without actively searching for them. Whereas the Austrian View highlights that business opportunities are found by coincidence, other researchers emphasize superior search and scanning processes as the main drivers behind the opportunity discovery process (Shaver and Scott 1991).

However, ‘coincidence’ and ‘search’ are not necessarily two exclusive and independent categories, but both can play an important role in identifying entrepreneurial opportunities. In our three software cases, each firm searches for areas where their core knowledge - the development of software - can be applied. However, the outcome of this search is often dependent on coincidence. This can be called conditional coincidence. Conditional on where, how and how much the companies search, they find different entrepreneurial opportunities. Nevertheless, the result is often also partially accidental.

The search for areas of application leads then to the first projects of the companies. The first projects help to establish the newly founded companies. In one particular case, the first gained project triggers the decision to start the company. The form of
the very first projects is diverse as already discussed in Section 4.2.3. The range of projects varies from hardware installations to first smaller software development projects.

Having presented the most fundamental elements that led to the establishment of the three companies, the elements are linked to two alternative causal models in the next section.

4.3.2.2 Alternative Causal Chains

In this section two fundamental models are presented that provide a theoretical framework for the foundation process of the three firms. Both models A and B refer to the very beginning of the companies’ history and are summarized graphically in Figure 3 and Figure 4. The main purpose of the models is not only to illustrate the relationships between different elements that influence the foundation process, but also to foster the understanding of the temporal sequencing and dependencies related to this process. While both models have a common basis, they differ in respect of sequencing and basic elements.

Model A:

![Diagram of Model A]

Figure 3: Alternative causal chain A

Model A represents the establishment of Adnovum and Netcetera. At the very beginning is the technological know-how that they have gained at university. This profound technological know-how leads to the recognition of its commercial potential through experience of action and experience by observation, triggering self-reflexive thinking.

Experience through action can be observed in the Adnovum case when Stefan Arn is asked to carry out the ‘potato’ project for which he is reimbursed 60.000 CHF. As a young student, he had definitely not expected to earn that amount. However, the successful realization of the ‘potato’ project gives Stefan Arn a hint about the commercial potential of software projects and also that he has the ability to do this.
In the Netcetera case, the commercial potential is recognized by a new experience triggering self reflexive thinking. Self-reflexive in this context means that the observer is animated by what is seen and experienced to think about his own activities. The observation and subsequent thinking is based on a comparison linking the outside world with his own activities. Andrej Vckovski’s statement (see Table 7) about his surprise when he visits conferences in the United States in the early nineties and realizes that the internet is already used for commercial reasons serves as an example. Until that time he had been convinced that the internet was mainly used in a research setting at universities. Being back, he and his colleagues start to think about doing something similar. They start to believe in the commercial potential of internet operations, due to the fact that other companies abroad already use a technology they are profoundly familiar with, but which they have used so far only in a non-commercial setting.

The recognition of the commercial potential then has a positive influence on firm founding. It basically triggers the formation process. In the case of Adnovum, the potato project generates a first income, which is used later for the establishment of the new firm. Additionally, it encourages and strengthens the intent to start a company, as the Netcetera case nicely exemplifies. Again, the founders do not specifically think about the different modes of exploitation – founding a company or selling the business idea. Initially, after the recognition of the commercial potential, the motivation and intention to found a company dominates the notion to sell the business idea. Furthermore, the selling of the business idea is also not a very realistic option, because, as already discussed, the insight that a certain service or activity has a commercial potential, e.g. software engineering, is per se not concrete and specific enough to sell on the market.

Although the focus lies clearly on software engineering when the companies are founded, it is less clear where their know-how should be applied. Forming a company without having a concrete project initiates a search process for areas of applications. In the case of the two software firms the search process is supported by an existing social network and fostered by imagination. The search for areas of applications results in the first projects, where customers look for and trust in the technological know-how of the young companies. As already mentioned in the previous section,

---

53 Of course, there exist other factors which may play a role why the companies are founded. For reasons of simplicity, they are not included here, but some of the factors are discussed later.
search and coincidence are not mutually exclusive as the search process and the identification of the first projects is also dependent on coincidental happenings.

By way of illustration, Adnovum first searches for areas of application in the graphical industry. Nevertheless, although Adnovum is primarily searching in that industry, it is coincidence that some companies are willing to place orders. After all, it is also a conditional coincidence because the first contacts are facilitated by Stefan Arn’s social network which might be a help to acquire the first work orders, as previous research also indicates (see e.g. Soh 2003). Similarly, Netcetera also searches for areas where they can apply their know-how. As already described, they come up with the idea of the online pizza courier. Contacting several pizza chain owners, it is accidental that they find one owner who is interested and open-minded enough to apply the new internet technology. It could also have been the case that nobody showed any interest.

The fact that the founding of Ergon evolved somehow differently is taken into consideration in the following model.

![Model B](image)

**Figure 4: Alternative causal chain B**

*Model B* represents the establishment of Ergon. In contrast to Model A, the recognition of the commercial potential is, in this case, positively influenced by three factors, namely technological know-how, job related business know-how and people know-what.

In contrast to Adnovum and Netcetera, which are exclusively founded by software engineers, Ergon is different because technological, business and people related knowledge are held by two separate persons. Whereas the technological know-how is
Prior Knowledge and Business Opportunities

primarily carried by Christian Juon, Theodor Graf brings in the business and people related knowledge. However, only when they meet and through combination of their know-how did Theodor Graf recognize the commercial potential of it. Only the combination of these three knowledge domains and their comparison enables him to recognize a gap of what is done in IT and what could be possible. This reciprocal interaction of the three knowledge domains is therefore depicted as a moderating effect in Model B.

An important aspect is therefore how Theodor Graf gets access to these different knowledge domains. One key factor is the experience undergone in two different contexts. On the one side, he had experience at his work place and on the other side he gains new experience about technological issues due to his further education at college. The comparison of these experiences fosters the recognition of the commercial potential of these different knowledge domains, which is also illustrated in Theodor Graf’s following statement (see also Table 7): “I realized then the differences in IT competences between the people where I worked and the competence I found here [EDP class at evening classes for adults]. And I also saw the difference between what was practiced and what was possible. And I started to think that due to these differences there must be a business possibility.”

When comparing the IT competence of his EDP teacher at evening school with the people’s IT-competence at his employer’s place, Theodor Graf’s job related business know-how and job related people know-what serves him as a reference point. Therefore, the comparison of job related internal business knowledge and people’s competences with an external knowledge source can foster the recognition of commercial potentials, especially when the knowledge domains belong to different persons.

However, although the three domains of knowledge come together and a commercial potential of the three domains is identified, a specific entrepreneurial opportunity is not immediately recognized. This leads to a search process for an area of application, similar to Adnovum and Netcetera. However, in the case of Ergon, the existing job related business know-how channels the search process towards an area Theodor Graf is acquainted with. Based on his job related business know-how he searches within his working environment for how and where the technological know-how could be applied. Additionally, possessing job-related people know-what

---

54 Just as a reminder, a moderation effect indicates that the effect of one variable depends on the level of another variable.
simplifies the search process in that he knows to whom he has to talk when having his
first ideas. Therefore, the relationship between recognition of commercial potential
and search for area of application is again moderated by job related business know-
how and people know-what.

The combination of the three knowledge domains together with the search for an
area of application has a positive impact on finding the first project. Theodor Graf
comes up with the idea of the ‘bondfinder’ and his employer was interested in the
project. As soon as they come to an agreement, Ergon started. The fact that the
company is not founded until the first project is gained, even though the intent of
doing so already existed before the search process began, is depicted in the triangle
relationship between search for area of application, first project and firm founding.
There are several reasons why this way could be chosen. First, by having a project it is
easier for Theodor Graf to convince a partner who possesses the necessary
Technological know-how to implement it and to join him. Second, it can also be seen
as a risk reducing strategy, knowing that if a concrete project has already been
obtained before the company is started contributed to the first initial investments.

Although the ‘bondfinder’ is a success, Ergon does not try to replicate and sell it to
other banks. There are three potential reasons why a software firm that focuses on
individualized projects does not replicate a product. First, there are legal restrictions
based on contractual agreements with the initial customer. Second, a further customer
with similar needs or problems does not exist or cannot be found. Or third, the
software company has no interest in replicating the product because there are other
project opportunities to enhance their knowledge base. Working on new and
technological challenging projects also positively influences the motivation of the
employees. Therefore, after Ergon has finished the ‘bondfinder’ project, the company
does not try to replicate it. The search for further areas of application goes on.

A final comment will be made referring to search activities, coincidence and
conditional coincidence. As has been shown above, search for new entrepreneurial
opportunities is an ongoing process in the initial stage of Ergon. However,
coincidence and conditional coincidence are detected within and beyond the search
process for projects. An illustration of this was how Ergon obtained the accounting
software project. By chance Theodor Graf came to know to Patrick Burkhalter at
university, who was able to bring the software accounting project. However, it is also
a conditional coincidence because both attended the same university. Therefore, the
latent chance that they would meet one day has always existed. That both have similar interests, get along with each other and one has a project “in stock” is then accidental.

4.3.2.3 The Possibility of Multiple Sequencing

As the two models presented in the last section demonstrate, there is not only one single generic model explaining the constellation of how firms are established and how they identify their business opportunities (see also Hansen and Bird 1997). Based on some core elements, several different models can be found depicting the chronological process of firm foundation and opportunity identification. However, the key question is then, how and why these models are different. In respect of the three models presented so far, the following observations can be made.

One difference can be identified with respect to the degree of specialization of the technological background. Whereas Shane’s model is based on the discussion of one specific technological invention, the 3DP™ technology, the three companies analyzed here rely on a broad technological know-how base. In Shane’s model (Figure 2) it is not essential to have a profound prior knowledge of the 3DP™ technology. In his case, it is more important to acquire the information about the new technological invention in order to become acquainted with it. Combined with prior knowledge about customers and markets, this may lead then to the recognition of an entrepreneurial opportunity. In model A and B (Figure 3 and Figure 4), on the other side, the broad prior technological know-how base of how to produce software represents the backbone. In case of the three analyzed companies, technological knowledge is built up over two and more years at the universities around Zurich before and during the period the firms are being founded. It is a very important element in order to eventually gain projects.

Furthermore, in Model A and B the technological know-how does not lead directly to the recognition of a specific entrepreneurial opportunity but leads first to the recognition of the commercial potential of the technological know-how. Entrepreneurial opportunities are only identified by opening up the first projects. This indicates that there is a difference between ‘recognition of the commercial potential’ and ‘opportunity recognition’. According to Shane and Venkataraman the recognition of a business opportunity is the identification of specific new future products and services that allows outputs to be sold at more than their cost of production (Casson 1982; Shane 2000; Shane and Venkataraman 2000). When the three software companies recognize the commercial potential at their outset, they have not yet
recognized specific entrepreneurial opportunities. They just know that they want to carry out software engineering activities, without having a clear idea what kind of the actual products and projects they are going to produce and implement.

Another distinction lies in the meaning of search activities. Due to the lack of a specific entrepreneurial opportunity at the very outset the search conducted plays an important role in Model A and B. In Shane’s model, the combination of technological invention with prior knowledge of markets and customer problems makes the search process for specific entrepreneurial opportunities redundant. In Model A and B, each software firm is forced to search for areas of application for their technological know-how, which can be applied in a vast variety. Although prior business and people related knowledge exist in Model B, similar to Shane’s model, the search process is not eliminated. The specific business know-how primarily channels the search process for the first project gained, but does not render it indispensable.

An additional aspect lies in the sequential outcome of firm founding and in the form of opportunity exploitation. Whereas in Shane’s model the opportunity is recognized first and afterwards the form of exploitation is chosen, in Model A the decision to found a company comes first and then the search for projects is initiated. Model B is in this respect a combination of the two, the intention to found a firm is already present beforehand, however, Ergon is not founded before the first project is obtained. Similar results are also provided by Bhave (1994). Furthermore, in Shane’s model, after the recognition of the opportunity the form of exploitation leads to firm creation or to the selling of the opportunity on the market. As previously discussed in 4.3.2.1, for the founder generation of all three software firms it is obvious that they want to use the company exploitation mode. This can be explained by personal preferences but also by the fact that there was no market for entrepreneurial opportunities such as individualized software projects.

Moreover, a further differentiation lies in the number and the characteristics of the analyzed entrepreneurial opportunities. In Shane’s model a company is created for exploiting one specific entrepreneurial opportunity. In contrast, in Model A and B the companies are constantly looking for projects and entrepreneurial opportunities to build up, strengthen and improve their firms.

One aspect that might influence the number of opportunities pursued is market size and expected returns. In Shane’s cases the entrepreneurial opportunity is clearly defined and specified beforehand, therefore, market forecasts and expected sales can
be calculated by the companies. In general, the potential value that can be extracted from each of these single opportunities is considerable. Annual sales forecast in 5 years varies between 2 and 315 million US-$ (Shane 2000: p. 455). In the cases of the three software companies, however, the value of each project and entrepreneurial opportunity is much smaller, varying between nearly zero and 80’000 US-$ at the beginning. This implies a reason for the need to look constantly for entrepreneurial opportunities. Furthermore, in contrast to Shane’s cases, it was hardly possible to estimate valid forecasts within the three companies at their outset, due to two main factors. First, because of the high dynamics in the software industry, forecasts are considered as rather unpredictable and unreliable. And second, all the firms had no real intention to rapidly grow in the beginning. Their main intention lay in remaining small and trying to get interesting software projects.

Lastly, whereas in Shane’s cases every entrepreneurial opportunity is assumed to be very new, unique and non-obvious in advance, in the case of the three software firms not every opportunity is new, unique, and non-obvious. At the beginning, activities are also undertaken that need specific know-how but that are not necessarily unique, non-obvious, or inimitably innovative, such as the installation of computers and servers, but are good opportunities in order to generate a positive cash flow and to help to ensure the survivability of the newly founded companies.

A final remark with regard to the entrepreneurial opportunity term. One may wonder why the opportunity construct cannot be found directly in Model A or B. The answer is simple, entrepreneurial opportunities are in a way “represented” by projects. Why is this done? The firms carry out projects, but not every project is an entrepreneurial opportunity, leading to new services and products - the definition of entrepreneurial opportunities. The other way round, most entrepreneurial opportunities in the three firms are seen in projects, but not every project is necessarily an entrepreneurial opportunity leading to new products and services. The main aspects of the three models are summarized in Table 12 (p. 86).
Chapter 4

<table>
<thead>
<tr>
<th>Technological background</th>
<th>Model A</th>
<th>Model B</th>
<th>Shane's Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Broad technological</td>
<td>Broad technological</td>
<td>Specific technological</td>
</tr>
<tr>
<td></td>
<td>know-how</td>
<td>know-how</td>
<td>invention</td>
</tr>
<tr>
<td>Recognition of</td>
<td>First, recognition of</td>
<td>First, recognition of</td>
<td>Opportunity and</td>
</tr>
<tr>
<td>commercial potential /</td>
<td>commercial potential,</td>
<td>commercial potential,</td>
<td>implicit recognition of the</td>
</tr>
<tr>
<td>opportunity</td>
<td>afterwards ongoing</td>
<td>afterwards ongoing</td>
<td>commercial potential at the</td>
</tr>
<tr>
<td></td>
<td>search for</td>
<td>search for</td>
<td>same time</td>
</tr>
<tr>
<td></td>
<td>entrepreneurial opportunities</td>
<td>entrepreneurial</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>opportunities</td>
<td></td>
</tr>
<tr>
<td>Search process for</td>
<td>Existing, ongoing</td>
<td>Existing, ongoing</td>
<td>None existing</td>
</tr>
<tr>
<td>entrepreneurial</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>opportunities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of</td>
<td>Numerous</td>
<td>Numerous</td>
<td>Recognition and</td>
</tr>
<tr>
<td>entrepreneurial</td>
<td></td>
<td></td>
<td>exploitation of one</td>
</tr>
<tr>
<td>opportunities to build</td>
<td></td>
<td></td>
<td>specific</td>
</tr>
<tr>
<td>up the firms</td>
<td></td>
<td></td>
<td>entrepreneurial</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>opportunity</td>
</tr>
<tr>
<td>Mode of exploitation</td>
<td>Firm founding</td>
<td>Firm founding</td>
<td>Firm founding or selling of</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>the entrepreneurial</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>opportunity in the market</td>
</tr>
</tbody>
</table>

Table 12: A comparison of the conceptual models

4.3.3 Additional Considerations

So far, the interaction between firm creation and entrepreneurial opportunities has been examined. This was mainly done using the background of Shane's conceptional model of opportunity recognition. Based on empirical data, two further models have then been presented. However, models are - and this is also their purpose - always a simplification of reality. For reason of simplification, clarity, scalability / generalization, focus on certain aspects of a problem and theoretical argumentation are always omitted. Nevertheless, it is worthwhile reconsidering some of these aspects in order to get a better understanding of the interplay between firm creation and
entrepreneurial opportunities. One aspect that deserves some deeper considerations is the university context as an important provider of technological knowledge. Furthermore, it is interesting to revisit the question of who is involved in firm creation – the common answer “the entrepreneur” is often a reduction which only tells half the story. Finally, technological invention and knowledgeable people are often not the only driving forces behind people pursuing technological opportunities. Some light is shed on further aspects such as interest, intent and volition.

4.3.3.1 The Impact of the University Context

In respect of the three software companies, universities play an important role in providing the technological know-how enabling the foundation of the companies and the search for entrepreneurial opportunities. The university is the place, where a profound technological knowledge base of young talented people is formed. It is quite obvious that without this basic technological know-how, the chance of finding and creating entrepreneurial opportunities in a technological business context is reduced.

However, the technological know-how which is taught at university is only a part of the know-how that is required in order to successfully implement software production in a business context. Members of all three software companies emphasize strongly that the successful realization of a software project can only be learned on the job.

In the case of Netcetera, the university is also the place where the later founders as research associates build up and enhance their technological know-how concerning the new internet technology. This happens, on the one hand, in research projects concerning their dissertations and, on the other hand, in realizing internal internet projects for the university. This provides the advantage of acting in a ‘safe’ environment where market forces such as competition, speed, and costs are less relevant. It can therefore be argued that the founding of Netcetera is a kind of university spin-off.

The university context also plays an important role for getting to know people with similar interests and sufficient technological competences in order to found the companies. Studying or researching together provides the opportunity to become acquainted with each other and to learn about each others’ interests, skills and competences. Therefore, it is not astonishing that colleagues from the university form the founding teams of the companies – a pattern which is not unusual in the software
industry. Netcetera and Adnovum are typical cases in that respect, but also the establishment of Ergon is based on an educational context in which Theodor Graf and Christian Juon meet each other for the first time.

The university context also has an important impact on the future development of the companies. Established contacts between founders within the university context help to recruit further software engineers, who are occasionally a very scarce resource. As long as young, graduated software engineers join the companies, bringing in their personal contacts from other graduates or shortly graduating software engineers, the link to specific universities is never interrupted and works as a self-generating process. Aldrich and Langton (Aldrich and Langton 1998) call this mechanism informal searching through social networks. As a consequence, the composition of people in terms of their educational sources can have an impact on the future composition of the companies. Of course, other factors such as university reputation, study content and availability play a role as well. Nevertheless, the composition of people at the outset of firm formation can result in a more homogenous or heterogeneous sourcing strategy of software engineers. For instance, Adnovum and Ergon, mainly composed of ETH software engineers from the outset, focus primarily on software engineers from the ETH, whereas Netcetera, founded by IT-PhD students with different academic and institutional backgrounds, follows a more heterogeneous recruiting strategy, sourcing people from different academic institutions.

4.3.3.2 Involved Persons

Traditional literature in entrepreneurship exhibits a strong person-centric perspective. The entrepreneurial individual is responsible for identifying and exploiting entrepreneurial opportunities. Differences in individuals are one possible reason why diverse opportunities are identified and exploited (Venkataraman 1997; Shane and Venkataraman 2000).

While the basic assumption behind this simplification is correct, it results in the omittance of certain additional aspects. The recognition of an opportunity takes place in the human brain, and the effort, energy and creativity of a single entrepreneur plays an important role in exploiting business opportunities. However, this might lead to the recognition of entrepreneurship as being only a one-man / one-woman show. Looking

---

55 For instance, Larry Page and Sergey Brin, the founders of Google, get to know each other at Stanford University. Microsoft founder Bill Gates becomes acquainted with Steve Balmer, today’s CEO of Microsoft Corporation, at Harvard University.
at the three software firms, it has been shown that several people are involved from the beginning - forming groups and teams. The establishment of the companies is basically not a single act but a joint effort, also in respect of identifying and exploiting entrepreneurial opportunities.

Of course, some people are more influential and decisive in setting the direction of the company than others. Within the founding generation, single persons shape the company more than others. For instance, Stefan Arn can be described as the driving force behind Adnovum. Theodor Graf and Christian Juon, as the founders of Ergon, clearly had a dominant position from the beginning. However, the interplay of opportunity identification and exploitation, the building up of the companies is the result of a group of people fulfilling a joint effort. Therefore, several people are substantially involved, participate and give their vote. This can also be seen in the organizational structure the companies have. There does not exist a formal hierarchical setting that dictates how the projects and the work are accomplished. Contrariwise, hierarchical structures are very flat, especially in respect of technological issues. Everybody can participate in technological discussions. Decisions are made not by formal hierarchy but by superior knowledge.

Furthermore, at the beginning formal roles and hierarchical positions are barely assigned. A differentiation of formal roles emerges over time and very often, people grow after a while into specific roles and positions due to their specific capabilities and willingness (Miner 1992; Aldrich 1999). For example, Matthias Loepfe eventually becomes CTO of Adnovum, Patrick Burkhalter CEO of Ergon and Andrej Vckovski CEO of Netcetera. As Stefan Arn points out: “Matthias Loepfe acquired the position as CTO organically over time, due to his technological excellence”. Or as Beat Stocker, former Chairman of Netcetera, brings up: “People have developed and matured due to the growth of the company. And Andrej suddenly emerged as somebody who can professionally lead the company as a CEO”.

Summing up, whenever we look at the identification and exploitation of entrepreneurial opportunities, the formation of companies, especially in a technological setting, we should carefully examine the contribution of the people involved and not automatically myopically attribute the achievements to a single entrepreneur. Just looking at the entrepreneur as an individual in isolation can be misleading and represent a false picture of the founding process.
4.3.3.3 Interest, Intention and Volition

So far, the analysis of how the three software firms are created and how they search for entrepreneurial opportunities has resulted in the two models presented in Figure 3 and Figure 4. These two models allegorize the institutional process of firm creation in an early stage, based on elements which can be related to epistemological (technological know-how), cognitive (recognition of the commercial potential) or action oriented characteristics (search and firm founding processes). Nevertheless, due to the interviews conducted it is worthwhile to also pay attention to some motivational aspects which affect behavior and which play an important role in firm creation and entrepreneurial opportunity identification and exploitation.

For that reason, three constructs are stressed and examined in particular: interest, intention and volition. Whereas intention has been given some attention in the entrepreneurial literature (Bird 1988; Katz and Gartner 1988; Shepherd and Krueger 2002), there is little written about interest and volition in the context of opportunity identification (see Mischel 1996; Metcalfe and Mischel 1999; Kehr 2004).

Interest is defined as a human feeling that accompanies or causes special attention to an object or to a certain activity. Interest is a central motivational factor that can be found on the individual as well as on the collective level. A single person can be interested in doing something, but it is also possible that interest is shared or transferred between people. Among others, two important basic interests can be observed in all three companies. First of all, it is the shared interest in developing software, thereby combining and integrating technologies and applying technological know-how to challenging projects. As a consequence, shared interest in developing software also influences the search process for entrepreneurial opportunities as these search activities are directed to interesting and challenging projects whenever possible. Second, it is the interest in creating their own working environment, in which the projects gained can be accomplished according to people’s own notions and claims, which positively effects firm founding.

Stefan Arn’s following statement illustrates this: “The bigger the software house becomes, the worse is the whole [software developing] process, the more it is dominated by marketing, product sales, HR, and financial people and everybody meddles in and the software engineer is just some jumping jack, who is also allowed to say something at the end of the process. This was not really my vision and therefore my intention was to found a software engineering company.”
Intention can therefore be defined as the determination to act in a certain way. Entrepreneurial intention aims at either creating new firms or new values in existing firms (Bird 1988). Shepherd and Krueger (2002) define entrepreneurial intention as the motivational attitudes to bring into existence future goods and services. Intention is therefore goal oriented. Without having intention, action is unlikely (Krueger 2000). Having resources and interest does not necessarily lead to action. For instance, technological know-how as an important resource and interest in software development and firm foundation alone does not automatically lead to firm foundation and to the pursuit of entrepreneurial opportunities. Intention is also necessary to start the activity. It is mainly the combination of motivational factors, such as interest and intention, and resources that enables entrepreneurial activity (Ajzen 1985).

Hence, in most conceptual models intention is directly linked to action (see e.g. Bird 1988). However, intention alone does not necessarily lead to persistent action. What happens if obstacles appear and if people start to deviate from their intention? Firm founding and the identification and exploitation of business opportunities are appealing thoughts and are also highly appreciated in society. However, even if an entrepreneur or an entrepreneurial team is interested in a topic and has the intention to establish a company and to identify and exploit entrepreneurial opportunities, it is easier said than done. Excellent business opportunities are often not easily found and implemented. Many obstacles exist, such as a lack of financial resources, lack of human and social capital, lack of reputation and so on. In such difficult situations it could happen that people deviate from their intention or their intention dies. Volition as a self-regulative strategy is therefore necessary for not deviating from intention and it can help the reaching of goals intended. For instance, the volition to keep going, although not everything immediately works out as was wished, is exemplified in Theodor Graf’s following statement: “These are great business opportunities for us, where we start running and talk to responsible people. And then, perhaps we achieve something or not. It can easily be the case that you have tried hard to accomplish something but it did not fall on fertile ground. But then there is only one thing you can do. You have to forget it and go for the next one. That happens and you have to deal with it. At the beginning, this is not easy. I took it quite personally. But you shouldn’t. Over time you will learn to deal with it, no question.”
4.4 Conclusion

Shane’s conceptional model highlights the importance of prior knowledge for recognizing an entrepreneurial opportunity. Especially, prior knowledge of markets, of how to serve markets and of customer problems play an essential role in recognizing and exploiting an entrepreneurial opportunity in his model.

Looking at three specific software firms, the generalization potential of Shane’s model is examined. Firstly, when analyzing the prehistory, the foundation and the first projects of the software companies, it becomes apparent that the examined companies were not founded due to the recognition of a specific entrepreneurial opportunity. Most opportunities were developed or perceived while the companies were building and this identification process represents an integral aspect of every company’s development. Second, there is not just one specific opportunity that a company creates and grows, but several. Therefore, the identification of entrepreneurial opportunities is not necessarily a nonrecurring event, but it is more likely a recurring and continuous process, in which firms permanently look for entrepreneurial opportunities. Third, there is no clear separation between actively searching for opportunities or recognizing them by coincidence, but both “active search” and “serendipity” play a role in finding new entrepreneurial opportunities and in acquiring new projects (see also Denrell, Fang et al. 2003). Fourth, entrepreneurial opportunities are mostly described as spectacular and unique cases. However, when starting a business, not every entrepreneurial opportunity is a spectacular and unique case. Less spectacular opportunities are carried out as well just to guarantee the survivability of the company and to generate liquidity for further investments. Additionally, as a young firm for individualized software projects, the access to new, interesting and highly innovative projects is difficult, due to a lack of reputation. Finally, when looking at the technological side, the companies make a choice - which is based on technological persuasion and personal stance - for a certain technological system. It is less a single and unique technological invention they rely on.

Analyzing the extent of prior knowledge the three software companies have before they are founded, there is clear evidence that prior knowledge of markets and customer problems only existed to a very limited degree. Prior knowledge of markets and customer problems is only an inferior factor with regard to how the three software companies come to their business opportunities in the very early stages of their existence. Concerning prior knowledge of how to serve markets, it can be said that
profound technological know-how exists from the beginning and represents an important factor in order in gaining new software projects and pursuing new entrepreneurial opportunities. However, at the outset, the experience of handling comprehensive projects is still limited, and prior knowledge about distribution, marketing and ways of organizing existed to only a small degree.

Based on these differences, two alternative models are presented, in which the following elements are scrutinized in more detail: technological and business know-how, job related people know-what, the recognition of the commercial potential, firm foundation, the search for areas of application and the first projects obtained. Shane’s model and the two alternative models highlight the possibility of multiple sequences in how firms come into life and how they recognize their entrepreneurial opportunities. The two alternative models differ from Shane’s model with respect to the technological background examined. Instead of just looking at a single technological invention a broader technological environment forms the backbone of the process. Model A and B also make a distinction between the recognition of the commercial potential of a knowledge domain or activity and the recognition of a specific entrepreneurial opportunity. It is shown that an entrepreneur or an entrepreneurial team can recognize the commercial potential of a certain knowledge domain without having identified a concrete entrepreneurial opportunity yet. Therefore, there is no necessity that the recognition of a commercial potential and the recognition of an entrepreneurial opportunity has to occur simultaneously and as a consequence, the recognition of a commercial potential and of an entrepreneurial opportunity should not be implicitly linked per se, but the relationship should be explicitly explained. The two models also show that the relation between the opportunity recognition and the form of exploitation does not necessarily have to be a determined recursive\(^{56}\) (hierarchical) one, meaning that the recognition of an opportunity does not necessarily lead to a certain form of exploitation. For example, the form of exploitation can already be chosen before a concrete entrepreneurial opportunity is identified or further entrepreneurial opportunities may arise out of a certain form of exploitation. Furthermore, this indicates that in cases where the interplay between opportunity recognition and exploitation is repeated over time the causal ordering may be perfectly non-recursive.

\(^{56}\) Recursive means that the causal ordering only goes in one direction.
As already mentioned, conceptional models represent a simplification of reality – which is desirable because it reduces overwhelming complexity and makes it easier to understand the world. The drawback of a model can consist of omitting certain aspects that may play a certain role as well but which, for reasons of simplicity and parsimony, have been left out. Therefore, some additional issues have been raised in the previous sections.

It is shown that the university context plays an important function in providing profound technological know-how and in providing a place where people with similar interests and technological competences meet. Furthermore, maintaining personal ties to the universities facilitates the engagement of human resources during the development of the companies.

The analysis of the companies also indicates that just looking at the entrepreneur as the only person is a limitation in these knowledge driven companies. Although there are persons who are in the lead, the realization of the projects is a joint effort, which takes place in flat and non-formal organizational structures. The informal way of organizing is also reflected in the fact that formal roles are not assigned, but people often grow into them.

The two models presented in this chapter mainly rely on epistemological, cognitive and action oriented elements. However, in addition to those factors motivational factors can also play a role in bringing knowledge to entrepreneurial action (Shepherd and De Tienne 2005; McMullen and Shepherd forthcoming). One of these factors is interest – defined as a human feeling that accompanies or causes special attention to an object or to a certain activity. The interest in software development and in realizing that activity in a self-defined environment is a precondition for the pursuit of entrepreneurial opportunities. However, interest alone may not be sufficient to pursue entrepreneurial activity; intention may be seen as the determination to act in a certain way. Nevertheless, even when having the intention, the identification and exploitation of entrepreneurial opportunities is not an easy walk-through - obstacles are many. Volition as a self-regulative strategy can therefore hinder deviation from intention and can help reach the intended goals, for example in being persistent in the search process for entrepreneurial opportunities. Volition as a construct is well known in psychological theory (see Mischel 1996; Metcalfe and Mischel 1999), but has not been sufficiently linked to entrepreneurial opportunities yet. This might be an interesting path for future research.
Summing up, this chapter has produced some interesting insights. In particular, the three software companies had only limited prior knowledge about markets and customer problems before they started, but had profound technological know-how. This does not mean that prior knowledge does not play a role in the process of opportunity recognition. It does. But we have to rethink how and when this prior knowledge is generated. This means, that prior knowledge is not necessarily a precondition for entrepreneurship, but is in many cases an integral part of entrepreneurial action *per se*. How the three software firms identify their entrepreneurial opportunities by generating information and knowledge about markets and customer problems is the main topic of the next chapter.
Chapter 5

5 Information and Knowledge Asymmetries – The Entrepreneurial Process and the Creation of Business Opportunities

The theoretical and empirical discussions in the previous chapter have shown that knowledge plays a key role in the entrepreneurial opportunity identification process. Despite the differences between the alternative models that have been discussed, they have one central commonality in that knowledge and the different aspects of knowledge gathering, processing and utilization are in the core of these models. To enable a better understanding of the entrepreneurial process this chapter therefore analyzes information and knowledge issues, information and knowledge asymmetries and what role they play in the entrepreneurial process in more detail.

The following theoretical part deepens the understanding of the foundations of Shane and Venkataraman’s work in respect of idiosyncratic information and prior knowledge by examining Hayek’s notion of dispersed knowledge (Hayek 1945) and Akerlof’s concept of asymmetric knowledge (Akerlof 1970). It is shown how these two works have influenced a part of the present research in entrepreneurship, highlighting the positive and negative aspects of dispersed knowledge and information asymmetries for entrepreneurs.

Based on the theoretical discussion some open issues in respect of information and knowledge asymmetries in the entrepreneurial process are addressed. In particular, the focus lies on a deeper investigation of asymmetric information and knowledge and its consequences for the entrepreneurial process of opportunity identification, evaluation, opening up and exploitation. This is done by means of the empirical data of the three software firms.

Finally, based on the theoretical implications of Shane and Venkataraman’s framework and based on the insights from the empirical part, a comparison of the two leads to a discussion about how customer and market knowledge are developed, how the entrepreneurial process can be characterized in light of these aspects and what the
consequences of a more differentiated view of information and knowledge asymmetries are.

5.1 Theoretical Background

Prior knowledge of customers and markets has its origins in Hayek’s (1945) notion of dispersed knowledge in society. The specific application of this concept in form of dispersed knowledge in economic transactions has indirectly led to Akerlof’s (1970) model of asymmetric information. This section provides the theoretical background with regard to these two concepts that forms the basis for the empirical discussion in section two. It further highlights the positive characteristics of dispersed knowledge as derived by Hayek (1945) as opposed to the negative drawbacks implicated by Akerlof’s (1970) work on asymmetric information.

The analysis of dispersed knowledge and information asymmetry provides deeper insights into the entrepreneurial process, because these two concepts have not only influenced researchers in pure economics, but also entrepreneurship research and they create a backbone in the entrepreneurial opportunity discussion as we will see in the next two sections. The examination of Hayek’s and Akerlof’s work, together with succeeding publications of other authors, leads then to some open issues with respect to asymmetric information and knowledge in the entrepreneurial process, which will be discussed in the last part of this section.

5.1.1 The Dispersion of Knowledge and Information

Before evaluating the implications of dispersed knowledge and information asymmetries for the identification and exploitation of entrepreneurial opportunities, the two central papers in these areas – Hayek (1945) and Akerlof (1970) – and their general implications will be summarized first.

5.1.1.1 Hayek and the Positive Characteristics of Dispersed Knowledge

Hayek was one of the first economic scholars to argue that the consideration of knowledge recognition is an essential element in any economic theory. In his essay “The Use of Knowledge in Society”, Hayek (1945) points to the misconception that some economists and also supporters of centralized economic systems often have with respect to the role of knowledge in society. Hayek criticizes the basic assumptions of
classical economic theory by indicating that not all relevant information is necessarily available in an economic system. Many preferences and productive means of the economic actors are not known to all other actors and, therefore, the efficient allocation of resources cannot be calculated just by mathematical means and solved by pure logic. Therefore, he also stresses the particular characteristics of dispersed knowledge in society, which in his opinion is essential in an economic system and which enables people to recognize and exploit different opportunities to the best of the whole economic system.

What does Hayek exactly mean when using the term dispersed knowledge? According to his understanding, an important aspect of knowledge in an economic system is that it does not exist in concentrated or integrated form, but rather as dispersed bits of incomplete and frequently contradictory knowledge, possessed by separated individuals. In other words, knowledge is not given to anyone in its totality, but knowledge differs in the particular circumstances of time and place.

Above all, Hayek makes a difference between two kinds of knowledge. The knowledge he mostly speaks of in his article - dispersed knowledge in particular circumstances of time and place - is local, unorganized and held by a few particular persons. He contrasts this dispersed knowledge with scientific knowledge, which in his understanding is more universal and is constituted through general rules. Both kinds of knowledge are important and Hayek warns that we should not consider one better than the other.

The positive characteristics of dispersed knowledge, as derived by Hayek, lies therein, that when practically every individual has some unique information which gives him an advantage over others, and when society makes use of this unique, dispersed knowledge, there exists the possibility that in a competitive market system the best opportunities are chosen and realized.

5.1.1.2 Akerlof and the Drawbacks of Asymmetric Information

In markets where asymmetric information between transaction parties exists with respect to the quality of traded goods or services and, additionally, when the quality of these goods and services is hard to judge due to various reasons, the danger exists that the market mechanism does not properly function anymore. As a consequence, products and services of good quality are driven out of the market by the ones with poor quality, because the market price will be an average price that is too high for the inferior and too low for the superior good or service.

This *adverse selection*, where “undesirable” members offering bad quality are more likely to participate in voluntary exchange in a market with asymmetric information than “desirable members” offering good quality, leads to the costs of dishonest behavior. These costs are the result of poor quality products or services being sold at too a high price and in addition to the overpaying by the purchaser they also include the harm borne by the society as a whole because dishonest dealings tend to drive honest ones out of the market.

Akerlof (1970) mentions several examples where the impact of asymmetric information can be seen. A famous one is the market for second-hand automobiles, where qualitatively poor cars (lemons) drive out qualitatively good cars, thereby providing an economic explanation for the big price depreciation for comparably new cars in the second-hand market. A further illustration is the market for insurances, where elderly people have difficulties of finding highly endowed medical insurances. A final case is a credit market with universal interest rates, where asymmetric information tends to result in rates that are set too high and consequently, “good risks” are driven out by “bad”\(^57\) ones.

In summary, Hayek and Akerlof both write about knowledge and information asymmetries. Whereas Hayek elaborates about the positive side of dispersed knowledge that causes markets to exploit existing opportunities and therefore forces markets towards equilibrium, Akerlof reflects on the negative side of asymmetric information that - in the worst outcome - makes markets to collapse.

5.1.2 Its Consequences for Entrepreneurial Opportunities

Since Hayek and Akerlof have created the notion of asymmetries in knowledge and information, their ideas have found extensive echo in many areas and have influenced

---

57 Those risks for which the chance of partial or complete bankruptcy is higher.
many researchers, also in the field of entrepreneurship research. The influence and interaction these two authors have had on the entrepreneurship field will be analyzed in more detail in this section. Specifically, the following three aspects are examined: (1) asymmetric information, market failures and the inversion of the argument; (2) information and knowledge asymmetries and their role in the discovery of entrepreneurial opportunities; and (3) information and knowledge asymmetries, opportunity exploitation and a theory of the firm.

5.1.2.1 Asymmetric Information, Market Failures, and the Inversion of the Argument

Venkataraman (1997) picks up the notion of Akerlofian asymmetric information in the context of entrepreneurs bringing new products or services into existence. A lot of information which is required by potential shareholders about new products or services is not available before the products and services are fully born. Even though information about the quality of new products and services might exist, this kind of information is mostly private and in the hands of the entrepreneur. Shareholders have to rely on the information they receive from the entrepreneur and are therefore faced with a situation of asymmetric information. Consequently, Venkataraman (1997) points out the inherent risks of opportunism and moral hazard problems\[^{58}\] in these situations and the potential risk of market failure.

However, Venkataraman extends the argument and reverses it by saying that there is not only a downside to situations of asymmetric information. On the contrary, circumstances of asymmetric information can also represent a chance for inventive entrepreneurs to act and to overcome the given obstacles.

Economic theory, for instance, suggests that asymmetric information can be mitigated by signaling (e.g. Spence 1973). By signaling economic actors, who possess the private information, invest in costly attributes which make information indirectly public. Examples are expenses in R&D\[^{59}\], which would not be spent if the entrepreneur did not expect to be able to extract profits from the results; the issuing of warrants, which would not be issued if the supplier of a product did not believe in the quality of

---

\[^{58}\] Moral hazard is the tendency whereby people expend less effort protecting those goods that are insured against theft or damage or are financed by others. Moral hazard occurs when the actions of agents cannot be perfectly observed or contracted for directly by the principal(s). In a narrow sense, moral hazard has been responsible for the effects which insurance contracts may have on the behavior of the insured persons. More generally, economic terminology refers to moral hazard to imply the lack of observability of contingencies and the consequence of hidden, unverifiable action within contractual relationships.

\[^{59}\] Research and Development
it, or the education degree as a signal for labor productivity. Furthermore, economic actors can provide ‘soft’ incentives, such as reputation building, meaning that entrepreneurs can build up reputation in respect of their products (Nelson 1974), their company (Wernerfelt 1988) and their person (e.g. Fama 1980) through honest declarations and high quality over time.

Venkataraman (1997: p. 127) also highlights the importance of social capital that entrepreneurs use to reduce adverse selection and moral hazards problems. In particular, he mentions the usefulness of trust and prior experience in cooperative relationships in order to reduce the adverse selection, opportunism and moral hazard problems. The general approach in entrepreneurship literature is to consider trust as a lubricant that facilitates cooperative exchange, in particular in situations of asymmetric information and uncertainty, or it enables entrepreneurs to overcome the lack of legitimacy.

However, not every concept of how to reduce asymmetric information may be used by all entrepreneurs. First of all, signaling theories are costly in realization and therefore require resources such as capital, for example to finance advertisement campaigns or investments in R&D. But those resources are often lacking or scarce in the entrepreneurial process and certain signaling strategies are therefore not available. Additionally, reputation is a long term concept, built up through repetitive and honest behavior in business relationships with certain stakeholders. For young companies and for young entrepreneurs, who are at the beginning of their “career”, reputation may not exist due to a non-existing historical track record. Therefore, an important concern of young firms may be to build up reputation to reduce the asymmetric information problem.

5.1.2.2 Asymmetries and the Discovery of Entrepreneurial Opportunities

In his seminal book chapter, Venkataraman (1997) underscores the value of Hayek’s notion of dispersed knowledge in order to understand the discovery of entrepreneurial opportunities. The fact that knowledge is partitioned in a market economy represents an essential explanation why entrepreneurs recognize and evaluate different opportunities. In particular, he develops Hayek’s idea of dispersed knowledge, according to Hayek a central feature of a market economy, into the concept of “knowledge corridors” (see also Ronstadt 1988). Owning specific knowledge guides entrepreneurs to profitable opportunities, which are not recognized
by people who do not possess this particular knowledge. According to Venkataraman, specific knowledge is acquired through each individual’s own circumstances including occupation, job routines, social interactions, and daily life.

Interestingly, it seems that Shane and Venkataraman (2000) in their further co-authored paper change the connotation of knowledge into information - without giving a particular explanation. They henceforth speak about “dispersed information” and “information corridors”. Furthermore, whereas in Venkataraman’s first paper in 1997, specific knowledge explicitly plays a role in the whole entrepreneurial process, from the recognition, the decision to exploit, up to the exploitation phase, in their later work (Shane and Venkataraman 2000) the role of specific information is primarily directed to the discovery of opportunities. Information stocks and flows are associated more specifically to cognitive properties in the discovery process, in so far as stocks of information create mental schemas, which provide a basis for recognizing new information. When it comes to the decision and the exploitation analysis, the question of knowledge recedes into the distance. Instead of exploring the function of specific knowledge further, the authors focus on two other determinates. First, the nature of the opportunity itself – meaning that entrepreneurs exploit these opportunities where the expected profit will be large enough to compensate for the opportunity costs of other alternatives (Casson 1982). Second, individuals may assess a given entrepreneurial opportunity differently, because of individual differences in entrepreneurial experience, optimism, social and financial capital.

Additionally, based on the previous work, Shane (2000) exclusively engrosses the notion of prior information, depicting the existence and non-obviousness of entrepreneurial opportunities due to information asymmetry\(^\text{60}\). Different people possess different information, which they can directly use for their own sake. Prior information influences the entrepreneur’s ability to comprehend, extrapolate, interpret and apply new information in ways that those lacking that prior information cannot replicate (Shane 2000: p. 452). Interestingly, although Shane is discussing the meaning of information, when formulating his propositions, he suddenly uses the knowledge term instead of the information expression, again, without specifying his motives. Therefore, his propositions concern, as we have already seen in Chapter 4, the central meaning of prior knowledge about markets, customers and how to serve

\(^{60}\) Information asymmetry is used here in the positive sense of Hayek’s notion of dispersed knowledge (Hayek 1945) and not in the negative meaning of Akerlof (1970).
Information and Knowledge Asymmetries: The Entrepreneurial Process and the Creation of Business Opportunities

markets in the discovery process. Hence, the most plausible explanation is that the two authors use the two denotations as synonyms.

5.1.2.3 Asymmetries, Opportunity Exploitation and a Theory of the Firm

A further aspect with regard to the exploitation of opportunities, raised by Venkataraman and Shane (2000) and researchers who are in line with the two authors, relates to the different modes of opportunity exploitation. In particular, the question is addressed when an opportunity is exploited by the institutional arrangement of the firm or the market (Shane and Venkataraman 2000); by existing firms or by new ones (Dew, Velamuri et al. 2004).

There exists hardly any literature yet about the question with regard to when opportunities are explored in the firm mode or when the market mode is chosen (apart from the classics in general market-firm considerations, such as Coase (1937) or Williamson (1975)). While Venkataraman and Shane (2000) highlight the institutional and market mode issue as an important question in the field of entrepreneurship, they do not provide a detailed answer in their article. In contrast, Dew, Velamuri et al. (2004) particularly investigate theoretically whether the exploitation of opportunities is pursued by new or existing firms.

More specifically, in analyzing the question of the exploitation mode, Dew, Velamuri et al. (2004) suggest that dispersion of knowledge (Hayek 1945) can be divided into three categories, namely: the dispersion of knowledge across people, across places and over time. They further argue that the dispersion of knowledge across people and places leads to information asymmetry in the Akerlofian meaning (Akerlof 1970), representing a situation of cross-sectional uncertainty, whereas the dispersion of knowledge over time leads to longitudinal uncertainty in the sense of Knight (1921), meaning that the probabilities of outcomes are unknowable.

---

61 The existing classical theory about related market-firm questions is not sufficient to give an accurate answer concerning the opportunity exploitation issue. In compliance with Dew et al. (2004), an entrepreneurial theory of dispersed knowledge generates several novel insights in respect of the firm. While previous theories of the firm, such as incomplete contract (e.g. Grossman and Hart 1986), transaction cost (Williamson 1985) and agency theory (e.g. Jensen and Meckling 1976) give an explicit explanation why certain activities are carried out in the institutional modality of the firm versus the market modality, these theories do not explain how firms come into existence and why a new firm or an existing firm will be the vehicle for taking a new opportunity to the market.

62 In his seminal work, Knight (1921) makes an important distinction between risk and uncertainty. Risk means that the probabilities of outcomes are known and therefore, risk is measurable and calculable. Uncertainty, on the other hand, cannot be measured and probabilities of outcomes are unknown.
Chapter 5

Additionally, Dew, Velamuri et al. (2004) claim that if people know different things and if the probabilities of certain outcomes are unknowable, people will build heterogeneous expectations about the future. These different expectations will lead to different individual-opportunity nexuses for new products and services (Venkataraman 1997). Consequently, a decision has to be made if a given opportunity is exploited within an existing or a new firm. As an organizing principle for this question, Dew, Velamuri et al. (2004) suggest considering the inter-subjective agreement among the relevant economic agents within and outside existing firms. They postulate that when there is almost no uncertainty attached to an opportunity, it is easier for people to agree about the value of an opportunity which consequentially leads to a high inter-subjective agreement. On the other side, when an enormous amount of uncertainty is attached to an opportunity, agents have very heterogeneous expectations about the value of an opportunity, and therefore, the inter-subjective agreement about it will be low. They conclude that when the inter-subjective agreement is high within a firm, opportunities are more likely to be explored within an existing firm. On the other side, when the inter-subjective agreement is low, it is more likely that opportunities are exploited by individuals or teams of individuals by forming new firms.

5.1.3 Some Open Issues

Given the theoretical background of dispersed knowledge and its application in entrepreneurial research as discussed in the previous sections, I would like point to some open issues that become relevant when comparing the given theoretical models with the empirical observations in the three underlying case studies of this work.

First of all, Shane, Venkataraman, Dew et al. (Venkataraman 1997; Shane 2000; Shane and Venkataraman 2000; Dew, Velamuri et al. 2004) refer to Hayek’s concept of dispersed knowledge (Hayek 1945). Thereby, they use the terms information and knowledge synonymously. Dew, Velamuri et al. legitimate their doing so by emphasizing that their main concern rests on the issue of dispersion and not on the differences between knowledge and information. However, the proponents of the knowledge-based view argue that there is an important difference between information and knowledge (e.g. Kogut and Zander 1992; Nonaka 1994; von Krogh,

63 The inter-subjective agreement is a kind of consensus among economic actors about the value and risks of an opportunity.
Roos et al. 1994). Therefore, it is worthwhile examining the difference of information and knowledge asymmetries in the entrepreneurial process more closely.

Second, Hayek, Venkataraman, Shane and Dew et al. underline the importance of the fact that knowledge and information are not equally spread over economic actors for understanding entrepreneurial action. However, when using the concepts of information and knowledge asymmetry, there is still room for specifying in more detail between whom these asymmetries exist and what consequences these imply. Therefore, this question is investigated in depth in the next section.

Third, after having clarified the difference between asymmetric information and knowledge and after having demonstrated between whom those exist, it is of interest to look in more detail at the role of these information and knowledge asymmetries in the entrepreneurial process of opportunity identification and exploitation. There, the focus lies less on the static view of prior knowledge (Shane 2000), but more on the dynamics of how information and knowledge are acquired and transferred in the entrepreneurial process.⁶⁴ Thereby, the focus of the analysis is primarily on the software firm – customer relationship.

5.2 Empirical Findings

In order to answer the issues brought up at the end of the previous section, in a first part of this sub-chapter, the different aspects of asymmetric information and knowledge are examined for the specific case of the individualized software market. Thus, the focus is on two aspects – the difference between asymmetric information and knowledge, and on the question between whom asymmetric information and knowledge exists in the entrepreneurial process. In the second part of the sub-chapter, the role of the addressed entrepreneurial process in reducing asymmetric information and in creating idiosyncratic knowledge is examined. In particular, four sub-processes – the identification, the evaluation, the opening up and the exploitation of entrepreneurial project opportunities – are discussed in detail. The final part of this

⁶⁴ The questions mentioned above are in line with Hayek’s article “Economics and Knowledge” (Hayek 1937), in which he explains that in order to understand economic actions and mechanisms, it is of fundamental importance to understand the conditions and the process of how people acquire knowledge, how much and what sort of. Interestingly, Shane, Venkatamaran and Dew et al. only refer to the latter article (Hayek 1945) although I believe that the article written in 1937 is of similar importance, because he emphasizes so strongly the dynamic aspect of knowledge acquisition in the market process.
sub-chapter consists of several project examples that show different patterns, characteristics and moderating factors in the four processes.

5.2.1 The Software Market for Individualized Solutions: The Dispersion of Information and Knowledge

To lay the basis for the following discussions, the next sub-section starts with a brief description of the software sector, particularly looking at the demand and supply side of individualized software projects. In a second sub-section, the special characteristics of the market for individualized software solutions are explained. This market is specifically characterized by a high degree of asymmetric information that exists between software firms and their customers, on the one side, and among competitors, on the other side. These asymmetries play an important role in the identification and exploitation process of entrepreneurial opportunities in the market for individualized software solutions. In a final sub-section, the question of asymmetric knowledge is discussed at length. Particularly, the nature of knowledge, asymmetric knowledge between software firms and customers, and possible knowledge asymmetries between competing software firms are studied. Both the second and the third part also address the inherent market and technological uncertainty of the software sector.

5.2.1.1 Software Industry Sectors and Individualized Software Solutions

The Software Industry and Market

A short description about the heterogeneity of the software market has already been provided earlier in sub-section 4.3.1.1. In the following the subject is deepened once more. Another way to categorize the software market and industry is to look at the different software industry sectors. A possible categorization is presented in Table 13. Two main segments can be identified. On the one hand, there is commerce with software products, organized in the wholesale and retail business. On the other hand we have actual service business, in which the whole software development, consultancy, and additional services take place. Key players in this segment are vendors of software technology and components, software producers and consultancy firms.
Table 13: Sectors in the software industry

Source: adapted to ICTswitzerland (2004)65

If we concentrate in more detail on the software service business, according to the Gartner Group, we can divide the service business into three core services (see Table 14 (p. 108)). The first core service comprises IT consulting - which includes business and IT related advisory services for analyzing and improving the efficiency and efficacy of IT-based business operations and strategies. A second core service represents the development of software, which encompasses several sub-services, such as the development, deployment and integration of software. Software development primarily focuses on the programming, enhancement and documentation of software and middleware solutions. Software deployment again incorporates several activities, such as software configuration, tuning, staging, installation and interoperability testing. Hardware procurement can be a part of the deployment activity as well. Integration services are detailed design, implementation and management services that link applications (custom or prepackaged) to each other or with the established or planned IT infrastructure. Finally, a third core service concerns IT management. It deals with the organization and operation of IT assets and processes. In particular, it includes application, help desk and operation services. Application management focuses on the maintaining and enhancing of used applications. Different degrees of help desk services can be provided in order to handle and support a customer’s internal queries and operational problems. Lastly, operation services help to handle the customer’s IT infrastructure. They comprehend activities such as system operation; support and administration; security issues; performance monitoring; technical diagnostics and configuration management.

65 ICT stands for Information and Communication Technology.
When looking at the formal categorization in Table 14, several issues are to be considered. First of all, not all companies that provide professional services for their customers necessarily cover all the activities mentioned listed in Table 14. Some firms focus on a specific activity, such as consulting or the development and integration of software applications. Other companies may cover more or less the whole range but weight each activity differently. Furthermore, each service needs its own skills and competences. For example, in order to calculate the economic utility of specific software solutions obviously other skills are required than for the configuration of a software system. Additionally, the level of skills and competences to provide certain services may also vary significantly. The skill set that is required to build software that is interoperable, scalable and reliable may be more demanding than that for providing operation services, such as hosting and backup management.

Table 14: Professional services in the software industry

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional Services</td>
<td>Consulting</td>
<td>Business consulting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IT consulting</td>
</tr>
<tr>
<td>Development and Integration</td>
<td>Software development</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Deployment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Integration</td>
<td></td>
</tr>
<tr>
<td>IT management</td>
<td>Application management</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Help desk management</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Operation services</td>
<td></td>
</tr>
</tbody>
</table>

*Source: adapted from Gartner Group (2004)*

It is worthwhile to remind the reader of the heterogeneous characteristics of the software market and therefore, the presented overview in Table 14 is a formalized simplification of reality and does not claim completeness.

Hosting is a service provided by Internet Service Providers and other companies that allows users to store and access their web page, data, and applications from the providers’ servers. Backups allow the user or company to restore important data if the computer encounters a computer virus or if the data happens to be destroyed or corrupt.
After having presented a broad overview of the software industry and services, the next section focuses on the demand and supply side of the market for individualized software. The main difference between customized and standard software production arises because customized or individualized software are tailor-made solutions that meet the specific needs of specific customers, whereas standard software is produced to meet generic needs of a broader market, generally, of the mass-market.

The Demand and Supply Side of (Individualized) Software

A main aspect of the demand side of the individualized software market arises from the question why customers buy individualized software solutions when standardized products are often cheaper. The simplest answer is, that for certain needs no standardized products exist. Therefore, companies that produce individualized software solutions are generally riding in front of the “standardizing wave”, picking up new areas in IT, where no standardized products are available. A second reason lies in the flexibility of tailor made solutions. A custom made IT solution can in this context be seen as the analogy of a tailor-made suit. It can be fitted to the specific needs of a customer. Finally, customized solutions are also a means for a company to differentiate itself from its competitors. For example, companies can gain a competitive advantage by building specific front-end software, by automating business processes, by converting specific business ideas in a technological solution, or by using new and more efficient technologies, to name just a few. This strategy has not only the potential to increase the efficiency of the business but may also serve as a market signal for innovative behavior.

Further insight about the specific characteristics of the market for individualized software solutions can be gained by analyzing its customers in general and, more specifically, with respect to company size and industry. Statistics for Switzerland show that in relative terms, investments in information and communication technologies (ICT) are more or less equally spread, regardless of company size (see Appendix A). On average, small, medium and large seized companies invest more than a quarter of their overall spendings in ICT. When looking at industry sectors,

---

68 It is also referred to Chapter 4.3.11, where certain kinds of software products have been presented. There exists for example application software, such as back-office, ERP, PLM and SCM; collaborative and personal software; engineering and academic software; front-office, such as CRM software. Further, companies produce infrastructure software, such as applications for development and middleware; information and storage; systems and networks management and DBMS. Additionally, operation system software is developed as well as software for a wide variety of hardware components.
companies in the service sector invest on average more in ICT than companies in the construction or industry sector (see Appendix B). On average, companies in the service sector invest almost a third of their overall investments into ICT. Nevertheless, if we specifically look at the different segments in the service sector, investment activities are more heterogeneous. For instance, computing and research institutions invest 59.4% of their overall investments into ICT, followed by banking and insurance companies (52.8%), and professional service firms (45.4%). Other service-related businesses invest much less, for instance, hotels and real estate companies invest around 18%.  

Turning to the overall market, absolute company investments in IT added up to over 3bn CHF in Switzerland in the year 2000, according to the Swiss Federal Statistical Office. Together with investments in communication technologies this number grows to almost 7bn CHF (see Appendix C). Other research institutes have even higher investment volumes. The European Information Technology Observatory (EITO) estimates that the total Swiss investment in ICT equals 20bn Euros in 2004. Out of these 20bn Euros approximately 10 percent alone are invested in software products, meaning a size of roughly 2bn Euros for the Swiss Software market.

For a separation of these numbers between individualized and standard software, no sufficient data is available. However, some helpful indicators can be found. Based on a survey of Accenture and Avanade in 2004, 75% of the persons interviewed are of the opinion that standardized software is especially important for back-office operations. 44% of the respondents believe that standardized software cannot cover all needs. Thus, 59% see individualized software as an important complement to standardized software. 35% consider an individualized front-end as an important factor in order to differentiate the company in daily competition.

Further indications can be derived from the interviews with the three software companies. According to them, companies that use custom-made software besides

---


70 The difference in the size estimates between these two sources is not attributable to the growth of the ICT sector from 2000 to 2004. It can be assumed, that the EITO used a broader classification of ICT than the Swiss Federal Statistical office.

standard products are in general large-cap enterprises for which IT plays a dominant role in their business and where IT is an important contributing factor to being successful in competition. Because sophisticated individualized solutions are typically more costly than standardized ones, and such costs can easily reach a six digit amount, depending on how many working hours have to be deployed, smaller companies normally do not invest in tailor made solutions. Conversely, bigger companies in the financing, insurance, and telecommunication sector have the means and the demand for individualized solutions, especially in those areas where standard products are not available or do not fit to their needs arising from the high complexity levels of their business activities due to their size and the range of services offered. Besides private companies, the public sector is also a potential customer for tailor made solutions.

Many of these large-cap enterprises possess their own well established IT departments. For example, the two biggest Swiss banks, UBS and Credit Suisse are the biggest employers of computer scientists in Switzerland. However, most companies instruct external firms to provide certain projects. The question is why certain IT projects are outsourced. The reasons are manifold. Companies may look for specific competences they do not have themselves. Additionally, they do not have the capacity and resources to handle all projects and activities. Furthermore, small external software companies normally work especially efficiently due to flexible teams and short decision making processes. Besides, by using special contract arrangements, such as fixed-priced or so called turn-key contracts, companies can reduce certain risks of software projects, such as exceeding costs. Lastly, by outsourcing certain IT activities, it enables companies to concentrate on their core business and competences.

Finally, when looking at the supply side of the software market, it is noticeable that beside a few large companies, such as IBM, HP\textsuperscript{72} or Accenture, most software producing companies are small and medium sized businesses (SMB). Given the approximately 10’000 software companies in Switzerland, ICTswitzerland specifies the average software company size to 6 persons (see Appendix E). Due to the smallness and the extensive quantity of firms, it is a challenge for every small and medium sized company that is interested in tailor made projects to establish customer relationships and to acquire innovative projects. This is especially the case when

\footnote{Hewlett Packard}
companies are young, but also more mature and older companies face difficulties in the acquisition of projects and the establishment of customer relationships. One reason lies in the asymmetric information constellation in the individualized software market which is the topic of the next section.

5.2.1.2 The Market for Individualized Software Solutions and Information Asymmetries

The market for individualized software solutions distinguishes itself through a high degree of asymmetric information that plays an important role in the identification and exploitation process of entrepreneurial opportunities. However, if we speak of asymmetric information, we should be more precise what is meant by it. Of course, one important element is the dispersion aspect as mentioned by Shane, Venkataraman and others (Venkataraman 1997; Shane 2000; Shane and Venkataraman 2000; Dew, Velamuri et al. 2004). However, I think there is more to say. First, I would like to concentrate on the characteristics of the information term and second, have a deeper look what kinds of asymmetric information exist in the entrepreneurial process - illustrated by the market for individualized software projects. Specific interview statements are represented in Table 15 (p. 118).

Asymmetric information between software firms and their customers: In relation to individualized software projects there can be different forms of ex ante information asymmetries between software companies and customers: (a) one form is the lack of information about possible innovative projects, (b) another form of asymmetric information results from the absence of specific information about the relevant people for software projects in large-scale enterprises (see also job related people know-what in sub-section 4.3.2.1), and (c) a third form consists of the difficulty of judging the quality and competence of providers of individualized software projects. Because asymmetric information between software firms and their customers exists in the vertical arrangement of the economic value chain, it is denoted as vertical asymmetric information. The three identified forms of ex ante vertical information asymmetries are examined in more detail below:

a) Lacking information about possible innovative projects: Due to the fact that buyers of innovative tailor made software projects are generally large-scale enterprises, it is often not an easy task for supplying software companies to spot such entrepreneurial opportunities within large corporations. Such projects can
Information and Knowledge Asymmetries: The Entrepreneurial Process and the Creation of Business Opportunities

arise within large firms at different places, times and among different people. It is therefore essential that software companies have access to the people responsible from the business and the technological side, in order to have an understanding of possible entrepreneurial opportunities arising from specific needs within these corporations. This is particularly important for SME, because they do not have the same market appearance and marketing apparatus as the few big IT players such as IBM or HP. On the other side, from a customer perspective, it is sometimes not an easy task to identify the most suitable software provider for a project, because of their relative smallness and extensive quantity.

b) Absence of specific information about the relevant people for software projects in large-scale companies: It is important to readdress the issue that software projects are basically realized among different people which leads to a second form of asymmetric information. In general, we assume, and often speak in this manner, that software projects are carried out between two institutions – a software firm and a large enterprise. Even though this is correct, at least from a legal perspective, it also represents a simplification. From a business perspective, it is not the institutions themselves, that arrange projects and conclude contracts, but people that work in the name of these institutions. Though this might be viewed as a detail, it can make a significant difference. Software companies in particular live from specific relationships and contacts with people, who are in charge of the respective functions in different departments and divisions. If people from a software company do not have the necessary information about who the important people on the customer side are, or if they have no established contacts or relationships with these people, this missing information is another form of asymmetric information that can hinder the understanding about where possible entrepreneurial opportunities exist or could be created. Even if people are informed about potential opportunities, it is still a challenging task to acquire a particular project when established relationships and contacts are missing, which is further highlighted under c) below.

c) Difficulty in judging the quality and competence of providers of individualized software projects: The creation of tailor made software projects is an extreme form of asymmetric information in an Akerlofian meaning (Akerlof 1970). It is difficult for a customer to judge the quality and competence of a software company in advance, before a project is started, without having common prior experience. This
is related to the special form of how individualized software projects are handled and due to the special characteristics of software \textit{per se}. Software is an immaterial good written in lines of code and it is a difficult task for a non-expert to judge the quality. Even if an expert is consulted at the beginning of a project, in the case of individualized projects, the software does not yet exist. It still has to be produced. Additionally, quality issues do not only concern the quality of the code, but also cover project management skills in respect of resource allocation, cost management, handling of time restrictions, and how well the problems and needs of customers are transformed into a valuable technological solution. Due to this specific asymmetric information situation in individualized software projects, trust becomes a very important issue. It is central that software companies can build up a sufficient trust level with their customers, which is a difficult undertaking in the circumstances characterized. As a way of illustration, Stefan Arn\textsuperscript{73} explains: “Software development is \textit{a priori} only believing. It is 99.8% about the customer believing in you. You sell foam, and when you turn it into concrete and finish the project, then it is not exciting anymore for you as a software company, but the customer has got something valuable“. And Theodor Graf\textsuperscript{74} underlines: “To get to know your customers and to build up mutual trust is the most difficult thing in the software industry, especially when you are a young company. The carrying out of a project, regardless of how big the customer is, is always a kind of marriage. And if you know today’s divorce rates, you know what that means!” Further statements can be found in the second row of Table 15.

\textit{Asymmetric information between competing software companies}: By establishing contacts and relationships with customers and with specific persons within these firms, software companies can gain an information advantage over their competitors in respect of potential software projects. This information advantage can be used to work proactively towards the acquisition of these projects before other competitors get the same information. However, this information advantage may only be temporary and not sustainable for several reasons. A company that is looking for a software solution is generally interested in obtaining more than one proposal in order to get the best price-performance ratio, except if it is \textit{a priori} already apparent that only one supplier comes into question. Likewise, large-scale organizations normally

\textsuperscript{73} CEO Adnovum

\textsuperscript{74} Founder and current CFO and Chairman of Ergon
have several established relationships with software companies and therefore information about potential projects disseminates through this network to several competing companies. Besides, when governmental institutions plan to undertake a software project and the project exceeds a certain threshold, then they are obliged to initiate a public invitation to tender as requested by the WTO\textsuperscript{75} Agreement of Government Procurement (GPA).\textsuperscript{76} In this case, every software company that is interested in the projects receives the same information in the form of a detailed project specification. Nevertheless, despite the different ways information about software projects disseminates into the market, a temporary information advantage may be sufficient to conclude a contract before most other software companies are aware of such work (see also third row of Table 15). Because the asymmetric information between software firms exists in the horizontal arrangement of the economic value chain, it is denoted as horizontal asymmetric information.

Asymmetric information between market players and “nature”: Another kind of asymmetric information relates to the fact that at any given point of consideration no party has accurate information about certain issues such as market development or future technological innovation and standards. Neither software companies nor customers or other economic agents possess accurate information about certain future outcomes. This information has still to be produced or it may already exist, but does not subsist in a form that is reliable, easily accessible or easy to interpret by economic agents. In analogy to game theory, I use as a matter of simplification the term “nature” to describe the circumstance where market players do not and cannot hold accurate information or cannot be sure whether they possess it. “Nature” is in game theory defined as a pseudo-player who takes random actions (see e.g. Rasmusen 1996). In this respect, asymmetric information between market players and “nature” indicates that certain future events and actions are uncertain and hard to predict. The meaning of asymmetric information between market players and nature is therefore similar to what Dew, Velamuri et al. (2004) describe as Knightian uncertainty (Knight 1921) or longitudinally uncertainty, in the meaning that in this situation no agent in the system can possess accurate information of the future and that accurate information has still to be created in order to predict the future. In this respect,

\textsuperscript{75} World Trade Organization

\textsuperscript{76} The GPA was signed in Marrakech on April 15, 1994 — at the same time as the agreement establishing the WTO. The new GPA entered into force on January 1, 1996.
asymmetric information between market players and “nature” can also be called *longitudinal asymmetric information*.

In the software industry and in individualized projects in particular, the degree of longitudinal asymmetric information and the resulting difficulty in predicting the future is distinct. Longitudinal asymmetric information can be composed of three major areas. First, there is longitudinal asymmetric information in respect of technological issues, where it is difficult in a fast moving technological environment to predict what new software technologies will be successful in the future. Second, there is a particular longitudinal asymmetric information in tailor-made projects related to customers’ future strategies, because it is uncertain, if after a first project a following project can be realized. Customers may also change over time for different reasons. Existing customers may change their IT-strategy, outsource their IT, have no demand for certain projects anymore, or simply intend to gain experiences with new software suppliers and so on. Third, there is also a certain amount of longitudinal asymmetric information with regard to where the whole software industry is heading. Topics such as major future areas of applications, the development of standardized and individualized software, consolidation and “industrialization” of the software industry, outsourcing of software development to countries with low production costs are all ongoing topics of discussions. It is possible to find information in the economic system about all these topics, but it is hard to determine how accurate this information is in order to determine future development. Therefore, reliable forecasting in the software industry is a difficult task. Again, some statements are represented in the last row of Table 15.

<table>
<thead>
<tr>
<th>Company</th>
<th>Adnovum</th>
<th>Ergon</th>
<th>Netcetera</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asymmetric</td>
<td>“With large-scale enterprises it is often the case that the customer</td>
<td>“The advantage of being a large scale software enterprise is evident. They normally get specifications about possible projects earlier than smaller companies. For most projects that are realized in Switzerland, companies such as IBM or HP</td>
<td>“Of course, we try to develop the company so that every time a decision maker, who plans to do a project and has had no well established business contacts with us so far, will nevertheless think of us. However, this does not yet happen automatically, and we still have to provide</td>
</tr>
<tr>
<td>information</td>
<td>X does not exist. Company X consists of many, many small groups that</td>
<td></td>
<td></td>
</tr>
<tr>
<td>between</td>
<td>often change and that often stand in reciprocal internal competition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>software</td>
<td>and it is clear, we live from relationships to specific people. It</td>
<td></td>
<td></td>
</tr>
<tr>
<td>companies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>and its</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>customers</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

116
### Asymmetric information between competing software companies

<table>
<thead>
<tr>
<th>always depends heavily on specific people.” (Matthias Loepfe, former CTO)</th>
<th>automatically get a software specification, which is not necessarily the case for us. This might be the disadvantage of not having a great marketing apparatus. On the other side, we don’t have to bear the costs for such an organization.” (Theodor Graf, Chairman)</th>
<th>some midwifery.” (Beat Stocker, former Chairman)</th>
</tr>
</thead>
</table>

“Sometimes you win a project, where another equal competitor exists. But you outpace him because you are in contact much earlier with the customer and the competitor therefore never gets around to showing that he can do it equally well or even better. Contrariwise, you think you can do a project much better, but somebody else comes first and wins the project.” (Stefan Arn, CEO)

“And therefore it is decisive that you are already in contact with your customer very early in order to make first suggestions for possible solutions so that there are not many other offerings from competitors.” (Patrick Burkhalter, CEO)

“In respect of governmental procurements there are strict guidelines. Projects which go beyond a threshold of 250.000 CHF have to be publicly announced. These procurements are of different qualities. The scope varies from 7 to 800 pages. The problem with governmental procurement is that you are not allowed to contact the governmental institution for further information because of the equal treatment agreement of the WTO” (Andrej Vckovski, CEO)

### Asymmetric information between market players and “nature”

| “I think it is difficult to say where we will be in two years. I think a prognosis is really difficult to make. When I look back two years, I wouldn’t have imagined where we stand today. Further, also customers can be unpredictable. They | “I once said that we will never work for a bank, and now we work for banks. We also said once that we don’t want to carry out big projects and then we realized many of them. Actually, in this respect we are relatively cautious with predictions, | “I think it is important, that in our highly volatile technological domain, you do not stand too much in the front line and do not invest too many resources there because that is where the greatest turbulences are. There is too much agitation

| --- | --- | --- |
Table 15: Statements representing different forms of asymmetric information

In summary, asymmetric information plays its particular role in the entrepreneurial process and it is important not to use the term as a smorgasbord expression, but to be more precise about what is meant by it. Information asymmetries are not only different from knowledge asymmetries, but it is also important to specify clearly between whom asymmetric information exists and what the consequences are. Exemplified by the market for individualized software products, three forms of asymmetric information are examined in more detail, namely asymmetric information between software firms and their potential customers; among software firms; and among market players and the overall economic system in which market players are imbedded. These three forms of asymmetric information are responsible that certain entrepreneurial opportunities, such as individualized projects, are not recognized by everybody, specific customer contacts are unknown, software quality issues are hard to determine, short term information advantages arise, and the future development of projects is difficult to predict. After looking specifically at information asymmetry, the next sub-section examines what forms of knowledge asymmetries play a role in individualized software projects.

5.2.1.3 The Market for Individualized Software Solutions and Knowledge Asymmetries

Based on the insights of the knowledge based view of the firm, whose proponents emphasize the clear distinction between information and knowledge; likewise, I have
claimed that it is important to make a clear distinction between asymmetric information and asymmetric knowledge. In the previous sub-section, the focus has been on information asymmetries in the entrepreneurial setting. In the following sub-section, the focus is laid on asymmetric knowledge. First, I briefly review the question, what characterizes knowledge and what makes it different from information. Subsequently, illustrated by the market for individualized software projects, the dispersion of knowledge among and between software firms and their customers is analyzed along the same dimensions as has been done for information asymmetries in the previous section: vertical, horizontal and longitudinal. A selection of statements is presented in Table 16 (p. 124).

The nature of knowledge: Brown and Duguid (2000) can serve as a starting point, looking at the knowledge part in their distinction between information and knowledge. In their opinion, knowledge is more tied to the knower, is therefore more difficult to detach and, therefore, it is harder to give and receive because its transmission requires more by way of assimilation. The reason for this lies in the tacit dimension of knowledge, meaning that the knower cannot easily transfer all his knowledge by formal language, but that knowledge often has also a very personal component, based on experiences made in specific contexts, which makes it more difficult to transfer (see Polanyi 1966; Nonaka 1994; von Krogh, Ichijo et al. 2000). In this line, one can understand knowledge also as knowing how to do things (Kogut and Zander 1992), based on its accumulated theoretical and practical experiences, that allows somebody to do something more or less smoothly and efficiently (von Hippel 1988). Therefore, the distinction between information and knowledge can be used as an argument by analogy with respect to the difference between asymmetric information and asymmetric knowledge. Due to the fact that information is easier to give, to transfer and to detach, as a result, asymmetric information can be optimally reduced when the volition of the different parties, the qualified knowledge to communicate and to understand a given piece of information, and the appropriate medium of communication are at hand. In contrast, the reduction of asymmetric knowledge is generally much more difficult. As we all know from daily experiences (for instance, think at the time at school or at university), in order to reduce extensive knowledge asymmetries, far more resources are required, such as time, talent, education, personal, learning etc. Consequently, there are situations where no asymmetric information exists, but still asymmetries in knowledge, which explains, as a simple example, that certain people with full information do not identify and exploit
opportunities because they lack specific knowledge. On the other side, there are people with the right knowledge, but they do not identify and exploit opportunities, because they lack the necessary information. Therefore, in the next sections, knowledge asymmetries between software companies and their customers are more profoundly analyzed.

Knowledge asymmetry between software firms and their customers: The dispersion of knowledge between software firms and their customers concerns several knowledge domains. Three of them are presented in the following, namely, a) technological know-how, b) business know-how, and c) translation skills. In analogy to vertical asymmetric information, the dispersion of knowledge between software firms and their customers is denoted as vertical asymmetric knowledge.

a) Technological know-how: In general, customers are looking for particular technological knowledge in software companies in order to solve specific technological problems, such as specific internet, security, or mobile issues, in order to carry out special application, middleware or expertise projects. Because customers do generally not possess the same extent of specific technological know-how like the software companies, they count on the capabilities of software firms to handle essential technological problems in large-scale IT environments, such as interoperability, security, performance and reliability issues of applications and systems. This inter-firm labor division is basically nothing other than a specialization on certain knowledge domains in today’s economy.

b) Business know-how: Beside their technological know-how, software companies also have to understand the business and administrative processes for which the software is planned in order to build a solution that supports a company in its business. The required business knowledge lies normally in the hands of the customers, and therefore is asymmetrically dispersed between suppliers and their customers. In order to build an effective solution, software companies must understand the problem not only from a technological side, but they also have to understand what the technology is used for. Therefore, it is essential that the understanding of the specific business and administrative processes is transferred from the customers to the software companies to the extent required to enable an effective solution that meets the customers’ requirements. However, the transformation of a business problem into a technological solution is not a one-to-one transfer but it needs a translation process.
c) Translation skills: A common mean to transfer business requirements into technological ones is by way of software specifications, which provide descriptive information about what the software should achieve. However, this transfer is not simple. To transfer a complex business problem into a technological solution, those written specifications are often not sufficient for direct implementation. There are two main reasons for this: First, from a technological point of view specifications are never complete. Parts are missing, are unclear, or still have to be determined. The creation of a complete specification is also economically costly because of the time needed to compose them and it is often more efficient to start working from a specification that does not define the last details but to define these in discussions during the development process. On the other hand, knowledge is often hard to transfer because of its particular characteristics, as described in the beginning of this sub-section and it is often not absolutely clear from an ex ante point of view, what the end solution will look like, because ideas and requirements may change during the project. Therefore, software firms for individualized software solutions establish special routines and procedures, where they temporally translate the business problem into a technological solution. However, when projects are worked on with new customers, depending on prior project experience, the knowledge about how this is done may differ between software firms and their customers and therefore, both parties have to find a way that suits them both.

Knowledge asymmetry between competing software companies: Knowledge asymmetries do not exist only between customers and software companies but also among software companies. In analogy to horizontal asymmetric information, the dispersion of knowledge among software companies is described as horizontal asymmetric knowledge. The following discussion points to certain factors that can lead to certain knowledge asymmetries between competing companies over time. In particular, differences can be primarily found in respect of (a) knowledge about the technological potential of projects, (b) customer knowledge, and (c) industry and market knowledge.

a) Knowledge about the technological potential of projects: In respect of technological asymmetries, an important element is the availability, selection and acquisition of innovative projects. The ability to acquire innovative projects has an influence on the technological knowledge base a company develops over time. In
general, innovation happens mainly directly in the projects themselves, by using new technologies or by solving specific problems, based on the needs of the customer. In the case of the three software companies investigated it can be observed that it is unusual that technological innovation is nourished by pure R&D activities independent of given projects. Consequently, the development of the technological knowledge base is influenced by the kind and range of projects that are selected. If a software company is able to acquire innovative projects over time, it is more likely that the company is also at the technological forefront in the near future.

b) Customer knowledge: With regard to customer knowledge, it is obvious that differences exist depending on how close and for how long a software company has worked with a specific customer. In general, the longer and closer a software company and a customer work together, the better known are the competences and the IT environment. Thereby, a software company can build certain knowledge advantages vis-à-vis other competitors. By completing projects, the software firm gains specific business knowledge of the customer, becomes possibly aware of further problems and needs in the customers’ IT environment and obtains insights into the customer’s project agenda. This specific customer knowledge can help software companies to identify and acquire new projects with a given customer more easily than competitors with no established relationships.

c) Industry and market knowledge: Similar to customer knowledge, software firms gain industry and market knowledge by carrying out projects. Specific industry and market knowledge is useful in many respects. For instance, for a successful project acquisition it is advantageous to know the particular habits in an industry or service sector. Furthermore, by building specific solutions, thereby incorporating specific industry knowledge, software companies increase the chances to solve similar problems within the same industry. Firstly, because they have identified a real need - which could be the need of not only one specific customer, but a general need of the whole industry, and secondly, because it generates trust on the customer side when he realizes that a software company has already completed projects in a similar context. Additionally, industry and market knowledge can also reduce transaction and production costs, because part of the necessary knowledge and part of the technological solution might already be at hand.
Knowledge asymmetries between market players and “nature”: The term “nature” is probably misleading in respect of the knowledge expression, because knowledge is generated by persons and does not exist in an abstract entity, called nature. Consequently, the term “nature” should not be taken literally, but rather as a metaphor for such circumstances where, in a particular point of time, no market player possesses accurate knowledge about certain aspects of technological and economic issues. Therefore, specific knowledge is missing, inconsistent, contradictory, or not justified and a certain amount of uncertainty exists until the missing, inconsistent, or contradictory piece is generated, clarified, or justified in the nearer or further future.

By way of illustration, it could be the case that when creating a new software solution, it is not known whether certain software components can be integrated. Before the interoperability has been tested by someone it cannot be known with certainty whether it works. Another illustration is given by the existence of contradictory knowledge about the potential of certain technologies and software developing methods. For instance, the internet as a technology was in the beginning considered as the technology that would revolutionize the economy in a short time. However, after the internet bubble burst, many people realized that they had had too high expectations and they changed their mind rather quickly and after the initial euphoria, pessimism took over. Nevertheless, the situation is changing again, e-commerce is growing and several dot.com companies that survived the crash have reached or will soon reach the profit zones again.

In analogy to longitudinal asymmetric information, the dispersion of knowledge between market players and “nature” is denoted as longitudinal asymmetric knowledge.

<table>
<thead>
<tr>
<th>Statements from the companies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Asymmetric knowledge between software companies and their customers</strong></td>
</tr>
<tr>
<td><strong>a)</strong> “It is always specific knowledge that creates an activation energy into a network.” (Andrej Vckovski, CEO Netcetera)</td>
</tr>
<tr>
<td><strong>b)</strong> “From the technological side, we can carry out almost every project. We know from experience that this works well. However, what we need are people from the customer side. People who understand the business, who know what we basically have to map.” (Patrick Burkhalter, CEO Ergon)</td>
</tr>
</tbody>
</table>
| **c)** “You have to understand the customer problem equally as well as the customer itself. This is the thing we are interested in. We get paid so that we understand what he is doing. He is permanently investing
Asymmetric knowledge between competing software companies

“We can use the specific know-how we gain in projects also in new projects and thereby we get market visibility which facilitates new contacts and projects. This is a very important factor. However, it is important that you do not overrate the know-how you have gained once, because the market is moving very fast – also technologically – you have to keep running.” (Andrej Vckovski, CEO Netcetera)

“Asymmetric knowledge between market players and “nature”

“If we speak about the software engineering process, especially about the technological leading edge, it is far from a static body, but is steadily in progression. And if we want to try out something new, there is always a discussion by a few people, who are interested in the topic. And then we test it in a pilot project. You realize then what works and what does not. You adjust things and then you know it by creating legacy.” (Stefan Arn, CEO Adnovum)

“Every project is a piece of innovation, in which we and the customer advance. For instance, we could build a billing system for a telecom company, and we could thereby build up extremely useful knowledge in this domain which would be helpful for gaining other projects in this area.” (Theodor Graf, Chairman Ergon)

“What we are doing is similar to Formula One racing. And we do this in the front row and not from somewhere behind. It is useless if somebody says: “it’s nice, I started in Monza.” And you reply: “I see, from which position?” And the answer is: “well, from the last one.” I mean, this is useless.” (Stefan Arn, CEO Adnovum)

“There is no better example than IT for the fact that it always turns out differently from expected. Every proposition is falsified sooner or later. People laughed some years ago, when I said that the internet will be successful. They thought: “typical engineer”. The internet did. Nowadays [in 2001], the internet is scaling down, hence, people can say the proposition was wrong. What I want to say is that it doesn’t matter so much what you decide, but what matters is that you make it fast and consistent.” (Stefan Arn, CEO Adnovum)

Table 16: Statements related to asymmetric knowledge

In summary, three kinds of asymmetric knowledge have been discussed in this section. In individualized software projects, vertical asymmetric knowledge is often a profound element in the relationship between a software company and its customer. In particular, individualized software projects distinguish themselves in so far as the technological know-how of software companies has to be combined with the business know-how of their customers. In order to do this successfully, software firms need specific skills to translate the business problem into a technological solution.

The term “legacy” describes old software or hardware that is still in use.
Furthermore, depending on which projects are realized, for which customers, in which industry, the knowledge domain of different software firms may evolve differently over time. Finally, because of the fast progress and dynamics in the software industry, knowledge may not be unified and homogenous, but is often contradictory and changing – depending on time and place.

After having identified and discussed the different dimensions of asymmetric information and knowledge, the next section evaluates what role these information and knowledge asymmetries play in the entrepreneurial process of opportunity identification and exploitation. In particular, the software firm-customer relationship is investigated in more detail.

5.2.2 Asymmetric Information and Knowledge and the Entrepreneurial Process of Opportunity Discovery and Exploitation

Based on the concepts of asymmetric information and knowledge discussed, this section will focus on how the three software companies came to their software projects. In this context, new software projects are understood as entrepreneurial opportunities, which enable software companies to use and enhance their knowledge base and to build a profitable business. From the customer’s standpoint, new projects result in new software products and services and represent a chance to enhance the customer’s IT system. A core question in this analysis is how a match between software companies and potential customers is reached, given the existing information and knowledge asymmetries. In order to provide an answer, the main focus lies in four specific sub-processes in the overall identification and exploitation process of entrepreneurial opportunities. Finally, at the end, some characteristics and moderating factors of the four processes are described. Before investigating these four processes in detail, the initial setting is briefly described.

5.2.2.1 The Starting Point of an Entrepreneurial Opportunity Process Framework

Two elements serve as a basis for analyzing the process of entrepreneurial opportunity identification and exploitation. The first one is Venkataraman and Shane’s generic framework for the entrepreneurial field, in which they argue that entrepreneurship research is concerned with the processes of discovery, evaluation and exploitation of profitable opportunities (Venkataraman 1997; Shane and Venkataraman 2000). The second element is the previously discussed concept of
vertical information and knowledge asymmetries between software companies and potential customers. As has been shown in the preceding sub-sections, this kind of asymmetric information covers issues such as information about potential projects, information about and contacts to relevant people, and information about required skills and competences to assure quality. In contrast, asymmetric knowledge mainly refers to the main knowledge domains of software companies and customers with regard to technological know-how on the one side and business know-how on the other side and to the knowledge differences between companies and customers in these areas.

Figure 5 attempts to illustrate the general situation faced between a software company and a potential customer. On the one side, we have the software companies, for which the technological know-how is the core knowledge domain and a precondition to enabling the implementation of individualized software projects. On the other side, we have potential customers with specific and profound business knowledge, who are confronted with specific technological problems relating to how their business can be supported by particular IT solutions. Given these information and knowledge asymmetries - which are symbolized by the two vertical bars in Figure 5 - a core question that arises is how software firms find their projects and how they realize them despite these asymmetries. Based on the empirical examination of this problem from the perspective of the software company, four processes, as shown in Figure 5, can be identified that play a major role in overcoming these information and knowledge asymmetries. These four processes describe a substantial part of the software company – customer interface and will be analyzed in detail in the next section.
5.2.2.2 *Four Entrepreneurial Opportunity Processes*

Before turning to the particular sub-processes for overcoming vertical information and knowledge asymmetries in detail, it is worthwhile clarifying what is understood by the term “process”. In the present context, process is defined as a series of actions, thoughts or operations leading to an end which describes the identification, evaluation, acquisition and realization of new, innovative software projects, in which novel software products and services are produced. The notion of process refers to the temporal dimension of a course of action and points to a certain chronology of related elements and emphasizes the constructive or deconstructive mechanisms which lead to a certain outcome.
Process I: Assuming, finding out and the recognition of entrepreneurial opportunities

Given the technological know-how software firms possess, they look for application areas where this know-how can add value for customers by solving certain technological problems. However, information about specific technological problems or particular projects of customers is often not publicly available. Nevertheless, there exist several ways how software firms try to access this information. The most common ways are described in the following.

One possible way is that the software companies just assume who could be a potential customer for relevant projects. Based on their technological know-how, they determine possible application areas and from those they derive possible technological questions that potential customers might have and then try to establish contacts to companies that are considered as potential customers.

Additionally, software companies can also search for possible projects by looking for calls for tenders, whether by public procurements or private invitations to bid, as long as this information is publicly available. In this case, the asymmetric information hurdle is low. Thus, the competition for a project may be increased by a greater number of interested parties.

On the other hand, the asymmetric information hurdle may still be high to other competitors, when a software company recognizes new project opportunities that arise from a project they have already worked on. Through being very close to the customer in existing projects, the software company might incidentally get information about further potential entrepreneurial opportunities or has identified further technological problems which will have to be solved in the future.

Furthermore, when software companies have obtained a certain reputation for solving certain technological problems, potential customers may contact software companies directly and ask for an offer, in which, however, rival firms may also be involved. Software companies also disseminate information about certain technological issues and possible solutions into the market by presenting specific technologies, technological solutions, and completed projects on certain conferences and IT fairs or by publishing these issues in technological journals or technologically related magazines.

---

78 An exception exists for public procurements for individualized software projects.
Finally, software companies might also receive relevant information from third parties, such as other software companies or suppliers of technological infrastructure. In case of other software companies, they might have another business focus or are interested in collaborating in a specific project and therefore disseminate information about potential projects. For suppliers of technological infrastructure it might also be of interest to inform software companies about potential projects, particularly about such projects where both parties can benefit through a complementary partnership. For example, Adnovum and Ergon have received certain information and support from Sun Microsystems, with the intention that the former deliver the tailor made software and the latter the underlying hardware.

In conclusion, software companies acquire or receive, and organize information about potential entrepreneurial opportunities in different ways. Consequently, there is not one definite way that software companies become aware of their entrepreneurial opportunities, but different activities play an important role. For instance, they assume that certain customers could have possible projects; they find out by looking for project specific information; they recognize new opportunities while working on projects; by receiving information from third parties or from the customer himself. A selection of company specific statements in respect of process I can be found in the first row of Table 17 (p. 144).

Having information about potential opportunities, however, is in itself not sufficient, but it also needs to be evaluated whether these opportunities fit in with the respective software company. Therefore, entrepreneurial project opportunities for individualized software are evaluated according to certain criteria as described in the next section.

Process II: The evaluation of entrepreneurial opportunities and customers

It is not only economical considerations that play a role in deciding which projects should be pursued (see e.g. Casson 1982). One factor that is also important is the key characteristics of a project. While taking into account the technical restrictions in respect of the customer’s IT-platform (see also Section 4.2.4), projects are ideally chosen which are technologically challenging and interesting in the sense that new technologies or a new combination of technologies are applied. Doing so provides two main advantages. On the one hand, it is a big motivational factor for software engineers to handle new technological questions. Innovative projects therefore serve as an important incentive factor. It keeps the working motivation high and it attracts
talented software engineers. On the other side, the pursuit of innovative projects also ensures that the software companies keep pace with the ongoing technological development and thereby, it contributes to the survival of the firm in the long run. Consequently, technologically interesting and challenging projects reflect a part of the “lifeblood” of a company.

However, technologically challenging and interesting projects do not imply that the whole software code has to be developed from scratch. Reuse and leveraging of existing code and software components are a common and important issue in the software industry (see also sub-section 6.2.2.4). Each of the three analyzed software companies has a clear understanding of how reuse and innovation are linked together and how those should be managed. These understandings are manifested in certain reference values that define how ideal projects should look. Stefan Arn79, for instance, defines optimal projects as follows: “The projects we prefer consist of one third reuse, one third serial development and one third innovation. In the reuse part we already possess the code. In the serial part we know how it must be solved. In the innovation part, we do something new, which implies risk management.” Similarly, Andrej Vckovski80 explains that in his view, a software company can only be innovative, when reuse takes a substantial part in the development process, because firstly, to write software that can be reused is not that simple and requires already innovative behavior, and secondly: “assuming that a company possesses 100% creative energy, it is more favorable, when you can reuse a bigger amount of standard or open source software in your system with only a smaller amount you have to create from scratch. Why? Because then you can use your whole creative energy for the new things and this is generally much more innovative than having to spread your available intellectual power over the whole system like a watering can.”

Nevertheless, technologically interesting and challenging projects are not the only decision factor. Customer related issues play an important role as well, as Patrick Burkhalter81 comments: “There exist several criteria that determine which projects you aim for. Of course, you evaluate whether it is technologically interesting, but it is equally important that the collaboration with the customer is good. You can have challenging projects, but when it is difficult to work together it can become very

79 CEO Adnovum  
80 CEO Netcetera  
81 CEO Ergon
arduous.” Therefore, in order to deliver a sophisticated tailor-made solution that fits the needs of a customer, it is essential that a software company and its customer collaborate well when a project is planned. However, due to the information asymmetries, it is rather difficult to assess the collaboration quality of a project in advance. Certain indicators that can help to overcome this problem can be derived from the direct interaction between people from the software company and the customer side.

One indicator that is emphasized in the interviews is a good “chemistry between people”. Although there is no academic definition of what “chemistry between people” means, it plays an important role in the acquisition and realization of individualized projects. In essence, a good “chemistry between people” describes the quality of the interpersonal relationship. It indicates that the involved parties accept and respect each other. It can also include a certain amount of appreciation for the work each party does. And it is an element that is not so easy to manipulate. Often it either exists or it does not. Good chemistry between people - when it exists - can therefore positively influence the evaluation process. However, it does not only play a role in evaluating and acquiring a project, it can also influence the success of the realization of a project, because it facilitates a good and open communication and thus increases the flexibility in the handling of problematic issues that might arise in a project. Good “chemistry between people” can therefore mitigate the asymmetric information problem.

Beside the project characteristics and the collaboration quality, an additional factor that has an impact on the evaluation process is the future potential beyond the particular project and the attractiveness of a customer. Whenever possible, software companies try to evaluate whether there is a chance to realize further projects with a potential customer. Although the outcome is uncertain and much of this evaluation is based on entrepreneurial intuition, the software companies examined are willing to accept certain restrictions for a specific project under investigation, when there is potential for further interesting entrepreneurial opportunities with such a customer. This indicates that not only single projects are optimized, but the three software companies also try to optimize the whole present and future project portfolio.

A further point that should be addressed is the moderating role that the available project capacity plays during the evaluation phase. The supply side of tailor made
solutions is highly inelastic in the short run and economies of scale are limited.\textsuperscript{82} The supply can primarily be enhanced by increasing working hours and/or by hiring new labor. However, the former has its natural limits and the latter is – in the short run - limited as well, because the demand for software engineers is positively correlated with the aggregated demand for software solutions. Furthermore, hired software engineers have first to be integrated functionally, become acquainted with work routines and standards, and adapt to the norms and values of how a company develops its software before they become fully productive. Economies of scale in tailor-made software projects can only be achieved when the reuse of code is intensified, but this has its limits as well. Therefore, when the capacity limit of a software company is reached, projects generally have to be queued. If, on the other side, project capacity is abundant, working hours are reduced and new projects have to be acquired.\textsuperscript{83} Consequently, the evaluation process also depends on the demand and supply side of individualized projects. If the degree of free capacity is high, projects and potential customers are generally evaluated less rigidly than if free capacity is low.

In summary, software firms typically do not accept every project presented to them but, circumstances permitting, they first evaluate the potential and fit of such projects before taking a decision. The element of this evaluation process are manifold and in addition to the factors discussed above, other criteria are often considered as well, such as the customer’s experience to work with external software companies, the degree of freedom in the realization of the project, the possibility to work efficiently in small teams and also the geographical distance to the customer. Company specific statements in respect of process II can be found in the second row of Table 17.

The software company’s interest in a potential new project only forms one side of the equation. Given the asymmetries of the situation, before an entrepreneurial opportunity can be exploited, potential customers also have to be opened up first. This process is analyzed in the following section.

\textsuperscript{82} The economies of scale in such projects are limited for two reasons. First, the source code of individualized software projects cannot be simply copied from earlier projects as is often the case for standardized software products. Second, the hiring of additional software engineers (input) often leads only to an underproportional increase of the output because coordination costs increase as well.

\textsuperscript{83} In tailor made software development, it is not common and also not expedient, to produce on stock, because it is difficult to estimate the needs of a customer in advance.
**Process III: Opening up, inspiring, convincing and trust building**

Opening up encompasses the activities pursued by the companies to gain or strengthen the interest of a potential customer in a new project. The empirical observations for the three software companies analyzed indicate the importance of these activities. In Stefan Arn’s opinion opening up signifies that Adnovum is recognized as a valuable partner by customers. In Patrick Burkhalter’s view the result of a successful opening up process is that whenever a customer encounters a problem they are convinced that Ergon is the right company to solve it and inevitably contact the company. In the case of Netcetera, Andrej Vckovski emphasizes that opening up the customer is an important aspect in the acquisition process. It determines to a great extent whether a software firm can conclude a contract or not.

An important element of the opening up process is to establish and foster contacts to a potential customer by building relationships with key decision makers in the targeted company. Stefan Arn explains that knowing someone on the customer side who enables further access and contacts in a company is a decisive factor. Ideally, this person should have the appropriate functional and organizational role within the customer’s company structure to be able to influence the required decisions or at least refer the software company to the responsible persons and provide credible recommendations to those people.

However, having established contacts with a potential customer is a necessary but not a sufficient condition. Established contacts alone do not guarantee that potential projects can be acquired. Given the particular information and knowledge asymmetries that characterize individualized software projects, trust building becomes a fundamental aspect in the opening up process. Trust building is related to convincing the customer that the software company understands the problem and is capable of solving it. Different activities are applied to foster trust on the customer side:

a) Software companies demonstrate competence through their human capital by involving key knowledge carriers already in the opening up process. Beside the CEOs, who generally initiate the first contacts and the opening up process, there are other persons who take part as well, such as particular sales persons, project...
managers and software engineers. Although the three software companies have slightly different approaches in general, this multiple person aspect is applied by all of them. As soon as a project is identified, project managers and software engineers who have the capability to interact with the customer are involved in the acquisition process. The involvement of several knowledge carriers also ensures that the project is set properly and the technological risks are minimized.

b) Software companies demonstrate competence by materializing partial solutions. Trust is built through the fast presentation of prototypes or pilot applications. They serve as an important basis for further discussions and help to identify the real needs of the customer. They are a mean for the software companies to present certain solution possibilities and serve at the same time as a proof that the software company is capable of transforming the needs of a customer efficiently into a technological solution.

c) Software companies demonstrate competence through their references, which are a very crucial factor in trust building. Reference projects are important, because with them software firms can show that they have already solved similar problems in previous projects. For example, a potential customer, for instance a pharmaceutical company, who is interested in tracking all its dispensing via the internet but simultaneously attaches high importance to security issues would rather trust a software company that can show that it has successfully solved similar security problems previously, for example in a banking environment.

Whereas prototypes are generally used to demonstrate the ability to handle aspects of new technologies or complex features, reference projects are used to convince potential customers about the overall competences of a software company in successfully managing and implementing substantial projects. Thereby, successful references can increase the demand for similar projects in a given software company - in particular, when the reference has also produced a positive echo in the market. For example, when Ergon built the first internet banking in Switzerland for an international bank, an intense echo was produced in the IT industry and consequently, Ergon was contacted by other banks.

It is self evident that many successful references are more valuable than just a few. Therefore, customers have an interest to not only look at one specific reference, but to account for the whole set of references. Given the fact that the average failure rate of software projects is rather high (see Appendix F), several people in the software
industry argue that the best quality criteria for a software firm is the number of failed projects. A software company that has never failed on a project represents a trustworthy indicator of high competence and quality. Additionally, the shape of how the references are distributed among the customers may also play a role in order to raise trust. If a software company has many references but was never been hired by one customer twice, it may be less trustworthy than a company that has less references overall but several references within one customer. Collaboration in several projects serves as an indicator for the customer’s satisfaction with the work completed.

A final remark concerning the opening up process should be added. The opening up process can occur both on the project and at the firm level. Software companies have to decide which way they want to pursue for each customer. The advantage of heading directly to a particular identified project is that when successfully opened up, the project can be executed and it generates cash flow and occupation. On the other hand, a drawback can result if the software company is considered only as particularly competent for the specific project solved, even if other kinds of projects could equally be solved. Therefore, the alternative strategy is to open up a customer without directly aiming at a particular project, but to open up a company on a more global level, establishing contacts and relationships with diverse people and presenting specific competences, making sure that the software company is recognized as a valuable software house, in the hope, and with the intent, that potential projects will follow.

In summary, the aim of the opening up process is to establish contacts, to be recognized as a valuable partner, and to generate trust in order to acquire projects. The opening up process therefore is helpful to eliminate a part of the information and knowledge asymmetries between the software firm and its customer. However, the real knowledge transfer takes place during the realization phase which follows the opening up phase if a project is acquired and is described in the next section. A selection of company specific statements in respect of process III can be found in the third row of Table 17.

Process IV: The realization of entrepreneurial opportunities: knowledge combination, reciprocal and unilateral learning

After a customer or a project has been opened up, the project planning starts. During the processes I to III software firms may get a notion and a high level understanding about the customer’s problem and project. However, the project often
looks different when it is started compared to when it is finished. The final specifications of the software often evolve *during* the realization phase. There are several reasons for this. Customers, in the beginning, often only have a general idea about how the product should look, but the details are not specified or unclear at the outset. Though the customers may think that they know exactly what they want, by deeper investigations the problem assumed beforehand often turns out to be a different one. Or the problem is defined, but the solution is not clear yet and the software firms are forced to find creative, but feasible ways to solve it. Through profound analysis, deeper investigations, and technological consultancy, original problems are very often redefined and the real needs are revealed.

This requires that the software firms and their customers have to work closely together during the realization phase. In order to develop a software solution that satisfies and corresponds to the needs of a customer, software companies have to be capable of amalgamating their own technological knowledge with the business knowledge of the customer. Literally speaking, the technological knowledge of the software firms has to be combined with the business knowledge of the customer, so that two different knowledge domains are bundled in a new product. Beside the technological know-how, the *combination of knowledge* is one of the key capabilities a software company creating tailor-made software must have. In order to ensure this, several *organizational measures* are taken:

a) The carrying out of a particular project is undertaken in a very *iterative process* (indicated by the curved arrow in Figure 5), in which people from the software firm and the customer meet each other on a regular basis in order to specify the software, to present possible prototypes or pilot software, to make adjustments, to exchange their technological and business knowledge, and to determine the next milestones.

The combination of the different knowledge domains – the technological know-how of the software companies and the business know-how of the customer – typically is in the responsibility of several different people. On the one hand, project managers are key persons who build an important interface between the software firm and its customers. One of their main duties is to gather and present the business knowledge in a way that it can be translated into a technological solution by the software engineers. For example, to solve a specific banking problem - such as a block order in portfolio management – the transactional and
business details related to it must clearly be understood, otherwise a solution would be meaningless, and therefore it first must be packaged so that it is understandable and realizable by the software engineer. On the other hand, when the problem is a purely technological one, for example, the transfer of data between different databases, the translation process is mainly in the hands of the software engineers and IT personnel of both sides.

Ergon often uses an instrument called the “storybook”, to combine the business and technological knowledge and to determine what the software application should look like. In several meetings and workshops this storybook is developed and extended with people from both sides. Lawyers and persons from involved partner companies are often involved. In these workshops and meetings, ideas, possible functionalities, needs, aims, and results are drawn and recorded on paper- and pinboards, insights which finally flow into the storybook and allow the definition of the detailed project specifications.

b) Due to the iterative nature of this process, the software is delivered in small units. This procedure not only has the advantage of the customer having initial parts of the software more quickly operative but it also serves to incorporate on a regular basis customer feedback in the further software development process.

c) In order to keep the projects flexible and efficient, the execution part of the projects is accomplished by small teams of 2 to 8 people with a high degree of decision power and autonomy. The experience of the three software firms shows that a higher number of people involved reduces the efficiency and flexibility of the projects undertaken. It seems that there exist negative economies of scale with respect to human resources involved in the realization part of individualized software projects due to increased coordination costs. With regard to the IT people involved from the customer side in the development of the application,

---

87 Decision power and autonomy does not mean that the teams are fully free, they follow the firm’s principles and norms of software engineering but inside these principles they possess great autonomy to organize themselves.

88 The organizational arrangements used by the three software firms are comparable with the values and principles of Extreme Programming (XP). XP is a method in, or approach to, software engineering, formulated by Kent Beck, Ward Cunningham, and Ron Jeffries. XP is the most popular of several agile software development methodologies. Agile software development evolved in the mid 1990s as part of the reaction against high ceremony methods, like Rational Unified Process (RUP), Prince and ISO 9000. The processes originated from those methods were seen as bureaucratic, slow, demeaning, and contradicted the ways that software engineers actually work.
similar principles apply and the overall amount of persons engaged in the project should not be too numerous.

Through close collaboration and the combination of business and technological knowledge during the realization process, a basis for *reciprocal learning between the software company and its customer* is laid which can have an important impact on the further development of the relationship between the two. Reciprocal learning is defined as the learning that directly stems from the interaction between the software company and the customer. Reciprocal learning comprises the generation of knowledge through interaction, where both parties can enhance similar or different knowledge domains. However, it does not necessarily imply that both parties have to generate the same knowledge. This can happen, but it does not have to happen. It is very well possible that the learning areas are different or that knowledge is transferred from one party to the other. The important aspect of reciprocal learning lies in the fact that it is triggered through the interaction of the software companies with their customers. To achieve a deeper understanding of reciprocal learning, analysis is provided for the three empirical cases in more detail (see also Figure 6 for a better understanding at the end of this section).

Starting with the area where both parties generate knowledge in the same knowledge domain, this generally takes place where, through close collaboration, both parties learn to manage a project together. The people involved get to know each other, find out the values and norms which are dominant in each company and learn what works and what does not in the handling of a project. In order to benefit from this kind of reciprocal learning, it is important that the fluctuation of the people involved is low. Otherwise, the learning process has to be started again, at least partially.

On the other side, if we look at reciprocal learning that generates specific, different knowledge domains for each party, starting with the software company perspective, different areas can be identified. On the one hand, through close interaction, the analysis of a specific problem, and the realization of a tailor made solution, software firms have not only the chance to apply their existing technological know-how, but also to apply new procedures, technologies or a combination of them to real problems in a given project. Through this innovation possibility the technological knowledge domain can be extended constantly and it ensures that a software company can keep pace with the ongoing technological evolution (see also first section of process II).
On the other hand, by specifying and realizing the project, software firms learn and incorporate software relevant business knowledge from the customers, such as specific knowledge about business processes, transactions, techniques, legal issues, and so on. Although the incorporation of the project specific customer’s business knowledge is not the core competence software companies want to develop – their focus still lies on the technological know-how – it helps not only to get further release projects, but also to acquire new projects in the same area, because with the existing knowledge projects may be realized more efficiently.

Furthermore, through close ongoing interaction, software firms get to know their customers and their technological problems and needs better and better over time. It enables them to build up relevant customer knowledge and it permits them to build customer intimacy. The more projects are realized for a customer, the higher is the specific customer knowledge and intimacy, which can be used to proactively approach a customer with possible solutions, which is illustrated by Stefan Arn’s statement: “Customer intimacy plays a role in the multiplication of projects, meaning that from a given project a further one arises. You are organically the one who takes care of the next project, because you were the one who helped them to have the idea, who drew their attention to it, and who helped them in the design, etc.” Therefore, just as a side note, reciprocal learning generates advantages for opening up and acquiring new products (see process III) and it enhances horizontal customer knowledge asymmetries vis-à-vis competitors.

If we look at reciprocal learning which generates mainly knowledge on the customer side, there are three main areas that can be identified. First of all, by realizing a project, the technological know-how of the customer can be extended. This is channeled through the transfer of the software company’s technological knowledge in the form of a finished application and, in cases where IT-people from the customer side are involved in the project, through the collaboration of them with the software company that can provide general insights into the technological knowledge of the software company and, more specifically, they receive insights into new technologies. Second, to work with an external company also means that the customer gets an external perspective on its own IT activities, and, as mentioned before, when

---

89 Intimacy defined as the quality or state of being familiar and a state of close relationship.
90 They may learn about software related issues, such as planning, methods, procedures, architecture, design, development, deployment.
the external company has enough customer knowledge and intimacy, the software company can hint to certain existing problems or to any that may arise in the future. For the customer this means a learning potential about its own strengths and weaknesses in specific technological areas. Lastly, a software company can also function as an important knowledge carrier, which can be used as a learning vehicle within the customer company. For example, when the customer loses knowledge about an application that is already developed and operative because the people involved on the customer side are not accessible anymore due to employee turnover, the software company may play an important part by transferring the necessary knowledge about application specific issues to the new persons who have charge of it. Thereby, the software company can also have a certain back-up function with regard to application specific know-how for the customer.

Finally, besides reciprocal learning, there also exists unilateral learning that takes place primarily within the companies themselves and is not directly triggered through the interaction among the companies (see also Figure 6). Some examples will briefly outline the characteristics of unilateral learning. For instance, the software companies constantly track the technological evolution in their specific areas and search for interesting new technologies and procedures and how they can be used in their projects. By testing and examining these technologies and procedures in a project, an internal learning process takes place. Therefore, unilateral learning typically takes place in internal R&D activities. From a customer perspective, unilateral learning happens for example when customers use and make experiences with their IT-systems and software applications, without exchanging these experiences with an external company.

![Figure 6: Reciprocal and unilateral learning](image-url)
Although it is not always possible to make a clear distinction between reciprocal and unilateral learning, as the boundaries are sometimes blurred, the interesting point is that unilateral and reciprocal learning influence each other. On the one side, unilateral learning can have an impact on reciprocal learning. For example, from a software company perspective, certain new technologies or technological procedures are at first only developed and tested internally and only when these are considered mature, do the companies try to find customers who are interested in them and who are willing to incorporate them into projects. As a consequence, unilateral learning can be a precondition for a certain project and further knowledge about these technologies that have been developed through unilateral learning can be gained through reciprocal learning in real projects. From a customer perspective, experiences with their own IT-systems and applications may influence the technological issues and problems that are discussed and solved with an external software company.

On the other side, reciprocal learning can impact unilateral learning, for instance, when a software company realizes a project and through their learning experiences in the project, further technological questions are advanced independently from an actual project. Or a customer starts to incorporate gained experiences with an external software company in the further internal development of its IT-system or in the selection of further external software companies.

To conclude, through close collaboration and combination of knowledge between the software companies and their customers, entrepreneurial opportunities are concretized and transferred into end-products and services. Thereby, reciprocal and unilateral learning take place and enable the identification and exploitation of further entrepreneurial opportunities. The concurrence of building up a relationship through close interaction, reciprocal and unilateral learning, together with the successful realization of the project, enables software companies to build up further trust and to establish reputation in the customer relationship. Trust, success and reputation, together with the unilateral and reciprocal learning are therefore important preconditions for gaining further projects from a specific customer (see also process III). Finally, selected statements concerning process IV can be read in the last row of Table 17 (p. 144).

---

91 Success again defined as delivering the software application in time, in budget and in specification.
<table>
<thead>
<tr>
<th>Company</th>
<th>Adnovum</th>
<th>Ergon</th>
<th>Netcetera</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assuming,</td>
<td>“Very often you know quite early where possible opportunities are, when you observe the market a little bit.” (Stefan Arn, CEO)</td>
<td>“The primary aspect is that big technological partners generally get bid invitations for large scale projects. Often, they can do the technological infrastructure and we can provide the software. For example, we have a very close collaboration with Sun Microsystems.” (Theodor Graf, Chairman)</td>
<td>“When I circumscribe the current situation, then we have about 5-10 percent of our projects where we have recognized certain needs, meaning that we said, hey, that could be something, let’s go and contact them. In 20-40 percent, the customer has a specific need and approaches us. Variants of this would be either by an invitation to bid or where we are approached directly, because the customer has heard good things about us. The remaining percentages are projects where we recognize a need, but the customer is already known. These are situations when we work on a project and we realize the need along the way. For example, you have heard in a meeting that the customer is thinking of extending this and that and you say, you know, basically, we could do that.” (Andrej Vckovski, CEO)</td>
</tr>
<tr>
<td>recognizing and</td>
<td>“In most cases you can get an idea about possible project opportunities from some contacts.” (Stefan Arn, CEO)</td>
<td>“You can still be mistaken about the opportunity. This happens continuously. You finally opened up a customer and then you realize this problem presents itself quite differently.” (Stefan Arn, CEO)</td>
<td></td>
</tr>
<tr>
<td>finding out</td>
<td></td>
<td>“We are in close contact with their salespersons [SUN Microsystems]. This is very important. They can observe in the market what projects might be interesting for Ergon.” (Patrick Burkhalter, CEO)</td>
<td></td>
</tr>
<tr>
<td>Evaluation</td>
<td>“We try to do something new in every project. We want to make progress, don’t we? In this sense, projects that are always the same tend to be</td>
<td>“To use a new technology where nobody has really great experience with it and which is therefore somehow uncertain is a great challenge for a</td>
<td>“You need a little bit of the entrepreneurial feeling. By choosing a project you make a bet. You try to evaluate what you get as a project from a</td>
</tr>
</tbody>
</table>
### Information and Knowledge Asymmetries: The Entrepreneurial Process and the Creation of Business Opportunities

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>boring. These are generally projects that simply generate cash. But in a large-scale project you always try to advance your knowledge domain. You always identify a technological area where you can say, this time, we do it differently.”</strong> (Matthias Loepfe, former CTO)</td>
<td>software engineer and it is something that is felt to be interesting. However, there are many facets of being interesting. For example, it can also be interesting to build an internet-banking, although there exist x applications today. But to develop an application that is very fast, that runs perfectly and provides real value to the customer still makes such a project interesting.” (Jakob Magun, CTO)</td>
</tr>
<tr>
<td><strong>Opening up, inspiring and convincing</strong></td>
<td>“What comes next is to open up the customer so they respect you. And this is not unbiased, except if you have market dominance such as Microsoft, where customers in certain areas have no other choice. In contrast, for a software house of our size, the process of opening up a customer is crucial and it often takes twelve months or more to do this.” (Stefan Arn, CEO)</td>
</tr>
</tbody>
</table>
| **Realization, knowledge combination and mutual learning** | “The project managers are the translators of the business problem into a technical solution. They look at how the problem is in reality, and how it must be | “We follow an iterative procedure with the customer in the project. This has the advantage that you don’t have to write too many specifications and we develop what | “Often, the customer thinks that he knows everything he needs about the new project. But when you analyze the problem with him, we both find out that it is
translated so that the IT engineer understands it. They organize the general framework; they basically deal with the problem in a way that it is consumable. Over the years now we have built up a set of senior software engineers who are also capable of doing it. They have developed the skill-set in the last 15 years. However, this is not their key duty.” (Stefan Arn, CEO)

the customer really wants. If we would only do one iteration, we would probably find out in the end that we have developed something that the customer basically does not need.” (Patrick Burkhalter, CEO)

not necessarily the case.” (Joachim Hagger, CTO)

“Therefore, the interaction with the customer is so crucial. There, we can find out what he really wants, what the problem really is.” (Patrick auf der Mauer, Senior Project Manager)

<table>
<thead>
<tr>
<th>Table 17: Company statements to the four entrepreneurial opportunity processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>In this sub-section so far, it has been shown how the three software companies use different processes in order to overcome the different forms of asymmetric information and knowledge. In the next sub-section, the focus again turns to these four processes, where certain characteristics are especially highlighted that must be considered when the four entrepreneurial processes are examined.</td>
</tr>
</tbody>
</table>

### 5.2.2.3 Four Entrepreneurial Opportunity Processes and Characteristics to Consider

The four processes described in the previous section are a general description of how software companies identify, evaluate, open up and realize software projects. However, as this is still a rudimentary framework it is important to consider certain issues that characterize and moderate the four processes more precisely. At first some characteristics that describe the chronology of the processes in more detail will be examined:

a) **Overlap:** The processes are not to be considered as being strictly chronological in the meaning that only when process I is completed, process II can start, but the processes have certain overlaps. For instance, when a software company assumes that certain project opportunities exist with a potential customer (process I), the evaluation process (process II) may already have begun and can hardly be separated from the identification part. In addition, when a customer is opened up, for example with the help of a convincing prototype (process III), with the
preparatory work of the prototype the carrying out of the project may already have been started (process IV).

b) **Non-recursive processes:** The causal chain of the four processes is not to be understood as a unidirectional, recursive (hierarchical) system, in which the causal ordering only goes in one direction, in the meaning of process I only triggers process II, process II only triggers process III and so on. The processes can influence each other in very different directions. This will be specified with the following simple example. A software company is asked to hand in a proposal for a tailor made project (process I). Even though the project is not considered as the technologically most interesting one, the project is accepted, because there is still some free project capacity (process II). After a conceptional formulation and the presentation of a possible solution and its acceptance (process III), the project is started (project IV). So far, the process has been perfectly recursive. However, during the further progress of the project, it might be observed that during the realization phase some unexpected challenging, but interesting technological issues arise, triggering the identification process of a new opportunity. Additionally, if the collaboration with the customer works well and because process IV runs smoothly, the whole project might be reevaluated (process II) and the responsible people from the software company may be thinking about whether there are still other equal project opportunities within the same company (process I) and may try to open up a further project (process III) and so on. Therefore, the causal chain has suddenly become non-recursive.

c) **Sequence / Iteration:** If the processes are non-recursive, it is interesting to examine in more detail the sequencing question of the four processes. On the one hand, if a software company realizes a project for a customer the first time, the processes are generally followed in a unidirectional, recursive way. On the other hand, if further projects follow, the sequencing can follow different patterns as shown in the previous example. It can also be the case that a sequence stops before all processes are passed or the sequence may be interrupted for a while and then be restarted. For example, a software company might not get a specific project (for instance, it

---

92 In recursive (hierarchical) systems/models the causal ordering goes only in one direction, which means that the chain of causation never returns to any starting point. In contrast to recursive systems/models, the causations can return to one or more starting points in non-recursive ones (Allison, 2003).
stops at process III), but at a later time the software company is contacted by the
same customer for a different project which is then evaluated, and maybe carried
out in the end. In general, the four processes are ongoing and iterative.
Furthermore, the weight and importance of the four processes may alter over time
due to changed conditions. For instance, if a software company has completed
several projects successfully for a specific customer, the less the software
company has to investigate the first two processes because of the better,
established relationship with the customer. The more customer knowledge the
software company has, and the better the customer problems are known.

However, customer knowledge and known customer problems are not the only
factors that have an impact on the four processes. Three further moderating factors are
described in the following paragraphs. In particular, the kind of projects, the stage of
the company and environmental factors are addressed:

a) *Kind of projects:* As already mentioned before, it makes a difference whether the
project is a private one or a public procurement. In case of a public procurement,
the identification of an existing project is a simple task, because the project has to
be publicly announced and therefore, there is only limited asymmetric information
in respect of its existence exists. The evaluation of the project may be less or more
difficult, depending on how well the project is described in the available
documents. However, the main difficulty lies in process III, where closer contact
on a bilateral base with the public authorities until the project is assigned, is not
permitted by law. Therefore, the possibility for a software company to analyze,
consult, inspire and convince their customer in an interactive process before the
assignment is limited. The challenge for the software companies lies in composing
an offer that fits as well as possible to technological and business needs of the
customer.

b) *Stage of the company:* Depending on the stage a company is in its business cycle,
the extent of, and required efforts for, the four processes look different. For
software companies that have just been founded and do not possess a real
customer base, it is evident that it is more difficult to identify, evaluate, open up
and complete a customer or a project, even if they possess profound technological
knowledge. The main reason is that young firms generally do not possess
sufficient reference projects and also have less established customer relationships,
which makes it more difficult to reduce the asymmetric information and
knowledge problematic in respect of demonstrating quality and competence. For more mature companies this is different, because they can relay on established customer contacts and on successful reference projects, they are generally better informed and finished projects can serve as a proof of their competences.

c) Environmental factors: As we will see in Chapter 6 in more detail, environmental factors such as the general economic conditions have a major impact on software companies for individualized software. Changes in the economic conditions substantially influence and alter the four processes. Economic development has a major impact on the demand for software in general and for individualized software in particular. In the case of a general economic downturn, customers tend to react with cutting their IT investments. They cut innovative projects, because these are more risky. Consequently, in process I and II it becomes more difficult to gather reliable information, because the further development of individualized projects is more uncertain. It is also much more difficult to open up a project or customer (process III), because there are less projects available and customers operate on a highly cost focused basis and thus limit the possible project scopes. Furthermore, due to decreased demand, the margins of the projects may come under pressure and will force software companies to enhance their efficiency in the operation of the projects (process IV).

5.2.3 Three Firm Specific Project Examples

In order to illustrate some of the specific characteristics of the framework discussed, projects of each of the three software companies are briefly described. In particular, the first project illustrates the very first large-scale project, Adnovum had when the company was still in a young stage with no more than 12 employees and when it was still extremely difficult for them to open up a big customer. The second example points to the ongoing characteristic of the four processes, illustrated by showing how Ergon established a customer relationship from which several interesting projects followed. The last example demonstrates in particular the impact of the economic situation on how Netcetera gained a new project through an international public procurement and shows the iterative procedure that was used to transfer the business knowledge of the customer into a technological solution.
Adnovum: The development of a general enterprise information system

In 1992, after Adnovum had gained enough experience in many smaller projects, the company tried to acquire a project within a big internationally-active Swiss bank. After a year of acquisition activities, which was spent in efforts to open up the customer, Adnovum won a large scale project within this bank. The hint for the potential opportunity came from a salesperson from Sun Microsystems which delivered Sun computers to Adnovum and its customers. The relevant bank planned to realize a general enterprise information system, in which key features of over 70 buildings, spread all over the city of Zurich, would be electronically supported, controlled and managed. There had been several attempts to complete the application before, but none of them were successful. The mentioned salesperson from Sun Microsystems was at that time the person who helped Adnovum to make contact with the persons responsible who were planning the particular project in the bank. The task was complex, because the new software application had to integrate data from more than 30 already existing control systems with more than 100’000 data points, such as entrance and fire control, burglary prevention devices, video and temperature monitoring, and so on. In a very short time, Adnovum prepared a prototype which people responsible in the bank found appealing, and which generated trust and helped to deepen the conversation. The proposed solution and the common meetings finally achieved its goal, Adnovum got the project. Over several months, Adnovum, in close interaction with the customer, specified and developed the first release of the modular application in 1994. The project was a great success, as it enabled the responsible manager in the bank, the principal of the project, to save substantial costs. Furthermore, the overall efficiency of the management enterprise in the area of Zurich was increased. For instance, over twenty building-entrances did not need guards anymore. The project became known in the IT department of the bank and the information even reached to the top level of the bank. Consequently, the project immediately generated further release projects and it helped Adnovum to build reputation internally in the bank and externally in the market by using the project as an important reference. The software is still in operation and has been
continuously expanded. For example, a direct connection to TUS Alarmnet\(^{93}\) was established in 2003.

**Ergon: Internet banking and the first steps into mobile applications**

In 1996, Ergon was asked by another big international Swiss bank to hand in a proposal for an internet banking application. The invitation to bid came as a surprise, because Ergon only consisted of 15 persons at the time. However, the company was not completely unknown in the bank. For instance, when Java\(^ {94}\) was introduced, Ergon supported and promoted the new programming language very early together with Sun Microsystems. In this context, presentations and workshops were also held inside the bank. In respect of the internet project, Ergon was not the only tender. The competitors in this offering were two big global IT-companies. Nevertheless, Ergon won the project due to the company’s profound technological knowledge and experience with open software systems, from which the internet technology basically stems. Even though the internet was a known technology for Ergon, it was the first big internet project for the company, *nota bene* in a time when the internet gained more and more attention in the business world. In the following eight months, in close interaction with the customer, the first internet banking solution in Switzerland was created and went online in April 1997. However, this was not the end of the story. Based on the established relationship and the success of the internet banking application, Ergon was asked by the bank in the end of 1998 to develop an internet discount broker, where customers could trade securities via the internet, manage their deposits and get market relevant information. The internet brokerage project had then, though incidentally, an important impact on a further project. One of the software engineers, who had been involved in the previous internet banking and brokerage projects and who was interested in the upcoming mobile and wireless technologies, started to experiment with Java programming on wireless devices.

---

\(^{93}\) TUS (Telekommunikation und Sicherheit) is a joint venture between Securiton AG and Siemens Building Technologies AG that delivers services for alarm transmission to the police, fire brigade and other institutions in Switzerland.

\(^{94}\) Java, originally known as "oak", is a programming language developed by Sun Microsystems that was first introduced to the public in 1995. Today Java is widely used to create Internet applications and other software programs. On the Internet, Java allows downloading of small programs, known as applets, which enable the user to perform specific functions or features that are not available with standard web browsers.
He had the idea to run a part of the brokerage application on a PDA.\textsuperscript{95} Therefore, he created a prototype that was connected to a server via a Palm-handheld and a WAP\textsuperscript{96} mobile phone and from which it was possible to make stock market transactions. Based on these first experiences, the prototype was presented at an IT conference and the first articles about wireless technologies were written for professional journals. The prototype was also presented to the responsible IT persons at the bank where the idea to complete their e-business service with a brokerage system operated from PDAs appealed to them. Ergon received the order to finish an application and in December 2000, the bank was the first financial institution in Switzerland that provided a service that enabled the trading of securities with Palm-handhelds.

\textit{Netcetera and the European railway coordination system}

After the internet bubble burst in the year 2000, the economic environment for IT solutions became less munificent. Therefore, Netcetera examined new ways in order to gain new projects. One way was for Netcetera to try to participate in public procurements. As already mentioned before, the problem of gaining such a project is not to get information about existing projects, but to hand in a suitable offering or solution proposal, because bilateral contacts or conversations with the client before the assignment are not allowed by WTO regulations. Consequently, it is difficult to anticipate what the customer’s real needs are. The only available information stems from the project description and short public briefings where all interested parties are present. Additionally, the customer is also not allowed to divulge the designated budget, which makes it difficult for a software company to estimate the extent of a possible tailor-made software solution. Nevertheless, Netcetera started to apply for several public procurements. One of these was a project which had the goal of coordinating the cross-boarder railroad traffic (passenger and cargo) between five European countries and seventeen European railroad companies over an internet platform. Before an internet solution could be tackled, the coordination of around 40’000 timetable adjustments per year were

\textsuperscript{95} Personal digital assistant

\textsuperscript{96} WAP is the abbreviation for Wireless Application Protocol. WAP is a specification for a set of communication protocols used to allow wireless devices to access the Internet and other network utilities such as e-mail, chat, etc...
organized in several annual conferences where railway companies representatives met each other, discussed and negotiated the necessary modifications. The adjustments were very time intense and produced a lot of paper work. Based on the project description, which contained around eight hundred pages, Netcetera prepared a serious solution proposal which was also presented and finally convinced the customer. Netcetera won the project against strong competitors. However, although the documentation was very detailed and even though the people involved from Netcetera read the documentations very carefully, it was an arduous task to transfer the customers’ business knowledge into a technological solution, because of the given complexity and the difficulty of transferring the railway related knowledge. For the offering handed in, Netcetera created user cases in which the coordination procedures were described in detail for each user. However, with not having the possibility to get into deep customer interaction on a personal level before the project was assigned, Netcetera realized that it was difficult to model the reality of the railroad. Therefore, when the project was won, Netcetera decided to work in a very iterative process together with their clients. In regular meetings, Netcetera received relevant information and feedbacks. Step by step the software company obtained a precise picture about what the coordination processes and constraining parameters looked like. Furthermore, during the working-out phase of the software, the progressing versions of the application were presented on a more or less monthly basis in order to incorporate and discuss responses from the users. The whole project started in August 2002 and went online in December 2003. A second release followed in Mai 2004, when local planning systems were integrated as well.

5.3 Discussion

Based on the empirical results and the framework developed above with regard to information and knowledge asymmetries that characterize the company-customer relationship, this sub-chapter sets the findings into the more general context of the

97 Very often software projects are realized in a consortium, in which companies divide a project according to the core competences of each company. This is also the case in the presented project examples. For example, sub-contractor were involved to create graphical user interfaces (GUI). However, each of the presented projects was realized under the direction of one of the three software companies Adnovum, Ergon or Netcetera.
entrepreneurial processes. The focus lies on three main issues. In a first part, the interplay between the entrepreneurial process and customer and market knowledge is discussed. In a second part, the entrepreneurial process and its characteristics are further examined. Finally, in a third part, entrepreneurial and competitive consequences that arise from information and knowledge asymmetries are formulated.

5.3.1 The Co-Evolution of the Entrepreneurial Process and Customer and Market Knowledge

Shane (2000) argues that prior knowledge is a crucial precondition to recognize opportunities. He especially addresses prior knowledge about markets and about customer problems as key variables. According to him, prior knowledge of customers, their problems and relevant markets has to exist before the actual entrepreneurial process starts.

Without question, the possession of this kind of knowledge facilitates the identification and exploitation of specific entrepreneurial opportunities. There is enough evidence, that the experience gained from people who have worked for a longer period of time in a specific market or industry helped to recognize and to exploit opportunities, for instance, by developing new businesses and companies.

However, not every person is so fortunate to possess detailed market and customer knowledge from the beginning. Very often, entrepreneurs do not possess this kind of knowledge when they start a business or when they approach a customer the first time. They have to acquire and generate it. While this lack of prior knowledge about markets and customers imposes additional challenges for setting up a business, it does not have to mean that they cannot be successful as well.

In the case of the three software companies Adnovum, Ergon and Netcetera, customer and market knowledge are primarily built through profound interaction with their customers. In doing so, they get to know to the customer’s technological background and habits. While the companies identify, evaluate, open up and exploit entrepreneurial opportunities, they acquire intense knowledge about their customers. The entrepreneurial process per se is thereby to be understood as the actual means to create the relevant information and knowledge.

In this respect, the entrepreneurial process and the creation of customer and market knowledge interact and influence each other at the same time, thereby representing
co-evolutionary processes. Through the multiple interactions in realizing software projects, knowledge about a specific customer and his problems is accumulated during the entrepreneurial process. This accumulated knowledge can then again be an important basis to identify and exploit further opportunities, and generates further knowledge about the customer and so on.

As a result, an important difference between the three analyzed case studies and Shane’s model (see Figure 2, p. 51) of prior knowledge and entrepreneurial opportunities is to be seen in that in Shane’s case, entrepreneurs only identify and exploit opportunities, if they already possess prior knowledge, which is used as a rather static entity. Whereas in the case of the software companies, relevant knowledge about a customer, its problems, and how he must be served is essentially built on the way during the entrepreneurial process. Entrepreneurial opportunities are thereby specified and concretized during the entrepreneurial process and specific customer and market knowledge are dynamically built, maintained and enhanced during this process. Furthermore, it is also often the case that in many tailor made software solutions the opportunity is not just fully identified and specified by a single entrepreneur, who, based on his prior knowledge, has an ingenious idea, but the entrepreneurial opportunity is defined and concretized in the software firm – customer interaction during the entrepreneurial process.

This also indicates that there is a difference in the understanding of an entrepreneurial opportunity. Whereas in Shane and Venkataraman’s framework the entrepreneurial opportunity is concretized and clearly defined from the outset, in the case of the software firms, an entrepreneurial opportunity is concretized during the whole entrepreneurial process in close interaction with their customers. Therefore, an entrepreneurial opportunity may look different at the time when it is identified to when it is realized. Thus, an opportunity is not just identified at a particular point in time but is rather developed through the whole entrepreneurial process (see also Ardichvili, Cardozo et al. 2003).

In summary, in accordance with the discussions in Chapter 4, prior knowledge about specific customer problems, markets and how to serve these markets often exists only to a limited extent, when a company is founded or when a potential customer, who is active in an industry that is not so familiar to the software industry, is contacted the first time. However, in these cases, it is the entrepreneurial activity in close interaction with the customer that accumulates these different knowledge
domains. Therefore, entrepreneurship in the market for individualized software solutions should not only be understood as the identification, evaluation and exploitation of entrepreneurial opportunities due to prior knowledge, but also as a dynamic, ongoing building of relevant knowledge about customers, markets and how they have to be served. In this sense, customer and market knowledge are not necessarily the precondition for entrepreneurial activities, but represent an integral part of the entrepreneurial act *per se*.

### 5.3.2 Entrepreneurial Opportunity Identification and Exploitation as an Iterative and Ongoing Process

Venkataraman and Shane’s (Shane 2000; Shane and Venkataraman 2000) work is an important and helpful formal framework in order to understand the entrepreneurial process. It highlights the role of prior information and of cognitive properties in the identification process. It explains elements of the evaluation process. In particular, the nature of the opportunity itself and individual differences in experience, perception and optimism are emphasized. Finally, it deals with the question under which conditions opportunities are exploited by the institutional arrangement of the firm or via the market.

Based on Venkataraman and Shane’s framework and model (see also Figure 2), the impression arises that the entrepreneurial process is sequential and somehow limited to a single opportunity, put simply, an entrepreneur identifies an opportunity, evaluates it and either builds a business out of it or sells it. However, the findings within the three software companies show certain differences in this regard.

First, the investigations show that the entrepreneurial process is an ongoing one. The software companies are constantly looking for new innovative projects and opportunities are iteratively identified, evaluated, opened up and exploited.

Second, if we look at each element of the entrepreneurial process in more detail, in Shane and Venkataraman’s understanding, differences in prior knowledge, cognitive properties and individuals play a major role in explaining why people recognize and exploit different entrepreneurial opportunities. These are definitely important factors. However, it is also important to add the role of action which is also an essential element in generating certain knowledge domains and cognitive frames. In particular, this applies to the interaction of the software firms with their current or potential
customers. In this regard, entrepreneurs also identify opportunities by becoming active, by meeting potential customers, by searching for specific information, by presenting and suggesting possible solutions, by inspiring and convincing people and so on.

Third, Shane and Venkataraman strongly stress economic criteria as the driving factors in the evaluation process - meaning that entrepreneurs exploit these opportunities, where the expected profit will be large enough to compensate for the opportunity costs of other alternatives. However, the case studies have shown that beside economic criteria, which also include the consideration of the potential for further projects with a certain customer, entrepreneurial opportunities are also evaluated in respect of their technological background, in respect of the customer’s experience and collaboration with external software companies, and in respect of loyalty to well established customer relationships. The degree of free project capacity is an important moderating factor in the evaluation process. Therefore, beside pure economic criteria other criteria also play an important role in the evaluation and selection of entrepreneurial opportunities.

Fourth, in Shane and Venkataraman’s framework the entrepreneurial process basically consists of three elements – the identification, evaluation and exploitation of entrepreneurial opportunities. In the case of the software companies examined, a forth process is central, namely the opening up of customers and the acquisition of software projects. In order to exploit a software project, every software company tries hard to build a trustworthy relationship with their customers, convincing them about their competences and reliability. Due to the fact that software projects are costly, risky, and information asymmetry exists, trust building and convincing the customer that one is the right partner is essential. Two kinds of opening up strategies have been identified. Either software companies try to acquire a specific identified project or they try to open up a customer without having a particular project in mind, which means that the identification process for possible projects cannot begin until the customer is opened up.

Fifth, with regard to the exploitation process, Shane and Venkataraman emphasize the mode of exploitation, whereas the researched software companies put more emphasis upon organizational measures to guarantee the efficient use of their technological know-how and of its combination with the business knowledge of the customer. Therefore, the decision about whether to exploit an opportunity inside the
Chapter 5

company or to sell it on the market, is a question that is less predominant than organizing the exploitation process internally and with the relevant customer.

Dew, Velamuri et al. (2004) also study the mode of exploitation in respect of exploiting opportunities in existing or new firms. Dew, Velamuri et al. particularly emphasize high risks and heterogeneous expectations as a decision criteria for exploiting opportunities in new or existing firms. The software companies examined add further arguments for founding additional new companies as subsidiaries or affiliated companies. For instance, the establishment of new companies is used as an organizational means to organize the company in different units in order to build identity for particular activities and to keep the flexibility of smaller units; or by separating activities that are not considered as the core activity of a company but are nonetheless promising; or by exploiting opportunities that have the potential to stand alone and are therefore also separately positioned in the market. Additionally, newly associated companies are founded as a result of being geographically closer to certain substantial customers or for off-shoring certain coding activities to countries with educated software engineers that have lower labor costs than Western Europe.

By way of illustration, Adnovum has been separated into different companies that are responsible for different activities. As already mentioned, the parent company, Adnovum Informatik AG, was founded in 1988. In 1994 an associated company was created in San Mateo, California, in order to detect trends early in the US IT industry and to provide the possibility for software engineers from Switzerland to work in the United States for a length of time. In 2000, Adnovum Informatik AG grouped senior software engineers and employees for support and operation in two associated companies, namely Adnovum Engineering and Adnovum Operations AG. In 2003, a small branch office was established in Bern in order to better serve existing and potential customers in the capital, and in 2003, Adnovum Hungary was founded as an offshore office in order to process certain parts of the software development in a promising location in Eastern Europe. In the case of Ergon, the company spun-off a small team in a new company, named Seclutions AG, in 2002, with the aim of building a standardized security software product from promising security software components that have been developed in Ergon since 1996. Netcetera itself has established two associated companies. On the one hand Panton AG - a partner software company in Skopje, Macedonia - was founded in 2001. On the other hand,
Information and Knowledge Asymmetries: The Entrepreneurial Process and the Creation of Business Opportunities

Eveni AG was established in Zurich in 2001. It develops and sells an ASP-based conference management solution.

Finally, beside these theoretical considerations I would like to point to a methodological problem. Given the fact that the entrepreneurial process is overlapping, iterative and non-recursive, we face a methodological problem when examining entrepreneurial opportunities. So far, it has become common to isolate and concentrate on single processes in the overall entrepreneurial process. For example, researchers concentrate only on the identification or the evaluation process. This approach is somehow understandable, because it reduces complexity and generates specific knowledge in respect of the respective processes. However, given that the whole entrepreneurial process is overlapping, iterative and ongoing, this is also a problematic approach, because the single processes are not independent of each other. Therefore, when one particular process is examined and studied, the impact of other processes should also be considered. Additionally, the concentration on one particular opportunity could also be misleading. The examination of a range of successive opportunities would generate a better and more generalizable understanding of the essential factors that drive the processes. For example, some researchers look in particular at the first opportunity out of which the company has been founded. However, this first opportunity is often only the starting point, out of which other opportunities will follow that are mostly more interesting and insightful than the very first one.

5.3.3 Asymmetric Information and Knowledge and Its Consequences

In the previous sections, it is argued that it is expedient to a) differentiate between asymmetric information and knowledge and b) to clarify between whom asymmetric information and knowledge exists and with what consequences. In the following, the two issues are further discussed and integrated in a broader context:

a) According to Shane (2000), asymmetric information and knowledge are reflected in the prior knowledge of individuals in respect of customers and markets. While it is true that in this sense prior knowledge that differentiates an entrepreneur from its competitors and enables the recognition of new entrepreneurial opportunities when for instance new technological inventions are brought forth, it has been

---

98 ASP is the short form for Application Service Provider. An ASP is a third-party provider that handles and distributes business data for its customers.
shown in the previous sub-chapter 5.2 that problems and needs of potential and existing customers are often not always exactly known\textsuperscript{99}. Therefore, before prior knowledge comes into existence, it has to be created. In this sense, the reduction of asymmetric information and knowledge, the gathering of information, and the building of knowledge in respect of customers and markets are important elements to study.

Thus, it is not only pertinent to emphasize that information and knowledge are of value, but that there also exist differences between asymmetric information and knowledge, because they play a distinct role in the entrepreneurial process. Concerning the software companies examined, asymmetric information exists in respect of innovative entrepreneurial opportunities, in respect of relevant information about people who have to be addressed in order to learn about potential opportunities and in respect of evaluating the quality of these opportunities and the quality of the competences in order to exploit them (see also Akerlof 1970). Before opportunities are exploited or before a relationship is built with a customer, asymmetric knowledge exists primarily in the form of technological and business know-how, but also in respect of a lack of profound knowledge about customer’s problems and needs and the habits in its industry.

Consequently, in order to identify, evaluate, open up and exploit entrepreneurial opportunities, it is essential to get opportunity related information and thereby to transfer and process asymmetric information into relevant knowledge (see also West III 2003). Furthermore, it is essential to combine technological know-how and business knowledge in order to build a valuable end solution. Hence, these are two mechanisms that foster the creation of customer and market knowledge.

b) Coming back to the notion of dispersed and prior knowledge (Hayek 1945; Shane 2000), the authors do not explicitly specify between whom dispersed and prior knowledge exists. Hayek simply states that knowledge is spread over society, whereas Shane’s concept of prior knowledge points to the fact that some people have knowledge about customers and markets that others do not possess, but it does not include the possible existence of asymmetric knowledge between an entrepreneur and potential customers. Hence, it is worthwhile to readdress this question and to show some consequences of it.

\textsuperscript{99} Especially, when individuals decide to found a company or when a company is young or wants to venture in new areas.
In the empirical part it has been shown that there exist asymmetries between three major parties, namely between customers, competitors and “nature”. Asymmetric information and knowledge between software firms and customers has been called vertical asymmetric information and knowledge, asymmetric information and knowledge between software firms has been described as horizontal asymmetric information and knowledge, and the lack of accurate information and knowledge at a certain point of time is declared as longitudinal asymmetric information and knowledge.

The implications of horizontal, vertical and longitudinal asymmetric information and knowledge are summarized in Table 18 (p. 160). On the one hand, horizontal asymmetries – i.e. asymmetries among peers - have a possible direct competitive impact, because the owner of specific information and knowledge can use it for his advantage vis-à-vis his competitors. Such advantages could for instance arise for a company that has a customer who plans to realize an IT project which no competitor has done so far, such as a project that improves internal business processes or ameliorates market appearance. Or a software company has information about a potential project or know-how about new technological procedures that other competitors do not have at the moment. Horizontal asymmetric knowledge is therefore - in respect of between whom it exists - consistent with Shane’s notion of prior knowledge.

On the other hand, vertical asymmetric information and knowledge between software companies and customers inherently bears potential opportunities that are still unexploited. When one or the other party eliminates this asymmetric situation, there is room for new projects, for new potential entrepreneurial opportunities in the form of new products and services. Through the entrepreneurial process, entrepreneurial companies can reduce this asymmetry and identify and exploit these new entrepreneurial opportunities.

It is important to add that competitive implications and potential opportunities generally exist in the short run, and are not sustainable. In a competitive dynamic market, information and knowledge diffuse when there are no particular economic barriers, such as patents, or knowledge and information are ageing rather quickly such as in the IT industry. The elimination of knowledge and information asymmetries is fundamentally open for every market participant in the market for
individualized products and leads therefore only to short-run competitive advantages and not to sustainable ones.

Furthermore, in respect of longitudinal asymmetries, the inherent uncertainty bears the potential for new opportunities in the future (see e.g. McGrath and MacMillan 2000). In this case, reliable information and knowledge has to be created, confirmed and justified over time through different means, for instance, through research and development, through experimenting, or through interaction with different parties - be it customers or partner companies. Through these activities potential new opportunities can be generated and consequently, they can have a competitive impact vis-à-vis competitors.

As a final remark I would like to briefly return to the ongoing debate about the role of entrepreneurship and strategic management that has been mentioned in Chapter 2. Some researchers claim that we should separate entrepreneurial issues (the identification and exploitation of entrepreneurial opportunities) and strategic issues (competitive and performance differences among companies).

<table>
<thead>
<tr>
<th>From… to …</th>
<th>Software Company</th>
<th>Customer</th>
<th>Nature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software Company</td>
<td>Horizontal asymmetric information and knowledge between software firms</td>
<td>Vertical asymmetric information and knowledge between software firms and customers</td>
<td>Longitudinal asymmetric information and knowledge</td>
</tr>
<tr>
<td></td>
<td><strong>Competitive Implications</strong></td>
<td><strong>Opportunity Potential</strong></td>
<td></td>
</tr>
<tr>
<td>Customer</td>
<td>Vertical asymmetric information and knowledge between customers and software firms</td>
<td>Horizontal asymmetric information and knowledge between customers</td>
<td>Future Opportunity Potential and Competitive Implications</td>
</tr>
<tr>
<td></td>
<td><strong>Opportunity Potential</strong></td>
<td><strong>Competitive Implications</strong></td>
<td></td>
</tr>
</tbody>
</table>

Table 18: Categories of asymmetric information and knowledge and their consequences
However, if we look at the elementary framework of Table 18, it can be seen that entrepreneurial and strategic issues are two different sides of the same coin. Therefore, in the context of the discussions of this work, we should not separate the two, but investigate their interaction in more detail (see also Hitt, Ireland et al. 2001).

5.4 Conclusion

This chapter started with a theoretical discussion about the foundations of the concepts of dispersed knowledge and asymmetric information. These have been absorbed and incorporated in a recent research stream of entrepreneurial research, especially with the intention of explaining the identification and exploitation of entrepreneurial opportunities (Venkataraman 1997; Shane 2000; Shane and Venkataraman 2000; Ardichvili, Cardozo et al. 2003; Eckhardt and Shane 2003; Dew, Velamuri et al. 2004).

However, it has also been shown, that certain aspects are neglected by the main research conducted so far in this area. In particular, existing studies do not consider the following aspects: a) differentiation between asymmetric information and knowledge, b) between whom do information and knowledge differences in the entrepreneurial process specifically exist, and c) with what consequences.

The empirical examination of the cases of three software companies has generated some interesting results in this respect. First of all, the production of individualized software solutions is typically characterized by a high level of asymmetric information and knowledge. Vertical information asymmetries consist between software companies and (potential) customers in respect of innovative projects, contacts with relevant people, and quality issues. Vertical knowledge asymmetries exist in particular with respect to technological and business know-how. Software firms therefore have to find out what the real needs of the customer are and to establish efficient ways of how to transfer the customer’s business know-how into a valuable solution.

Horizontal asymmetric information between competing software firms arise especially from establishing contacts and relationships to specific customers. In doing so, a software firm can gather project related information very early in the setup of a possible project and can proactively influence the specification of the project.
Depending on which problems are solved, which technologies are used, for what customer and in which industry, software firms may build different technological, customer and industry knowledge.

Beside vertical and horizontal asymmetric information and knowledge, there longitudinal asymmetries also exist. Due to the high dynamics of the IT industry, information and knowledge may be inaccurate or contradictory at a certain point of time. This kind of uncertainty can generally only be solved by activities such as research and development, technological experimenting, or through interaction with different parties.

In order to eliminate information and knowledge asymmetries on the one side and in order to enhance necessary information and knowledge on the other side, the entrepreneurial process of identifying, evaluating, opening up and exploiting projects plays an important role. The entrepreneurial process is therefore not only a means to reduce asymmetries but also a means to transfer and generate opportunity related information and knowledge, for example by ways of knowledge combination and reciprocal learning.

Additionally, in contrast to current publications, the empirical results point to some new issues that have not been stressed so far. First, the identification process is not only dependant of cognitive and epistemological issues, but is also profoundly driven by different activities, such as approaching and interacting with (potential) customers and partner companies. Through these diverse activities, information and knowledge about opportunities are fostered. Second, in respect to the evaluation of entrepreneurial opportunities, beside pure economic criteria other factors are also considered, such as technological challenge, innovation potential, and the positive collaboration between software companies and customers in a project. Third, the process of opening up a customer and the acquisition of projects are essential in a service business such as individualized software development. It is especially important to build a trustworthy relationship to a (potential) customer in which the customer is convinced that the software company is the right partner for carrying out a project. Fourth, the exploitation process emphasizes, beside the technological know-how, the importance of organizational measures in order to transfer the customers needs into a valuable end solution. In particular, the regular interaction with the customer and the early involvement of engineering resources are an important element in order to transfer and generate useful business and customer knowledge.
Overall, the entrepreneurial process is the way in which the entrepreneurial opportunity is concretized, it includes all four sub-processes of opportunity identification, evaluation, opening up, and exploitation, and it is fostered by close interaction with the customer throughout all its elements. The whole entrepreneurial process is also a means to build specific customer and market knowledge over time. Combined with the successful realization of projects, software companies build reputation within customers and on the market.

Finally, because specific software projects are limited in time and technological development in the IT industry is rapidly progressing, software companies are forced to look constantly for new entrepreneurial opportunities. The entrepreneurial process is therefore iterative, overlapping and non-recursive and is dependant on the stage of the company development, the kind of projects, and environmental conditions.

Software companies with the necessary technological know-how, which promote and execute the entrepreneurial process proactively, are able to reduce information and knowledge asymmetries by transferring asymmetries into useful information and knowledge. Thereby, they pave the way to new entrepreneurial opportunities. The information gained and knowledge about customers and their problems enable software companies to achieve short term competitive advantages, which are often sufficient to gain particular projects.
6 Entrepreneurial Opportunities and the Role of the Individual, the Firm and the Environment

This chapter analyses the moderating role of the firm and the environment in the entrepreneurial opportunity identification process. The starting point of this analysis is the individual-opportunity nexus, suggested by Shane and Venkataraman (Venkataraman 1997; Shane 2000; Shane and Venkataraman 2000), which serves as the core relationship in studying the identification and exploitation of entrepreneurial opportunities. Although this nexus is a central relationship in entrepreneurial opportunity research, it is argued and shown in this chapter that we should not exclusively focus on this relationship, but go beyond it and also reconsider the importance of the environment (see e.g. Zahra and Bogner 1999; Lumpkin and Dess 2001; Zahra and Dess 2001) and the firm-level (see e.g. Bruyat and Julien 2001).

With regard to the environment, the impact a changing economic context on the three software companies and their entrepreneurial opportunities is analyzed. In particular, it is shown that during the economic downturn the demand for innovative tailor-made software was reduced and that the companies’ economic efficiency came under pressure. It is further evaluated how the three companies reacted internally and externally to the changed economic conditions. The internal reactions were similar for all three companies: the efficiency of project proposals and of the software engineering process was increased, the whole planning process was tightened, and projects’ risks were reduced. In terms of external measures, the companies also reacted similarly in searching for new entrepreneurial opportunities by extending their business models and their project scope. However, they reacted differently in respect of the diversification patterns into new technological applications areas and in applying their competences in different industries. One reason for searching and exploiting new entrepreneurial opportunities in different diversification patterns can be seen in firm-specific characteristics and reasoning.

The chapter is structured as follows: In the first theoretical part, the foundations of Shane and Venkataraman’s individual-opportunity nexus are examined and extended by economic and firm-level considerations. In the subsequent empirical part, the analysis of the impact of the environment is deepened, by showing how the economic
context of the software industry changed around the millennium and how the three software companies experienced that change, also in respect of innovation in software projects, companies’ economic efficiency and the reuse of software. It is then shown how the firms reacted to the changed economic conditions and what firm-specific explanations were responsible for the differences that were observed with regard to certain aspects of their chosen direction. In the last discussion part, the impact of the changed economic context and the consideration of the firm level on entrepreneurial opportunities are discussed and a multi-level model for entrepreneurial opportunity research is presented.

6.1 Theoretical Background

6.1.1 Technological Invention in the Individual-Opportunity Nexus

As has been shown in the previous chapters, Venkataraman, Shane, and related researchers (Venkataraman 1997; Shane and Venkataraman 2000; Eckhardt and Shane 2003; Dew, Velamuri et al. 2004) have based their entrepreneurial opportunity research strongly on the nexus between the enterprising individual and the entrepreneurial opportunity.

They argue that previous research in entrepreneurship has mostly focused on the characteristics of the entrepreneur alone and has largely overlooked the roles of opportunities. They further argue that this person centric approach is problematic, because entrepreneurial behavior is not stable but transitory over time and depends heavily on episodic information that people have gathered about particular opportunities (see e.g. Eckhardt and Shane 2003: p. 334).

Shane and Venkataraman emphasize in particular the correlation between the attributes of an individual with the attributes of an opportunity. As Shane expounds (2000: p. 450): “Much of the existing empirical evidence on opportunity exploitation has assumed that the attributes of people who discover opportunities are uncorrelated with the attributes of the opportunities that they discover. Researchers making this assumption have studied how individual differences affect the way people exploit opportunities while ignoring the attributes of the opportunities themselves.”

In this sense, the above mentioned researchers have started to study the attributes of individuals, such as prior information and cognitive properties, and the attributes of entrepreneurial opportunities, such as their existence and characteristics, and have in
particular started to investigate possible correlations between the attributes of the two
ends of the individual-opportunity nexus (Shane and Venkataraman 2000; Eckhardt
and Shane 2003).

New technologies and technological inventions, which are used in order to create
new goods and services, are also put into the interplay of the individual-opportunity
nexus, emphasizing that individuals use new technologies to exploit different
entrepreneurial opportunities, depending on the attributes of the individual and the
opportunity identified (Shane 2000).

In this respect, Shane’s understanding stands in contrast to the opinion of other
researchers, such as the neoclassical economists. Shane (2000: p. 450) emphasizes that
neoclassical economists have argued that multi-purpose technologies should be
exploited by a single entrepreneur across different market applications because such
centralizations minimize duplication of effort and contracting costs, and increase
economies of scale and scope (see e.g. Bresnahan and Trajtenberg 1995). In contrast,
Shane underlines that if people do not identify the same entrepreneurial opportunities,
a decentralized approach to use multi-purpose technologies is superior to the
centralized one, because no central agent can identify all the possible entrepreneurial
opportunities of a new technology with the consequence that it would lead to under-
identification of possible opportunities.

As a conclusion, the individual-opportunity nexus certainly plays an important role
in the entrepreneurial process, such as emphasized by Shane and Venkataraman.
However, I would also like to stress that other levels of investigation should not be
forgotten. Based on the empirical data of the three software firms researched and
based on some academic comments in respect of Shane and Venkataraman’s
framework (see e.g. Erikson 2001; Singh 2001; Zahra and Dess 2001), the individual-
opportunity nexus can be expanded by two other important elements in the
entrepreneurial process, namely, the consideration of the firm level and the
environmental context.

6.1.2 Beyond the Individual-Opportunity Nexus (I): The Impact of the
Environment

In their seminal paper “The Promise of Entrepreneurship as a Field of Research”,
Shane and Venkataraman explicitly mention that their framework aims at the
following issues (2000: p. 219): “(1) we focus on the existence, discovery, and
Entrepreneurial Opportunities and the Role of the Individual, the Firm and the Environment

exploitation of opportunities; (2) we examine the influence of individuals and opportunities, rather than environmental antecedents and consequences, and (3) we consider a framework broader than firm creation.” In the following, the focus is laid on issue two.

As mentioned before, there is no question that the nexus of the individual and the opportunity is a core relationship that has to be investigated in entrepreneurship research. However, entrepreneurial individuals also act in an environment and it is difficult to argue that entrepreneurial individuals do not have to consider the environmental context in their decisions and behavior.

In this respect, Zahra and Dess (2001) criticize Shane and Venkataraman’s framework in an academic dialogue, indicating that environmental factors are important antecedents to entrepreneurial activities and change. They also mention that the understanding of environmental factors can help to contextualize the results of empirical studies and that it is a means to improve prescriptive theory.

Shane and Venkataraman (2001) defend themselves by arguing that they do not recommend ignoring environmental forces, but that the individual-opportunity nexus is the first-order force that explains entrepreneurship and that environmental forces are second order forces, because environmental forces alone can not explain entrepreneurial activities.

Interestingly, Bruyat and Julien (2001) incorporate the individual-opportunity nexus and the environmental context in a theoretical framework. In particular, they place the entrepreneur as an individual, the entrepreneurial project, and the environmental context at the core of future entrepreneurial investigations. Based on a constructivist stance, they view the entrepreneur as a person who is in a constant dialogue with his entrepreneurial project. The two authors argue that this dialogue takes place within a specific environmental context and at a particular point in time. In particular, the environmental context on the one side influences the entrepreneur and

---

100 Bruyat and Julien (2001: p.167) explain a constructivist perspective as follows: “The constructivist perspective is often placed in opposition to so-called positivist science. This family of thought draws together authors form different disciplines. Some of the founding members include the philosophers E. Kant, A. Schopenhauer, L. Wittgenstein, and J. Searle, and psychologists J. Piaget and P. Watzlawick. Very briefly, the positivists view the world as deterministic. There is a plan waiting to be discovered by the scientists. For the constructivists, and especially in the social sciences, the world is a construct in constant evolution that can only be approached through representations. Constructivism is concerned more with understanding problems, while positivism is concerned more with prediction. Some authors, like sociologist of science D. Bloor, have pushed this reasoning to its extreme. Others consider both approaches to be usable, with the choice depending on the problems to be solved and the state of knowledge at the time.”
its project, but on the other side, the entrepreneur as a creative and intelligent human being also shapes the environment. According to Bruyat and Julien, the phenomenon of entrepreneurship will not be understood comprehensively, unless the individual (the entrepreneur), his projects, and the environment are considered and examined together.

Beside this theoretical work, there also exist several empirical studies that demonstrate the impact of the environment on entrepreneurial endeavors. Most of them show the moderating role of the environment on firm performance. For instance:

- Zahra and Bogner (1999) examined different technology strategies of 116 US-based software ventures, exploring the moderating effect of the competitive environment and its impact on the ventures’ performance\(^{101}\). The authors analyze five technology strategies (development and introduction of new products ahead of competitors; the intensity of product upgrades; the level of R&D spending; the use of external technology sources; the use of copyrights) under different environmental conditions (the degree of dynamism, price hostility, non-price hostility, and heterogeneity)\(^{102}\). Their results show that not all technology strategies had an impact on firm performances and that influential strategies were moderated by the external environment. For instance, only frequent product upgrades had a significant impact under all four environmental conditions. New radical products enhanced performance in dynamic environments but decreased firm performance in price hostile environments. Or, external technology sources positively influenced the ventures’ performance in all environments, except in non-price hostile ones.

- Lumpkin and Dess (2001) analyzed the influence of two dimensions of “entrepreneurial orientation” - proactiveness and competitive aggressiveness\(^{103}\) - on firm performance, moderated by the environment and industry life cycle. Results show that in dynamic environments, characterized by rapid change and uncertainty, proactive firms had a better performance relative to competitively aggressive firms. In hostile environments, where competition was intense and

\(^{101}\) Performance is measured by return on equity (ROE) and growth of market share (GMS).

\(^{102}\) Dynamism measures the rate and continuity of change within an industry; price hostility shows the intensity of rivalry in an industry based on costs and reduced prices; non-price hostility indicates an emphasis on product quality and service as the key to succeed in an industry; heterogeneity indicates the diversity of the market segments in the industry.

\(^{103}\) Proactiveness refers to how firms relate to market opportunities by seizing initiative in the marketplace; competitive aggressiveness refers to how firms react to competitive trends and demands that already exist in the marketplace.
resources were constrained, competitively aggressive firms had superior firm performance compared to proactive companies.

- Covin, Slevin et al. (2000) examined the impact of entrepreneurial pioneers and followers on firm growth, studying different competitive tactics in different environments. Their findings indicate that in general market pioneers did not significantly grow more or less rapidly in terms of sales than market followers. However, in hostile environments, pioneers might break out of the dominant price-based competition and might grow equally well regardless of higher prices charged by them. In hostile environments, pioneers also profited from limiting their product line to specific and narrow market needs. On the other hand, followers should seek to reduce their cost structures following a low price strategy in order to be competitive.

These studies underline the importance of the environment as a key moderating factor for the success of entrepreneurial strategies and firm performance. However, the environmental impact on opportunity identification *per se* has so far hardly been examined. One of the rare studies in this area is the one by Sine and David (2003) in which the authors examine the effect of environmental jolts on institutional change and the creation of entrepreneurial opportunities in the US electric power industry. Their findings indicate that in stable institutional environments, incumbent organizational forms and embedded logics in big enterprises might intensively hinder entrepreneurial activities. On the contrary, in times of environmental jolts, search processes are triggered and institutional logics are reevaluated. Therefore, their findings imply that in environments characterized by scarcity and crises, existing and well-established institutional arrangements are scrutinized, new search processes are initiated and new solutions are worked out and checked, which expatiates for new entrepreneurial opportunities.

### 6.1.3 Beyond the Individual-Opportunity Nexus (II): The Consideration of the Firm Level

Shane and Venkataraman (2000) argue that their framework of identifying, evaluating and exploiting entrepreneurial opportunities is broader than just firm creation. In this respect, entrepreneurship can, but does not necessarily have to, include the creation of new organizations. Doing so takes into account that existing
organizations undergo entrepreneurial activities, identify and exploit new entrepreneurial opportunities (see e.g. Dess and Lumpkin 2005).

However, the main focus of Shane and Venkataraman’s framework lies in the individual-opportunity nexus. And even though they mention firm level considerations, such as firm creation or entrepreneurship on a corporate level, it does not become clear how far the firm level plays a role in identifying and exploiting entrepreneurial opportunities. The reader can easily get the impression that the organizational context in which an entrepreneur often operates is somewhat neglected.

The consideration of the organizational and firm-specific context can be assumed to play an important role in the entrepreneurial process as well - beside the individual-opportunity nexus. As shown in the previous chapters, entrepreneurs and entrepreneurial teams often do not only identify and exploit one but several opportunities over time. And when the mode of exploitation takes place in the same company - in which case we do not look at opportunity exploitation within a new firm or look at serial entrepreneurs who constantly found new companies - then the entrepreneur is often not free to pick any entrepreneurial opportunity, but has to consider the possible impacts of certain firm-specific characteristics.

Consequently, we can assume that there exists not only a correlation between certain individuals and opportunities, but also between firm characteristics and attributes of opportunities. This is in line with Bruyat and Julien (2001), who argue that the relationship between the individual and the entrepreneurial project has to be understood as a dialog.

In this respect, if several entrepreneurial opportunities are identified and exploited in the institutional arrangement of a firm over time, the opportunities shape the firm and the firm shapes the opportunities. In the former case, certain firm-specific characteristics and structures are developed as a result of identified and exploited opportunities, such as specific relationships to customers, suppliers and partners; specific competences and knowledge domains; specific self conceptions and business logics. In the latter case, these established characteristics and structures also have a constraining or enabling influence on which opportunities are identified or created next, how they are evaluated, and finally how they are exploited. If there is no appropriate fit between the characteristics of a firm and the attributes of an opportunity, then, as a consequence, the opportunity may not be pursued in the respective firm, but may be dropped or exploited in a different firm.
Therefore, if we want to understand not only the identification and exploitation of one specific entrepreneurial opportunity, which would be equal to regarding entrepreneurial behavior as a “one-shot” game, but also how firms constantly identify and exploit entrepreneurial opportunities over time, it is necessary to study – beside the individual-opportunity nexus - the firm level as a unit of analysis as well and in particular, how the firm and opportunity characteristics influence each other over time. This requires that multi-level (individual, project, firm, environment) and longitudinal studies are conducted. However, Davidsson and Wiklund (2001) show in their investigations, that multi-level studies in entrepreneurship research are relatively rare and even declining. Nevertheless, the two authors conclude that in order to understand the phenomena of entrepreneurship, different levels should be combined, an issue for which Low and MacMillan (1988) called for nearly twenty years ago.

6.1.4 Some Open Issues

Given the considerations of the two previous sections, two main issues are at the core of the analysis of this chapter.

Issue one deals with the question of how the environment, in particular the economic and technological context, influences the firm’s identification and exploitation of entrepreneurial opportunities. Thus, the consequences of a changing economic context for the activities of the three software companies in respect of identifying and exploiting entrepreneurial opportunities are examined.

Issue two deals with the question of how far firm-level considerations influence the identification and exploitation of entrepreneurial opportunities. Thus, firm-specific characteristics and explanations are examined in respect of how the three software companies reacted to the changed economic situation.

In the following sub-chapter the two issues are examined in more detail.

6.2 Empirical Findings

This sub-chapter starts with a brief analysis of the changed economic conditions in the software industry in general and with a specific focus on the perspective of the three software companies in particular. In the second part of this sub-chapter, the impact of the changed economic context on technological innovation and the firm’s economic efficiency is studied in more detail, and internal measures of the companies against possible organizational threats, such as endangered, project related,
technological innovations and profitability are analyzed. The final part consists of an analysis of firm-specific external reactions and diversification patterns that were chosen by the three companies as an answer to the economic downturn.

6.2.1 Economic Change in the Software Industry

As discussed in the previous chapters, firms and economic actors are affected by the economic context. The focus of this section lies in explaining the impact of the economic context – especially of the downturn that followed after the boom years in the late nineties – on the software industry in general and, specifically, on the three software companies researched. Furthermore, how firm-specific characteristics and structures impacted the further development of the companies is analyzed, as well as the selection of entrepreneurial opportunities.

6.2.1.1 From Up- to Downturn in the Software Industry (1994-2004)

The software industry is characterized by its high degree of dynamics, and of the up- and downturns in the economic context during the last decade. In the mid nineties, the industry was favored by good economic conditions, which culminated in increasing growth rates of the whole industry and of particular companies especially. The main reasons for the extraordinary growth rates can be seen, among other things, in the emergence or broader use of new technologies, such as the internet and mobile applications, and in the millennium problem.\footnote{The year 2000 problem (also known as the Y2K problem or the millennium bug) was a flaw in the design of many computer programs that caused some date-related processing to operate incorrectly for dates and times on and after January 1, 2000. It turned into a major fear that critical industries (electricity, financial, etc.) and government functions would stop working at 12:00 AM, January 1, 2000, and at other critical dates which were billed as "event horizons". This fear was fueled by the high degree of press coverage and speculation, as well as by copious official corporate and government reports. All over the world companies and organizations had to check and upgrade their computer systems. The preparation for Y2K had a significant effect on the computer industry. In the end, significant disasters such as nuclear reactor meltdowns or plane crashes did not occur, but the number of non-critical Y2K errors encountered on January 1, 2000 was extensive. Due to the lack of disasters and the faulty "end of the world" expectations, the public largely, but perhaps wrongly, regarded the Y2K passage as a non-event (Source: Wikipedia).} These factors increased the demand for IT services. Additionally, a real technology euphoria evolved driven by the upcoming internet technologies, which further stimulated the demand for IT services. The situation changed quite dramatically after the year 2000. As can be seen in Figure 7, growth rates in information technology investments increased by 12% in Western Europe from 1994 until the year 2000, but collapsed in 2004 and sunk to more than minus 3% in 2002 (growth rates for Switzerland are similar, see also Appendix C).
Based on the data of the interviews, the downturn for individualized high-tech solutions was even worse, the number of innovative project opportunities dropped nearly to zero in 2002.

![Figure 7: Western European IT market investments: Annual growth (in %) 1992 – 2004](image)

How can this sudden and large reduction in IT investments be explained? Among other factors, there are two main explanations:

a) A first reason can be seen in *a more critical perception* of the value of new technologies after the technology boom and euphoria in the late nineties. Before 2000, people were very optimistic about the potential of new IT technologies, such as the internet. The suddenly low price for worldwide communication and connectivity, and the possibility of selling to or hearing from potential customers at the same moment when they were reached, promised to overturn established business dogma in advertising, sales, customer relationship management, production and other areas and demanded new services, business models, organizational forms and companies.
The whole technological euphoria also increased investors’ expectations. The share prices of information technology driven companies increased dramatically during this time. The technology weighty NASDAQ index more than quintupled from 1995 to 2000 (see also Appendix G) and many investors hoped that this trend would continue.

By and by, the fast growing economy ran the risk of overheating. Several national banks counteracted by increasing their interest rates. For instance, the Federal Reserve increased the target interest rate six times in 1999 and 2000. A similar strategy was followed by the Swiss National bank (see Rais and Stauffer 2005).

Additionally, doubts started to grow in the markets about to what degree the “new economy” was real and how many of the new technology driven business models and companies were viable and profitable businesses. Companies also started to worry about whether all their investments in new technologies would pay off.

Accordingly, the economy started to slow down and the whole technology euphoria disappeared to a great extent when the so called “dot.com bubble” burst in the beginning of 2000. In March 2000, the NASDAQ index started its rather dramatic downswing and subsequently lost more than 70% from its highest level until the third quarter of 2002 (see also Appendix G). The whole technology euphoria turned into its opposite which also concerned the IT industry and dampened the demand for new technologies and IT services.106

b) A second reason for the decrease in IT investments in Western Europe can be seen in the recessive or low growth situation many Western European countries have been stuck in after the year 2000. For instance, while Switzerland had an average real economic growth rate of 2.6 percent from 1998 until 2000, the Swiss economy grew by only 0.3 percent from 2001 until 2003 (see also Appendix H).107

105 The Federal Reserve (also called Fed) is the central bank of the United States.
106 While in 1999 many believed that the new economy and the internet would immediately turn the economy upside down, in the beginning of 2001 many thought that the new economy and the new internet technologies had just been an unrealistic promise fostered by the new dot.com companies and the media. Many even questioned the relevance of internet and telecommunication technologies and the existence of the so called “new economy”. Today, people have become more realistic about these issues. On the one hand, the internet, increasing bandwidth and digitalization play an important role in our daily life. On the other hand, the new economy can be seen, probably not in the form as it was expected six years ago, but in terms of economic globalization, increased importance of education and research, knowledge driven labor markets, increased importance of technologies in all kind of businesses and in enhanced competition worldwide.
107 Growth rates are measured in respect of the gross domestic product (GDP).
Additionally, certain IT intensive industries suffered from the economic downturn, either because their economic development strongly correlated with the overall economic development or because they had to deal with the “failures” of the booming years. Financial institutions especially suffered from substantial revenue losses, which were mainly driven by the poor stock market performance in the years 2001 and 2002 that resulted in poor performance of their investment and trading activities and by the drop in the revenues of their commission business, which in turn was also the result of decreasing investment returns and the lack of investment opportunities. For instance, the gross value added of Swiss financial institutions dropped by 14.4 percent in 2001 (see Rais and Stauffer 2005: p. 27). But the telecommunication sector also suffered from digesting the high investments that have been made in the mobile area, such as the high costs for infrastructure and UMTS\textsuperscript{108} licenses.

That the decreased demand for IT services had a real impact on the industry can also be seen from the fact that a large number of software companies went out of business. According to the Swiss Federal Statistical Office, the absolute number of IT companies was reduced by more than 100 companies in Switzerland between 2002 and 2003.\textsuperscript{109}

So far, the economic changes in the software industry have been studied on a macro level. In the next section, the investigation is centered around the question of how the three software companies researched experienced the change in the economic context. Firm-specific statements can be found in Table 19 (p. 180).

6.2.1.2 The Economic Change from the Software Companies’ Perspective

All three software companies used the favorable economic conditions from the mid-nineties until 2000. They profited heavily from their sound knowledge about internet technologies. The companies grew from approximately twenty people to more than 60 people, although their main goal was not primarily growth, but the sustaining and fostering of software engineering competence and quality. Although the number of staff grew, the companies ran at capacity limits, and projects inquiries had to be rejected.

\textsuperscript{108} Universal Mobile Telecommunications System (UMTS) is one of the third-generation (3G) mobile phone technologies.

\textsuperscript{109} See also Neue Zürcher Zeitung (NZZ), June 22, 2005, page 64.
When the economic context changed at the beginning of 2000, none of the three companies were extremely worried, stressing the fact that there was still enough work in the software market, which was basically true for the three companies. There were still enough projects in the “pipeline”. In addition, there were further outstanding release projects, change requests, and software supports. There also existed a perception that the market for individualized high-tech software solution would not dry up. In their perspective, many IT problems could only be solved with tailor made solutions.

Additionally, none of the companies could be categorized as a typical dot.com company. None of the three companies tried to establish a risky internet business model. All companies were soundly self-financed and they were not interested in an initial public offering, although they were courted by different financial institutions. Therefore, the three companies were alert but not shocked when the technology bubble burst and the economy started to show downward tendencies.

However, in the course of time, the three software companies started to realize that the market for software and especially the market for individualized software had become tighter and tighter after the year 2000 and that the economic conditions had also changed in the IT market. Some of the central aspects are discussed in the following:

First of all, customers and potential customers for individualized high-tech software solutions were strongly affected by the economic downturn. In particular, as has been shown before, the financial and telecommunication sector, two major customer areas for the three software companies in the late nineties dealt with difficult economic conditions and collapses in profits. As a consequence, certain companies underwent certain business reorganizations in order to reduce their cost structures. The cost saving measures also concerned the companies IT budgets (see also Celent 2004).\(^{110}\)

Second, as a consequence of the reduced IT budgets, the demand for individual high-tech software solution nearly dried up at the beginning of 2001 and 2002.

\(^{110}\) Celent (2004) reported that the main IT-objective of European banks is to reduce the costs of their IT systems. The IT consulting company estimates that European banks spent € 44.6 billion in 2004 which was a reduction of 5 percent compared to the former year. The largest IT investor among European banks in 2004 was HSBC Holdings, spending € 3.05 billion, followed by Deutsche Bank (€ 2.64 billion), UBS (€ 2.63 billion). Credit Suisse, with IT investments of € 1.44 billion, was ranked sixth. Compared to 2003, Deutsche Bank cut their budget by 15%, the budget of Credit Suisse and UBS dropped by 10% and 6% respectively.
However, the negative effects of reduced IT budgets were strengthened by further factors:

a) During the internet hype and the economic upturn, many customers also used the new technologies as a means in competition. By applying innovative software solutions in the front-end area, companies also signaled innovative behavior to their customers. Because technology became a differentiation factor in the front-end market, the innovation rate in software projects was increased and it ended somehow in a technological arms race between competing companies, in which the marginal technological costs were often bigger than the marginal business benefits. With the beginning of the downturn, technological innovation lost its value as a marketing instrument and also the innovation cadence decreased again. Furthermore, more weight was put on cost-benefit analysis in respect of the usage of IT technology.

b) Due to the budget restrictions and corporate saving policies, for managers on the customer side it needed courage to push innovative software projects. In times of increased lay-offs and a more rigid labor market, there was a tendency to be more risk averse and it was hard to find managers who strongly supported innovative projects.

c) There was also a tendentious shift in how new technological opportunities were perceived and evaluated. Whereas in the booming years a mediocre technological opportunity was perceived by the management as an excellent opportunity, in the recessive phase, an excellent technological opportunity was often perceived as a mediocre one.

Third, as a result of decline in demand for innovative technological projects, the competition for remaining projects increased. The increased competition for projects took place primarily between external software companies, but in some respects, also internal IT departments were competitors. This was a delicate situation, because internal IT departments were often also the principals in certain projects and it therefore required a tactful and not overly aggressive acquisition behavior by the software companies.

Forth, the increased competition resulted in an augmented price pressure, which was characterized by the following tendencies: These had three main implications on the software companies’ income side:
a) The price charged for software engineers dropped substantially. Before the recession, a software engineer had approximately cost 2000 CHF per day. After 2000, the amount dropped by 25% with experienced software engineers only able to charge around 1500 CHF or even less.

b) Customers generally expected certain discounts on the overall project price – which accounted for 10 to 15% of the calculated price.

c) More activities were expected to be free of charge, whether it was preparatory works before the project had started, such as certain specifications, or during the project, when smaller changes occurred which were not negotiated in the prior specifications.

Fifth, projects got smaller and bore a lower innovation potential. Whereas big sophisticated projects were on average between half a million and one million CHF in scale during the booming years, projects dropped to 100,000 and half a million CHF during the recession. Furthermore, the available projects were in general less innovative in technological terms, the market generally required more “ordinary” than “extraordinary” software applications.

This also leads over into the next section. Technological and organizational innovation is an important integral of all three software companies. The next section deals in particular with the economic change and its impact on technology and innovation within the three software companies, but before the next section is tackled, there are firm-specific statements in respect of the economic downturn to be seen in Table 19.

<table>
<thead>
<tr>
<th>Company</th>
<th>Adnovum</th>
<th>Ergon</th>
<th>Netcetera</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changing economic conditions and a decreasing demand for software projects and IT-services</td>
<td>“What we feel at the moment is the pressure. Our business project leaders understood extremely fast that the situation has changed. Suddenly, they realized how difficult it was to ask for example for a change request in a project. In the booming years, this was no problem and now it is a” (Theodor Graf, Chairman)</td>
<td>“It was like sailing on the lake of Zurich and when the boats were in the middle of the lake, suddenly, the winds stopped. You could turn the sails as much as you wanted, but there was no ‘project-wind’ anymore.” (Theodor Graf, Chairman)</td>
<td>“The recessive situation in the last two years has been difficult and has led to a great amount of nervousness in the industry. The whole industry has changed a lot. And people were worried as to how long there will be work to do.” (Andrej Vekovski, CEO)</td>
</tr>
</tbody>
</table>
Entrepreneurial Opportunities and the Role of the Individual, the Firm and the Environment

<table>
<thead>
<tr>
<th>The technological hype is over</th>
<th>“The annual investment budget for an e-commerce application as measured in person-months decreased from 70 to 6 in one year. From a business side, it does not cover the costs. It is getting much more professional. If we are honest, during the boom years, software was built where the business case was not understood and therefore it was not profitable.” (Stefan Arn, CEO)</th>
<th>“At the moment you feel it. Whereas two, three years ago, we only talked about technology during the hype, the hype is really gone now. The interest is not in technology anymore, but the customers say rather: ‘I have this and that problem and I want to have a solution for it’.” (Theodor Graf, Chairman)</th>
<th>“It is not the same as two, three years ago, when the customer said, here is 2 millions, get started. Nowadays it is more that projects are more divided into different pieces. Projects are carried out using salami tactics.” (Andrej Vckovski, CEO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased Competition</td>
<td>“At the moment, the mood among competitors is getting frostier. The feed through is getting smaller and whereas in the boom years one did not eat from the neighbor’s hay box, nowadays, there is less food and many software companies are not reluctant to eat in their neighbors’ garden.” (Stefan Arn, CEO)</td>
<td>“Competitors will collide more often in the future. The contention in certain areas will increase. There are certain areas we don’t go in, because it is not our core business and in this case we say to the customers that they should go directly to a specific other firm, because they have already done several projects in this domain.” (Patrick Burkhalter, CEO)</td>
<td>“I know from companies (customer side) that they invite tenders for the subsequent projects of a release project, although they were satisfied with the first software companies product. Earlier, this had never happened, but today, the market is quite different.” (Andrej Vckovski, CEO)</td>
</tr>
<tr>
<td>Price pressure</td>
<td>“For sure, certain customers instrumentalize you as a software company and they dictate prices to a certain extent.” (Stefan Arn, CEO)</td>
<td>“What you realize now is that certain customers try to lower the price. It goes up to 30, 40 percent. One ambition is that the wages of internal and external software engineers are the same.” (Patrick Burkhalter, CEO)</td>
<td>“The industry has changed a lot and last year you realized that the price pressure had really started to work.” […] “Today, when you write in a proposal that you charge 200 CHF per hour for a software engineer, everybody laughs at you.” (Andrej Vckovski, CEO)</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Increased project acquisition time and costs</td>
<td>“The acquisition activities have become extensive, because there is no budget available or because customers don’t know where they should go.” (Stefan Arn, CEO)</td>
<td>“We still have nearly the same revenue as last year, but it is associated with an enormous effort. The acquisition effort of going around, in writing offers amounts to 10 to 15 percent of all working hours. This is more than three times more than in earlier times.” (Patrick Burkhalter, CEO)</td>
<td>“During the internet-hype, one of two offers was accepted, nowadays, only one of five offers is accepted.” (Andrej Vckovski, CEO)</td>
</tr>
<tr>
<td>Smaller and less innovative projects</td>
<td>“You also realize it when you speak with colleagues. There are nearly no innovative projects anymore. And we also had internally discussions about the question where the new innovative projects are.” (Stefan Arn, CEO)</td>
<td>“Projects have become much smaller. Earlier, 80 percent of the projects were between 1 and 1½ million CHF. Nowadays, most projects are between 100,000 and 500,000 CHF.” (Patrick Burkhalter, CEO)</td>
<td>“I don’t have detailed numbers, but I think that the project size has decreased” (Andrej Vckovski, CEO)</td>
</tr>
</tbody>
</table>

Table 19: Firm-specific statements in respect of the economic downturn
6.2.2 Changed Economic Context and Its Impact on Technology, Innovation and Firms’ Economic Efficiency

In this part, a more differentiated view is taken with regard to the relationship between the economic context and technological innovation. Technological innovation has been shown to be a core element of both identifying and exploiting entrepreneurial opportunities in the industry for individualized software. The innovative potential of a project especially plays an important role in the evaluation of opportunities and the innovative abilities also directly impact the efficiency of a software company in exploiting opportunities. In particular, the focus lies in the impact of the economic context on innovation at the firm and industry level; on factors that influence the firms’ economic efficiency; and on the role of software reuse. All three aspects are examined against the background of the changing economic context - from economic upturn to economic downturn.

6.2.2.1 Technological Innovation during the Economic Upturn (1996-2000)

During the economic upturn, the demand for innovative projects increased significantly. First of all, IT budgets on the customer side were munificent and managers were strongly interested in, and actively required, innovative projects. Furthermore, their willingness to pay for innovative projects was high, because innovative software solutions were a means of differentiating the company towards competitors, to get attention on the market but also internally in the company. Innovative projects themselves also triggered certain subsequent reactions that further increased the demand for innovative projects. For instance, in the financial sector, as soon as online banking became available, further IT based services were planned such as automated call systems and WAP applications that allowed clients to check their account balance, account transactions, stock prices and to initiate account transfers and stock exchange orders using mobile devices and technology. In general, the demand for innovation increased in the economic upturn.

However, at the end of the boom and overheated market, the high demand for innovative technological solutions paradoxically also hindered innovation to a certain extent at the firm and at the industry level.

At the firm level, there was a strong “time to market” pressure and most software companies, specialized in high-tech software projects, were running at full production capacity. Because the companies were very busy and engaged in carrying out their
projects and in working off their full project pipelines, the time to invest in new innovations, to experiment with new software combinations and new software procedures, was limited. This time pressure also pushed software companies multiply and economize existing technological solutions than to allocate resources into new ones.

At the industry level, although the innovation cadence of new technologies and versions was high, the increased variety also led to more debates about technological standards and how these new technologies should be incorporated in the existing IT architectures. The normative debate about standards and architectures and about the pros and cons had very beneficial aspects, but also drawbacks. Sometimes, too much weight was attached to these debates, with the consequence that the real problems to be solved were pushed into the background.

The overheating of technology markets during the boom years also carried another threat. The discrepancy between actual innovation rates and marketed innovative solutions started to grow. There was a tendency towards ordinary software solutions being multiplied and sold as innovative projects. A circumstance that was fostered by the asymmetric information problem in the Akerlofian sense (see Chapter 5). Certain innovative software projects started to become “look alike” innovative solutions rather than real ones. As a result, consumers of IT solutions became more critical and less courageous to advance technological innovations - to the damage of the whole IT industry. For this reason, all three software companies examined emphasized strongly how important it is to deal frankly and honestly with its customers in software projects – for the sake of the reputation of the entire software industry.

6.2.2.2 Technological Innovation during the Economic Downturn (2001 and Beyond)

During the economic downturn, the demand for projects was reduced, leading to a somewhat paradoxical situation for the three software companies. The companies were eager to be technologically innovative but innovative projects were rare. Technological innovation, a core part of their competencies, could be a means of differentiation in a competitive market but the market for these projects was non-existent for a certain time. Accordingly, the three companies could not apply their full innovative potential and the innovation rate within companies slowed down.

111 For instance, the extensions of the object-oriented programming language Java were vast during the boom years.
In order to maintain a certain innovation level, the three software companies pursued different strategies. On the one hand, projects were selected and acquired that still had a relatively high innovation potential, even though the revenue volume of these projects was smaller. On the other hand, a part of innovation was self-financed. Ergon, for instance, initiated several internal projects where certain technological topics were deepened and examined. Netcetera also institutionalized a program, in which proposals for innovative ideas could be handed in and if they were accepted a certain budget was allocated to them. Finally, Adnovum self-financed a substantial part of its innovation in real customer projects by applying new technologies and technological procedures without charging for it.

However, these strategies also have their limits. First of all, it is difficult to be very selective in a recessive market, when innovative projects are rare. Second, these strategies are costly and risky. There is no guarantee that these investments will pay out in the future. Moreover, internal projects have a tendency to be only successful when they do not last too long. As Andrej Vckovski explains: “The danger with internal projects is that it is often difficult to achieve very innovative results if you do not have a concrete project and the real pressure of such a project.”

6.2.2.3 Software Companies’ Economic Efficiency under Changed Economic Conditions and Internal Measures

During the economic upturn, the economic efficiency of projects was favorable because revenues were satisfying – customers were willing to pay for innovative efforts and IT-applications. Furthermore, projects could be selected in a way that allowed to optimization of the overall project portfolio. For instance, the reuse of already existing software components could be optimally tuned, which led to lower production costs and higher efficiency.

However, during the economic downturn, the situation changed. Due to the difficult economic situation and the resulting decrease in the demand for software projects, the software companies’ economic efficiency came under pressure driven by price reductions, higher acquisitions activities and costs, and longer-winded decision making processes on the customer side. Whereas the acquisition costs accounted for approximately 5% of the overall costs during the booming years, their share increased up to 15% during the downturn. During the internet hype, close to 1 of 2 offerings

\[112\] CEO of Netcetera
were successful, the success rate sank to 1:5 during the downturn. In essence, the margins of projects came under pressure.

Consequently, the three companies undertook strong organizational efforts to counteract the decreasing economic efficiency. In particular, the following measures were implemented:

- The quality of offers and the efficiency of writing them was increased – through the multiplication of existing parts; better pre-selection of projects; and through routinization of labor division and work flow.

- The efficiency of the software engineering process was improved – by reducing the number of people involved in the projects; by cutting unnecessary administrative activities; by increasing the cost consciousness of employees; and by optimizing the reuse of software components.

- The whole planning process was tightened - the allocation of labor was organized and monitored in more detail and the number of project milestones was augmented.

- Project risks were reduced – by emphasizing the importance of the design process; by reducing risky technological experiments; and by relying more on existing components.

- Labor costs were reduced – by reducing wages or bonuses and by near-shoring certain coding activities to low wage countries.\textsuperscript{113/114}

The reuse of software, as it can be seen in the list of measures above, has a particular meaning in software development. Therefore, it is further analyzed in more detail in the next section with focus on its impact on innovation and economic efficiency.

\textsuperscript{113} The term near-shoring is related to the term off-shoring. Off-shoring is the relocation of business processes and services to a lower cost location. In the IT industry typical off-shoring locations are India and China. A special form and terminology of off-shoring is near-shoring, a term often used in a European context, meaning that outsourcing activities take place into low cost countries of Eastern Europe.

\textsuperscript{114} The near-shoring activities only apply for Adnovum and Netcetera. Ergon has not undertaken similar activities so far.
6.2.2.4 The Reuse of Software Code and Its Impact on Production Efficiency and Innovative Software Solutions

A particular issue in software development is the reuse of already existing software codes and components. Reuse can clearly reduce the software development time and consequently increase the economic efficiency of a software company. Though it may sound counterintuitive, the reuse of already existing software is also a major source for innovative software solutions. By skillfully and creatively combining existing components in new ways, highly innovative solutions can evolve. Thus, by using something that already exists, software firms can obtain a high positive correlation between increasing production efficiency and increasing innovation levels of software solutions, depending on the competences and the creativity of the software engineers.

Metaphorically speaking, innovative reuse can be compared to playing with LEGO bricks,\textsuperscript{115} where different components are added to each other and where the quality and value of the end product depends on the builder’s creativity and skillfulness. This also shows that software engineering is people business – in particular with regard to the impact that the competence of people can have on production efficiency and on the degree of innovativeness of the end solution. Successful and efficient reuse of software components requires first the ability to create software components that can be reused and second that the components are reused in a creative and efficient manner, given the problem that has to be solved. The second task can probably also be compared to the skills of a good cook, who is able to combine given ingredients into something special.

As already indicated in the last section, the upturn and downturn of the economic situation also has an impact on the reuse of software. In the upturn, it is generally easier to optimize the software reuse across the whole project portfolio of a software company, because the company is freer in the selection of its projects. During the downturn, it generally becomes more difficult to optimize the overall project portfolio in respect of software reuse, because firms have less degrees of freedom in selecting their projects due to the difficult economic conditions. The selection becomes more pragmatic, in a sense that it is of the highest priority that a company is able to acquire any projects at all. Therefore, the reuse of software tends to be optimized in each single project, but less across the whole project portfolio.

\textsuperscript{115} The LEGO brick used as a metaphor for a piece of software code, component or module.
So far, the analysis has focused on the economic context and its impact on innovation and efficiency. It has also been shown what internal measures the software companies took in the economic downturn. In the next section, the focus turns from this internal view to an external view, leaving the field of exploiting entrepreneurial opportunities and concentrating on how the companies reacted externally and on the impact on opportunity identification.

6.2.3 Firm Specific External Reaction Patterns

This section shows how the changed economic conditions triggered search processes for new entrepreneurial opportunities. In a second part, similarities and differences in the external reactions of the three software companies are shown and explained. In a final part, firm-specific explanations of different diversification patterns are presented.

6.2.3.1 Changed Economic Environment and Triggered Search Processes

During the nineties, the three software companies were able to build and enhance important relationships to financial institutions in and around Zurich. The companies implemented several large-scale software projects for the financial industry during this time. At the end of 2000, the business focus of all three companies was mainly centered around the financial and telecommunication sector,\footnote{With exception of Netcetera, which was not heavily active in the telecommunication sector.} although the three companies emphasized that the core of their activities is not a specific industry focus but their technological competence to solve sophisticated, individualized, large-scale software projects. Therefore, their industry focus was rather a result of the “natural” external economic conditions, as these two industries had a high demand for high-tech solutions at that time and the firms were able to deliver them.

With the economic downturn, the three companies were forced to expand their search area for new projects and customers (see also Sine and David 2003). Interestingly, in certain areas the companies developed their business in similar directions, while in others they went different ways, identifying and selecting different entrepreneurial opportunities. These differences are of interest because all firms had highly identical prior knowledge about markets (the market for individualized software projects, especially in the financial and telecommunication sector), a similar
understanding of how to serve these markets, and a similar knowledge about customer problems.

In the next sub-section, the focus is on which directions the companies developed and why they did it. In particular, the investigation focuses on how far firm-specific characteristics can explain certain identified differences in their developments.

### 6.2.3.2 Concentrating on Established Markets or Moving into New Fields

The economic downturn triggered similar and different strategic and operational actions of the three software companies. In general, two main patterns could be observed in all three companies:

- **Extension of the business model**: Before the economic downturn, the activities of the three companies mainly focused on comprehensive realization of software projects. Normally, these activities contained the project related consultancy, the specification, the development, the documentation, the installation, the support, the migration of software. In most cases, the software was run by the customer. After the downturn, the software lifecycle was expanded. In certain cases the companies started to run the software for their customers, taking the responsibility that the software was in steady working order. One reason for conducting such a service level agreement was that generated regular revenue streams independent of the economic context.

- **Increased flexibility of project scope and realization**: Through the economic downturn and the consequently decreased demand for software projects, companies could not claim only the realization of certain types of projects, for instance claiming that only sophisticated middleware or application project were completed. Companies had to be more flexible and pragmatic in respect of available projects. The important point was to have projects which could be carried out. It was also important that companies could quickly react through their flexible organizational forms to the broader scope of projects.

On the other side, three specific diversifications patterns could be observed among the three software companies, especially in respect of their industry focus and in respect of new technological fields:

- **Diversification into specific industry sectors**: Before the economic downturn, the three companies were mainly active in the financial sector, and Adnovum and Ergon also carried out projects for the telecommunication industry. Because both
industry sectors got themselves into a difficult economic situation at the beginning of this millennium, a relevant question for the software companies was if they should also look for projects in other industries and try to identify entrepreneurial opportunities there.

- **Concentration on a specific industry sector** is the opposite of a diversification pattern into several industries. For the three companies it was a further option to decide if a company mainly wanted to focus on a particular industry.

- **Technological diversification:** A further diversification pattern that could be observed was the diversification into new technological fields. By using particular technologies, new application areas were entered in order to gain new customers and projects.

Each company reacted differently and different diversification patterns evolved over time. Each company’s actions and moves are presented in more detail in the following:

- **Adnovum:** The company’s main business focus lay in the financial and telecommunication industry in the second half of the nineties. In particular, the company completed over forty projects for one big Swiss bank, concerning online banking, customer relationship management (CRM) applications, middleware and infrastructure solutions. However, this business focus was not understood as a necessary and given fact, but it was a means to the end to carry out interesting and challenging projects. Like the other two firms, Adnovum’s priority was their technological competence, and not their business focus. However, a characteristic of Adnovum was to work only with a few customers, but in a comprehensive way.\(^\text{117}\) Interestingly, when the economic downturn came, Adnovum primarily started to focus and concentrate on the financial sector, even though the financial sector itself was strongly affected by the economic downturn.

\(^\text{117}\) Since their founding in 1986, Adnovum has worked so far with 14 customers, of which 9 companies belong to the financial sector, one belongs to the telecommunication sector, one to the pharmaceutical sector, two customers are federal departments and a final customer is a formula one racing team. In comparison, Ergon, which was founded 1984, has worked so far with 30 customers, out of which 8 are operating in the financial sector, 7 belong to the telecommunication sector, 6 to the IT sector, 3 customers are in the insurance business, one pharmaceutical company and one railway company, the remaining 4 customers are in other businesses. Netcetera, founded in 1996, has worked so far with 25 customers, out of which 13 belong to the financial sector, 2 belong to the aerospace industry, 2 are federal institutions, one is a railway company, one customer is active in the insurance business, one customer is a media company, one customer belongs to the automotive industry, the remaining 4 customers are active in other businesses.
Entrepreneurial Opportunities and the Role of the Individual, the Firm and the Environment

- **Ergon**: Before the downturn, Ergon mainly completed projects in the financial and telecommunication sector and was a key supplier for another big Swiss bank. In contrast to Adnovum, Ergon identified their project opportunities over a larger number of companies. When the downturn came, their main customer reduced its demand for external projects. Ergon decided to shift a part of their free capacity to the mobile area, where they already had had some experience (see also Section 5.2.3). They started to establish contacts, with producers of mobile devices and with possible users of mobile devices and applications. They contacted companies in the service and classical industry sectors, and could soon achieve their first projects. In this respect, a diversification of the technological area of application led to a diversification into different industries, such as weather broadcasting, retail business, logistics and transportation.

- **Netcetera**: At the end of the economic upturn, Netcetera generated around 70% of its revenue in the financial sector for different customers, mainly with internet and integration solutions for business processes. The interesting point is, that before the economic downturn fully hit the financial sector and the IT industry, Netcetera started to think about their customer portfolio, because there were the first signs that the market for IT solutions in the financial sector was cooling down. Shortly before, Netcetera had started to strengthen the management structures and had also introduced regular strategic planning workshops. In one of these workshops, they decided to approach, beside the existing financial industry, also other industries and also to participate more in public procurements, in order to reduce their dependency of the financial sector. Additionally, the company started to think about possible business cases, and came up with the idea of an online registration application for conferences. Thus, Netcetera diversified into different industrial sectors, by finding new entrepreneurial opportunities in transportation, aerospace and science.

The different diversification patterns of the three software companies are summarized in Table 20 (p. 190).
### Table 20: Firm-specific diversification patterns

<table>
<thead>
<tr>
<th>Company</th>
<th>Adnovum</th>
<th>Ergon</th>
<th>Netcetera</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business</td>
<td>Customized software and internet projects</td>
<td>Customized software and internet projects</td>
<td>Customized software and internet projects</td>
</tr>
<tr>
<td>Main industry focus (2001)</td>
<td>Financial and telecommunication sector</td>
<td>Financial and telecommunication sector</td>
<td>Financial sector</td>
</tr>
<tr>
<td>Diversification into specific industry sectors</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Concentration on a specific industry sector</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technological diversification</td>
<td></td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

### 6.2.3.3 Firm Specific Explanations

The fact that the three software companies examined developed different diversification patterns in answer to the changing economic context is an interesting issue, because individual prior knowledge can explain the phenomenon only partially - prior knowledge of customers, markets and how to serve markets was highly similar within all three companies before the economic downturn. A further explanation is to look at the specific characteristics of each company itself - its specific structures, characteristics, and reasoning during the economic up- and downturn. In the following, firm specific explanations are analyzed more profoundly for each company.
Entrepreneurial Opportunities and the Role of the Individual, the Firm and the Environment

- **Adnovum**: There are several reasons why Adnovum even focused more strongly on projects in the financial sector during the downturn:

  First, there was a *structural* argument consisting of three parts. To begin with, Adnovum had always worked with a few customers, but comprehensively. Furthermore, during the nineties, the company became one of the main suppliers for one big Swiss bank, completing more than 40 projects for it. Finally, beside software applications, the company also produced software infrastructure and middleware projects. Due to the first two items, Adnovum was broadly personally linked within each of its customers, which also helped to acquire new projects with these customers during the downturn. Furthermore, Adnovum was also a strategically important knowledge bearer for the customers. Additionally, infrastructure and middleware solutions were to a certain degree less cyclical than plain software applications. Finally, Adnovum also profited from the fact that their main customer was one of the financial institutions that mastered the difficult economic situation best, which probably left its management some freedom to realize projects.

  Second, there was a firm-specific *customer business context* argument. According to Stefan Arn,\(^{118}\) it is generally possible to solve a broad range of problems in different industries. However, when the economic downturn came, it was more important to focus on the industry where the customer’s business context was best known. The company had learnt in the previous years how to best achieve projects in the financial sector. Having a solid business and context knowledge enabled Adnovum to realize projects more efficiently, for example, because the business knowledge transfer needed less effort. Therefore, Adnovum had a competitive advantage against firms which did not possess the business context knowledge, such as off-shore companies from low wage countries. There was also the concern, that the realization of projects in a broader range of industries would increase the project variance and therewith hinder synergies between projects, also in respect of reuse of software components.

  Third, there was a firm-specific *characteristics of the problem space* argument. Adnovum’s main focus on the financial industry did not preclude that projects were carried out in other industries or for public institutions. However, according to Adnovum, projects in other industries needed to have a similar problem space as

\(^{118}\) CEO Adnovum
in the financial sector, which enabled Adnovum to apply their technological competences and software components efficiently and effectively. Nowadays, Adnovum carries out about 60 percent of their projects for the financial industry and the remaining 40 percent for other industries with similar software problems.

- **Ergon:** There are three main arguments why Ergon diversified into different industries and technological areas during the economic downturn:

  First, there was a *structural* argument consisting of three parts. To begin with, the diversification into new fields was basically triggered by the decreasing project volume of the main customer. As a result, Ergon decided to use their free capacity in other areas. Furthermore, Ergon had historically already worked for a wider numbers of customers, which on the one side increased the number of relationships but probably also reduced the number of personal links within a customer. The greater number of customers did help to find new entrepreneurial opportunities across a wider range of customers, but it may also be that within one customer the company was less personally linked and as a result the number of possible project opportunities within one customer was smaller. Finally, Ergon’s main focus lay less on infrastructure and middleware projects but on the realization of software applications, which are often more cyclical, as mentioned before.

  Second, there was a firm-specific *pioneering characteristic* argument. It was a certain tradition in Ergon to pioneer new technologies. The decision to push mobile applications was not the first time that Ergon was involved in pioneering technological activities. The company was one of the first companies that used a Unix-platform for their software projects; they were the first Swiss-based authorized Java Center; and they built the first internet-banking in Switzerland.

  Third, there was a particular *technology-market conviction* argument that all three software companies hold, but in the case of Ergon it appeared distinctly during the economic downturn. According to Patrick Burkhalter,\(^{119}\) the company has primarily a technology focus and not a market focus. In other words, technologies come in first place, markets in second place, which underlies a logic that by choosing good technologies, markets will inevitably follow. In this sense, Ergon first diversified with mobile technologies into a new technological application area, and started then to search for possible customers and thereby diversifying into different industries.

\(^{119}\) CEO Ergon
Netcetera: There are three main arguments why Netcetera diversified into different industries during the economic downturn:

First, there was a **structural** argument. In 2000, Netcetera was still a young but fast growing company, and was on the way to becoming as established as Adnovum and Ergon. However, the company did not have such a central position within one customer as the two other companies had within the two biggest Swiss banks. Additionally, similar to Ergon, Netcetera’s customers were also spread wider in the financial sector. Therefore, the decision to also look for entrepreneurial opportunities in other industries, when the economic downturn came, was not so much dependent on one specific key customer.

Second, there was a firm-specific **strategizing** argument. Shortly before the economic downturn started, Netcetera began to install more management structures in the company to meet increased requirements resulting from the growth of the company. Among other things, there was also an increased effort in institutionalizing strategic workshops, which was also strongly supported and initiated by the former chairman. These strategic workshops fostered deliberate decisions to diversify into different industries and to take more part in public procurements. However, the diversification process had also an inherent coincidental element. For instance, the company diversified into the transportation sector, because they saw a public procurement for a European wide railway coordination software system, and after a careful evaluation of whether the company should invest time in a rather extensive offer, Netcetera decided to do it because the project bore a certain degree of sustainability and international character, which could possibly lead to further opportunities. The entrance into aerospace related software projects started with some smaller projects for the European Space Agency (ESA). And through these smaller projects Netcetera was asked to participate in a public procurement for a large project, where it was important to integrate data from different systems.

Third, there was a firm-specific **customer business context** argument. In Netcetera’s view, to have business knowledge of the customer is helpful, but not absolutely necessary. According to Andrej Vckovski,\(^{120}\) a software company only acquires a sophisticated software project, if it can authentically show that it has

---

\(^{120}\) CEO Netcetera
understood and can solve the problem. Most often, the necessary business knowledge, when not already at hand, is then transferred during the project.

6.3 Discussion

This sub-chapter starts with a summarizing discussion about the effects of a changed economic context on the identification and exploitation of entrepreneurial opportunities. In a second part, the impact of firm-specific characteristics on entrepreneurial opportunities are discussed. In the final part, based on the previous insights, a multi-level model for entrepreneurial opportunity research is presented.

6.3.1 The Impact of a Changed Economic Context on Entrepreneurial Opportunities

The case of the three software companies shows that the environmental context has an important impact on the identification and exploitation of entrepreneurial opportunities. In particular, the environmental context is examined on the basis of the economic and technological up- and downturn during the last two decades. Some interesting patterns are found by analyzing the data.

During the economic upturn, the positive general economic development combined with rising technology exaltation produced an increased demand for innovative high-tech software projects and enlarged the number of entrepreneurial opportunities for the software companies.

The three software companies mainly profited from the generally munificent economic environment combined with their technological competence. For instance, all of them were already familiar with the internet technology before the internet boom started, based on their Unix background. Furthermore, the three companies profited from the financial sector’s demand for sophisticated software solutions. This demand was reinforced through the financial sector’s positive economic situation, which strongly correlated with the overall economic cycle.

At the peak of the upturn, there were more entrepreneurial project opportunities than the companies could exploit. They ran at their full capacity although they were growing quickly in the number of employees. As a consequence, the companies also had to reject several projects, which was sometimes a delicate undertaking when an established customer was concerned and on the other side, together with the increased
time to market pressure, the time to invest in new innovations was becoming limited. As a result, the booming economic situation also hindered to a certain extent the innovation potential of each entrepreneurial opportunity being fully exploited.

In respect of the four entrepreneurial processes (see sub-section 5.2.2.2), on the peak of the economic upturn, the identification of project opportunities and the opening up of customers became less significant than under less favorable economic conditions, because at the time it was a sellers market where the demand was bigger than the supply. Therefore, the two entrepreneurial processes of project selection and exploitation were more important. The selection of entrepreneurial opportunities was important in order to optimize the reuse of software components across the whole project portfolio and the exploitation process was important to complete projects efficiently to meet market pressure.

*During the economic downturn,* the demand for innovative high tech software solutions decreased and therefore the number of entrepreneurial opportunities declined or ceased to exist at the bottom of the downturn.

As a consequence, search activities for entrepreneurial opportunities were intensified. This also meant that more time was spent in opening up customers for new project opportunities. Furthermore, the search area became broader, which resulted in an extension of the software companies’ business models, including, to a certain extent, the offering of new services and thus implying a bigger variance of the project scope. Additionally, the search process was also extended to other industries.

The perception of what an entrepreneurial opportunity is may also change depending on the outer economic context – both on the side of the software firms and on the customer side. As already shortly discussed in sub-section 6.2.1.2, in the booming years a mediocre technological opportunity was often perceived by the customers’ management as an excellent opportunity, while in the recessive phase, an excellent technological opportunity was often perceived as a mediocre one. Similarly, whereas software companies may have rejected a given entrepreneurial opportunity during the economic boom, the same project opportunity would possibly be accepted during the bottom of the recessive situation.

Finally, the exploitation process also received extensive attention in the downturn, because the companies had to take several measures in order to improve their economic efficiency and thereby to compensate for decreasing income. One particularly interesting measure was caused by the reduction of the general innovation
potential in projects during the downturn. Therefore, companies partially self-financed their own innovation in order to be prepared when the economy normalized again.

6.3.2 Firm Specific Impact on Entrepreneurial Opportunities

As Shane and Venkataraman (Venkataraman 1997; Shane and Venkataraman 2000) have indicated, the individual-opportunity nexus is the central relationship to explore, in order to understand how opportunities are identified and exploited, because in the end, opportunities can only be identified and exploited by individuals. This argument particularly makes sense, when an entrepreneur acts outside an institutional arrangement of an existing company. For instance, when he plans to start a new company in order to exploit a given entrepreneurial opportunity.

However, as soon as a firm is founded, the firm will become an entity on its own. Therefore, as soon as we leave the very specific case of an entrepreneur who acts outside an existing company, it can be assumed that the firm level itself will have a certain impact on which opportunities are identified and how they are evaluated and exploited. The cases of the three software companies confirm this assumption. Though their initial situation was rather similar, each company had its firm-specific arguments as to why they moved in one direction or the other, by searching new entrepreneurial opportunities in new industries or in new technological application areas, or by concentrating their focus primarily on industries already served by them. Firm-specific structures (such as the quantity and quality of their customer base), firm-specific-characteristics (such as a distinct pioneering behavior), or firm-specific reasoning (such as the function of customer related business and context knowledge), played an important role with regard to the selection of areas in which companies looked for entrepreneurial opportunities during the economic downturn.

Adnovum profited from the firm-specific long-lasting relationship to its main customer in the financial sector. Although the bank reduced the number of external software suppliers, the active business relationship with Adnovum continued. Therefore, Adnovum was less forced to look for project opportunities in other industries. However, given the situation of a reduced demand and highly intensified competition, it was also an active decision by the company to concentrate more heavily on a known industry and existing customers, to use the firm-specific competences, human capital, and context knowledge gained in this particular industry, and to proactively position the company in this respect in the market.
In Ergon’s case, the structure of its customers changed because the main customer had decreased demand for individualized projects during the downturn. Ergon kept up the relationship, in case the demand would come back when the economic situation improved. However, Ergon also shifted its resources into new areas. New entrepreneurial opportunities were looked for by investing technologically in the mobile area, counting on firm-specific pioneering behavior, and secondly by using the broad range of firm-specific project and customer references. In which industries these new project opportunities were found was to a certain degree of secondary interest and primarily driven by the selection of the technological area.

Netcetera, as a younger company, had a broad range of customers in the financial sector before the economic downturn, but was not in the same position as Adnovum and Ergon, who were the main supplier for a particular customer. Interestingly, it was an early strategic decision, when there were the first signs of a tightening software market in the financial sector, to look for project opportunities in other industries and to increase the number of participations in public procurements. Additionally, the company achieved sophisticated internet-projects, which also had potential in other industries. Furthermore, though Netcetera saw the importance of customer related industry knowledge, it emphasized more the importance of understanding the customer’s problem from a technological standpoint and to transfer the required business knowledge for the software solution during the project.

All three examples indicate that firm-specific characteristics and considerations had an important impact on the selection of the areas where new entrepreneurial opportunities were looked for, identified, created and exploited during the economic downturn, even though all three companies had similar prior customer and market knowledge before the downturn.

The firm-specific considerations for all three cases also show that the areas in which opportunities are consequently identified and exploited have a repercussion on the future firm-specific characteristics and firm development. Adnovum increasingly started to focus on software problems related with those in the financial industry. Ergon, through its engagement in the mobile area, gained new customers that were active in more “traditional” industries, such as transportation and logistics. Likewise, through its sector related diversification activities, Netcetera started to build up context knowledge in different industries.
To conclude, the three examples demonstrate that it is essential to include, beside the individual-opportunity nexus, firm-level considerations and the economic context as important elements of the entrepreneurial opportunity research as they enable a better understanding of entrepreneurial activities and behavior. These findings are further formalized in the next section.

6.3.3 A Multi-Level Model of Entrepreneurial Opportunity Research

Based on the insights gained in this chapter about the impact of the economic and technological environment on the software firms’ reaction, technological innovation and entrepreneurial opportunities, combined with the insights of Chapter 5, where the different forms of asymmetric information and knowledge and their consequences for the entrepreneurial opportunity identification process have been specified, it is argued that there is a need for a more integrated framework that reconsiders the different levels of analysis that have been identified so far. The empirical observations presented underline that entrepreneurship and the identification and exploitation of entrepreneurial opportunities are a multi-level phenomena in which different forms of information and knowledge are involved. Therefore, an important issue of understanding entrepreneurial activities and behavior is to analyze these different levels and the different forms of information and knowledge. The model depicted in Figure 8 can be used as guide.

The model starts with the nexus between the individual and the opportunity itself (represented by the dotted arrow), based on Shane and Venkataraman (Venkataraman 1997; Shane and Venkataraman 2001), who have mentioned, that this is an important relationship in order to understand the identification and exploitation of entrepreneurial opportunities. However, beside the individual and the opportunity level, it is also important to analyze the relationship between the individual and the firm context in which individuals operate and in which entrepreneurial opportunities are handled. Likewise, it is essential to examine the entrepreneurial opportunity in the customer context, because this is the place where the opportunity creates its value.

\[\text{121 There can also be more than one.}\]
\[\text{122 Provided that a firm exists.}\]
Additionally, in order to understand how the entrepreneurial opportunity comes into existence between these different entities, it is necessary to explore the different forms of vertical asymmetric information and knowledge between entrepreneurial individuals and their customers, in particular, to understand how the different forms of asymmetric information are reduced and the different knowledge domains are combined.

Furthermore, it should also be examined why certain competitors identify the same entrepreneurial opportunities and others do not or why certain competitors evaluate a certain opportunity differently. On the one hand, in analogy to the discussion in the previous section, the relationship of the competitors’ context should be analyzed vis-à-vis the customers’ context, also exploring the vertical situation of information and knowledge asymmetries between them. On the other hand, the relationship between the firm’s context and the competitors’ firm context should be studied, also exploring the horizontal situation of asymmetric information and knowledge among the competing firms.
Moreover, it is of interest to analyze the relationships between the economic context, the technological context and the firm context. In particular, to analyze the economic and technological context in which each firm, competitor and customer operate and how they influence each other provides deeper insights in respect of which entrepreneurial opportunities come into existence, how and why. As the examination of the three software companies and the market for individualized software has shown, the economic and technological context has an important impact on the innovation level of entrepreneurial opportunities; the demand and supply side for certain software solutions; and the quantitative amount of entrepreneurial opportunities in the software market. In addition, all levels of analysis bear a certain degree of inherent uncertainty, which has an impact on the behavior of the economic agents, also in respect of which entrepreneurial opportunities are selected. Therefore, it is of interest to study the extent of longitudinal asymmetric information and knowledge and its changes over time among all discussed levels of analysis.

Overall, in order to understand how and why entrepreneurs, entrepreneurial teams or firms identify, evaluate and exploit opportunities, the unit of analysis should not only be the individual-opportunity nexus. Entrepreneurs do not act in a vacuum or in laboratory like situations. Most of the time they are embedded in an environmental and firm-specific context, which has an influence on the decisions and actions entrepreneurs make and execute. Therefore, if researchers are interested in studying why and how entrepreneurs handle opportunities, they have to carefully consider which levels of analysis are relevant to be explored. The framework in Figure 8 can thereby serve as an important guideline, which does however not mean that in every investigation each of the mentioned levels is of significance. Depending on the research question and the studied setting, every researcher has to determine from case to case which levels are crucial. Additionally, further levels of analysis may be added, such as suppliers or business partners, plus the related forms of asymmetric information and knowledge.

6.4 Conclusion

This chapter started with a deeper investigation of the individual-opportunity nexus (Venkataraman 1997; Shane and Venkataraman 2000), as a core relationship for explaining the identification and exploitation of entrepreneurial opportunities. However, it has also been argued that beside the individual-opportunity nexus, further levels of analysis should be incorporated in a model of entrepreneurial opportunity
Entrepreneurial Opportunities and the Role of the Individual, the Firm and the Environment

research. On the one hand, it is the environment, measured in this study as the economic up- and downturn in the whole economy and in particular in the IT industry. On the other hand, it is the impact of specific characteristics on the firm level that determine which opportunities are identified and exploited.

In respect of the economic context, it has been shown that changing economic conditions have an impact on the number and quality of entrepreneurial opportunities. During the economic upturn, the number of project opportunities increased, as well as the innovation level of those projects. Managers were willing to invest in sophisticated technological solutions. However, during the peak of the upturn, the surplus in demand for innovative solutions caused the innovation level of software solutions to flatten, because firms were forced to invest less in innovative solutions because of time to market pressures. During the economic downturn, the number of innovative project opportunities dropped dramatically. The innovation potential of software projects decreased significantly as well and, as a result, provoked the software companies to partially self-finance innovation activities in order to maintain the internal innovation rate. In addition, the three software companies underwent similar internal measures in order to increase the firms’ economic efficiency which came under pressure during the economic downturn, being the equivalent of intensifying the efficiency of project opportunity exploitation. Thus, it also led to a changed attitude with regard to the reuse of software components. In general, whereas in the economic upturn, the reuse of software components was optimized across the whole project portfolio, in the downturn it was optimized in each single project, because of an increased variance of completed projects.

With regard to external organizational measures, the software companies increased their search activities for new entrepreneurial opportunities, by undertaking partly similar and partly different strategic actions. On the one hand, all companies extended their business models with further services and they increased the flexibility of their project scope. This resulted in a reevaluation of identified opportunities in respect of the project scope and with regard to an extension of provided services along the lifecycle of software projects. On the other hand, there were differences in the diversification patterns for new project opportunities, meaning that the three companies diversified differently in respect of customer related industries and technological application areas. The reason for this unequal diversification behavior is explained through firm-specific characteristics and reasoning. Each firm had its own
firm specific reasons to search for new entrepreneurial project opportunities in familiar or new areas.

A further interesting question, which has not been addressed in detail here, is why among the three companies internal measures were more homogenous than external ones. A possible explanation may be that internal measures are heavily dependent on the extraordinary degree of professionalism that all three companies show in respect to software engineering. In essence, the homogeneity of internal measures in respect of project opportunities is dependent on the profound technological knowledge and competence of the three companies. By contrast, the identification, creation and opening up of entrepreneurial opportunities do probably not rely on uniform and explicit knowledge, but each company has to find its own way and firm-specific characteristics and reasoning are probably more influential here.

To conclude, the analysis of the economic and firm-specific context in this chapter, together with the insights of different forms of asymmetric information and knowledge in Chapter 5, suggest that a more comprehensive, multi-level model of entrepreneurial opportunity research, such as explained in Section 6.3.3, can be helpful in order to get a better understanding of the phenomena how entrepreneurial opportunities are identified and exploited.
7 Conclusion

7.1 Summary of Results

This study provided a detailed analysis of the entrepreneurial opportunity identification process and aimed to enter into a dialogue between the currently dominant theoretical concepts in this area, such as those developed by Shane and Venkataraman on prior knowledge, information and knowledge asymmetries, and the individual-opportunity nexus, based on the empirical observations gathered from three case studies of companies active in the market for sophisticated, individualized software solutions. By studying how these three companies identified and exploited entrepreneurial opportunities at different stages of their existence, the adaptability of Shane and Venkataraman’s concepts has been analyzed and possible extensions to provide a more encompassing framework have been suggested.

The results of this study underline the importance of prior knowledge in identifying and exploiting entrepreneurial opportunities (Shane 2000). However, Chapter 4 also indicates that there is a necessity to understand prior knowledge in a more dynamic way. Observations of the three company cases show that at their inception, they had only limited knowledge of markets, of how to serve markets, and of specific customer problems. In contrast to Shane (2000), who concluded that these three types of prior knowledge are major pre-conditions for identifying entrepreneurial opportunities, these companies based their search for project opportunities for individualized software solutions mainly on their technological competence. In particular, they built their knowledge of markets and customer problems during the opportunity identification and exploitation process and they defined their project opportunities mainly through close interaction with their customers.

Consequently, based on the evaluation of the empirical observations, two further models were presented in addition to Shane’s model of prior knowledge. In particular, these two alternative models indicate that opportunities are developed and perceived while the companies are being founded, while Shane assumes a chronological order in which company foundation follows opportunity identification. Second, it was not just one particular entrepreneurial opportunity out of which the companies were built, but
several. Third, both “active search” and “coincidence” contributed to the identification and exploitation of project opportunities. Fourth, not every opportunity pursued was a unique and spectacular one at the outset. Projects were also realized that mostly contributed to the financial and survivability objectives of the companies. Finally, the two alternative models also point to the fact that the identification and exploitation of opportunities can be a multi-sequential process, in which different activities are conducted in different points of time.

The analysis of the three software companies further showed that additional elements contribute to the identification and exploitation of entrepreneurial opportunities. First, access to nearby universities is a crucial element in providing people with profound technological know-how for the realization of project opportunities. Second, an exclusive focus on the entrepreneur as a single person is too limited a view, which neglects that often several people are involved in identifying and exploiting entrepreneurial opportunities in a high-technology context. Finally, the impact of motivational factors, such as interest, intent and volition, has only sparingly been explored in entrepreneurial opportunity research to date.

Chapter 5 provides a more differentiated view on asymmetric information and knowledge in the context of the entrepreneurial process of opportunity identification and exploitation. In particular, it is shown that it is necessary to differentiate between information and knowledge and that asymmetric information and knowledge exist along different dimensions – vertical, horizontal, and longitudinal – and between different parties. In order to detect new entrepreneurial project opportunities, the software companies had to reduce especially the given vertical information and knowledge asymmetries. Thereby, the four processes discussed in the following paragraphs played an essential role.

It was shown that different activities, such as pure assumption or finding out by interacting with potential customers, by being coincidentally contacted by customers, or by receiving information from third parties (e.g. technological partners or other closely related software companies), led to the identification of project opportunities (process I).

Furthermore, the researched companies did not only select projects opportunities based purely on revenue-cost considerations, but also took into account other decision-making factors, such as the technological potential of project opportunities,
the customer’s experience and their ability to cooperate in software projects with external companies (process II).

In addition, even if a project opportunity and a potential customer had been identified and evaluated, it remained to be seen whether the given opportunity would also be exploited. A major step towards exploiting project opportunities was to open up the relevant customer, i.e. putting intensive effort into acquiring projects by inspiring and convincing the customer, through presenting possible solutions and through building trust that the software companies were able to carry out the projects in the best value-producing manner (process III).

Finally, the exploitation of project opportunities implied an iterative process of knowledge combination and reciprocal learning, in which the software companies’ technological competence and the customer’s business knowledge were transferred into an end solution (process IV).

Overall, the four core processes are characterized by their overlapping, non-recursive, and iterative qualities, and their design and weight vary depending on the kind of projects, the stage of the company, and the environmental conditions. Furthermore, it is illustrated that through the ongoing process of opportunity identification and exploitation, knowledge about customers, about markets, and about how to serve these markets and customers co-evolves. Finally, it is argued that the chosen way of dealing with vertical, horizontal and longitudinal asymmetric information and knowledge has an impact on future entrepreneurial opportunities and on the competitive situation of each company.

Chapter 6 begins with a closer investigation of the individual-opportunity nexus. Although the individual-opportunity nexus is a core relationship in explaining the identification and exploitation of entrepreneurial opportunities, the empirical data of this study illustrates that other levels of analysis are likewise central. In particular, this study shows the impact of a changing environment and of firm-specific characteristics and arguments on entrepreneurial opportunities.

The bursting of the technology bubble, and subsequent economic downturn, had a dramatic impact on the market for individualized, large-scale software solutions. In essence, the IT budgets for those solutions were decreased; managers became more risk averse towards innovative software projects. Consequently, the competition for individual software solutions increased, leading to an augmented price pressure. In addition, projects got smaller and the innovation level of projects dropped on average.
Accordingly, the software companies were forced to take internal measures to increase the economic efficiency of realizing software projects by improving the quality and efficiency of software offerings, tightening the internal software engineering planning process, reducing the technological risks of projects, and increasing the re-use of software components within projects. On the other hand, they also had to maintain a certain level of technological innovation to preserve their competitive advantage. Different ways were chosen to accomplish this, such as financing internal research projects and offering innovative components in existing projects without additional charge.

Furthermore, the changed economic conditions triggered novel search activities for new entrepreneurial opportunities, by extending the business model through new services and enhancing the range and scope of software projects. However, among the three software companies examined, different diversification patterns could be observed depending on different firm-specific characteristics and arguments, such as different customer structures, different opinions about the prior understanding of the customer’s business context, different definitions of the problem space, and a somewhat different understanding of the relationship between technology and markets. Overall, these firm-specific factors played a role in whether companies diversified into new technological areas (e.g. software development for mobile devices), focused on established markets and industries, or diversified into new ones in order to open up new project opportunities.

Examination of the environment and firm-specific characteristics and arguments has indicated the necessity for a research setting that goes beyond the individual-opportunity nexus with regard to how and why entrepreneurial opportunities are identified, evaluated and exploited. In particular, the relationship between individuals and opportunities, firm and customer context, and competitors, in combination with different forms of asymmetric information and knowledge, has to be examined. The conceptual layout of such a setting has been given at the end of Chapter 6.

### 7.2 Contributions

This dissertation contributes to entrepreneurship research in both a theoretical and an empirical manner. First of all, it contributes to the existing theoretical and conceptional models of entrepreneurial opportunity identification, evaluation and exploitation (Venkataraman 1997; Shane and Venkataraman 2000). In particular,
instead of looking at prior knowledge of markets, of how to serve markets, and of customer problems as a relatively static measure (Shane 2000), the results of this study stress the dynamic characteristics of how the researched software companies acquired customer and market knowledge through profound learning and interaction with their customers.

Second, this study contributes to the discussion of dispersed knowledge (Hayek 1945), by showing the difference between asymmetric information and knowledge and by categorizing these two variables along three main dimensions of vertical, horizontal and longitudinal.

Third, based on the categorization of asymmetric information and knowledge, this work provides a more detailed and comprehensive description of the entrepreneurial process of opportunity identification and exploitation, by mentioning different aspects of how opportunities are identified, evaluated, and exploited. In particular, the findings of this study emphasize the importance of opening up customers and the different activities necessary to acquire specific project opportunities. Furthermore, it emphasizes the importance of inter-organizational learning through knowledge exchange in the exploitation process of project opportunities.

Fourth, this study confirms the multi-level argument of entrepreneurial opportunity research (Bruyat and Julien 2001), by highlighting the role of the economic environment and the firm level as important levels of analysis in understanding how and why certain opportunities are identified and exploited.

Finally, this study has added particular value by conducting an in-depth case study, based on rich data, which helps to achieve a better understanding of how entrepreneurial opportunities are identified and exploited. Furthermore, it is one of the few studies that investigates the service sector, by examining small and medium-sized software companies in the market for individualized high-technology software solutions.

7.3 Limitations

Every method has its advantages and disadvantages. Nevertheless, the most important aspect is to find the most suitable method to answer the given research questions. When this research project began in 2001, very little empirical work existed about the identification and exploitation of entrepreneurial opportunities, and it was of great interest to me to understand how people and entrepreneurial firms handled their
opportunities. In order to gain a better understanding, I decided to conduct a qualitative study in a very dynamic industry.

However, there are certain limitations to the research approach of this study. An appropriate way to discuss the limitations of this study is to look at validity and reliability criteria.

First of all, most identified categories and constructs were derived from the definitions in the interviews or from the entrepreneurial literature. Although the categories and constructs are carefully described, discussed with the interviewees and multiple sources of evidence are used, a further step would be to measure categories and constructs exclusively in quantitative and numerical scale.

Similarly, in respect of internal validity, although the causal relationships were validated by pattern matching (Yin 1984) and careful explanations of causalities were provided, a further step would be to use statistical methods to further validate the significance of the identified causalities.

With regard to external validity, although the case study approach aimed not to produce generalizable results based on statistical sampling, but to produce analytical generalization in respect of a theoretical discussion, the findings of this study were derived from a rather specific industrial setting of individualized large-scale software development. Therefore, the results can mainly be generalized to a setting in which different forms of information and knowledge asymmetries exist, close customer interactions are required to identify and exploit entrepreneurial opportunities, and firms act in a very dynamic environment.

Finally, in respect of reliability issues, although the methodological background and the conducting of the research are clearly documented, there can always be some variance in the findings, because the results are also influenced by subjective interpretations of the researcher and of the interviewees. Therefore, to check the reliability, it would be advisable to conduct further studies in other industrial contexts into the topics discussed so far.

7.4 Practical Implications and Future Outlook

The following sections outline the practical implications of this dissertation and then discuss future research possibilities.
Practical implications: For entrepreneurs, both within new ventures and established entrepreneurial firms, who have no prior knowledge of specific markets, of how to serve these markets, or of respective customer problems, but who have profound technological competences, one way to identify and exploit new entrepreneurial opportunities lies in intensive interactions with potential customers and the establishment of profound relationships with them.

Therefore, entrepreneurs and entrepreneurial firms have to think about how they can reduce vertical information and knowledge asymmetries. For this purpose, the four entrepreneurial processes described in this study provide a framework for how they can identify new opportunities, what the key measures are to evaluate them, how the customer can be opened up and opportunities acquired within customers, and in what respect it is important to transfer knowledge domains between the company and its customers to execute the opportunity.

By reducing vertical asymmetric information and knowledge, entrepreneurial companies can benefit not only by identifying new opportunities, but also by gaining information and knowledge advantages over possible competitors. This can lead to short-term competitive advantages by building up horizontal information and knowledge asymmetries, which can be crucial in project-oriented businesses. Furthermore, by reducing vertical asymmetries through close customer interaction, the market risks of an identified opportunity can be reduced, because the needs and problems of specific customers are better known. However, recognition of specific customers’ needs does not necessarily reduce the risks regarding whether the identified opportunity can be leveraged to other potential customers.

Another way of creating new entrepreneurial opportunities is to reduce horizontal asymmetric information and knowledge. This can be achieved by, for example, exchanging information and knowledge about market trends and customer problems with other software companies or partner companies. This exchange can lead to new opportunities, from which all involved companies can benefit. Either the opportunity is exploited together, for example by combining different firm-specific competences, or opportunities are mutually exchanged in cases where one firm is not interested in a particular opportunity that is of great interest to another company. By doing so, a win-win situation can be created for all involved companies in the long run.

Finally, entrepreneurs and managers encountering difficult economic conditions can learn from the company cases explored in this study. The results indicate that
changed economic conditions have a strong impact on the identification and exploitation process of entrepreneurial opportunities. In order to handle the changed environment, the software companies undertook internal measures to increase the economic efficiency of the company and to cut costs, as well as external measures such as intensified search processes and the broadening of the scope of services and projects. Therefore, they not only concentrated on the cost side, but also made great efforts to maintain the revenue side. Furthermore, whether concentrating on established customer-industry contexts or technological areas, or diversifying into new ones, firm-specific characteristics were an important factor influencing which opportunities were pursued and exploited. This indicates that the companies looked for a fit between identified opportunities and firm-specific characteristics. This might be of interest, for example, to companies working with external consulting companies to identify new business opportunities, suggesting that they have to check carefully the fit between firm-specific characteristics and proposed opportunities.

**Future outlook:** Based on this study, five main areas for future research can be derived. First of all, the influence of motivational factors, such as interest, intent and volition, on entrepreneurial opportunity identification and exploitation should be studied more profoundly. In addition, besides exploring intrinsic factors, research should also be conducted in respect of extrinsic factors; for instance, how firms can set extrinsic incentives such as monetary ones, how effective they are in fostering opportunity identification and exploitation, and how and to what extent intrinsic and extrinsic incentives can be supported by organizational measures, such as team building, autonomy, partnerships, or participation.

Second, future research should not only look at entrepreneurial processes of opportunity identification, evaluation, and exploitation in isolation. More emphasis should be put on exploring the interactions between these different processes in more detail in order to fully understand what leads to the exploitation of opportunities that have been identified; this requires a more process-oriented and longitudinal analysis. To reach these goals, both qualitative and quantitative longitudinal research should be conducted. One potential direction lies in quantitative event history analysis in this area.

Third, this work has shown that many factors influence the identification and exploitation of entrepreneurial opportunities. Therefore, future research should invest more in multi-level analysis, investigating the interplay between individuals and
opportunities, firm-level, technological and economic environments, regions and so on.

Fourth, this study has shown the significance of the combination and co-evolution of market knowledge, customer knowledge, and technological competence in the identification and exploitation of entrepreneurial opportunities. In order to increase the number of valuable entrepreneurial opportunities in an economy, an interesting future research field would be more detailed study of how these different knowledge domains can be better pooled; for instance, how can the technological knowledge generated in universities better be linked to market and customer knowledge, so as to foster the generation of valuable new entrepreneurial opportunities.

Finally, although Shane and Venkataraman (2000) point out that the final goal of entrepreneurship research is not the explanation of performance differences, it would be interesting and beneficial if future research linked factors leading to opportunity identification and exploitation to performance measures. Recent research has shown that prior knowledge leads to more opportunities (Shepherd and De Tienne 2005); an interesting question that has been raised is whether more identified entrepreneurial opportunities also lead to better firm performance.

There is more exciting work to be done in exploring how entrepreneurs and entrepreneurial firms identify and exploit entrepreneurial opportunities by producing new products and services, and how they thereby transform the economy and the society we live in.
References


Aldrich, H. and M. Martinez (2001). "Many are called, but few are chosen: An evolutionary perspective for the study of entrepreneurship." Entrepreneurship Theory and Practice Summer: 41-56.


References


European Information Technology Observatory (2004).


Appendices

Appendix A

ICT-Investments split by Firm-Size in Switzerland (2000):

<table>
<thead>
<tr>
<th></th>
<th>ICT company investments compared to overall company investments in %</th>
<th>Changes of ICT company investments between 1995-1997 and 1998-2000 (companies in %)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Decrease</td>
<td>Unchanged</td>
</tr>
<tr>
<td>Small enterprises</td>
<td>29.0</td>
<td>3.9</td>
</tr>
<tr>
<td>Small and medium sized enterprises</td>
<td>31.5</td>
<td>2.9</td>
</tr>
<tr>
<td>Large-scale enterprises</td>
<td>27.2</td>
<td>1.6</td>
</tr>
</tbody>
</table>

Source: KOF 123

123 Konjunkturforschungsstelle der ETH Zürich
Appendix B


<table>
<thead>
<tr>
<th>Industry sector</th>
<th>ICT company investments compared to overall company investments in %</th>
<th>Changes of ICT company investments between 1995-1997 and 1998-2000 (companies in %)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Decrease</td>
<td>Unchanged</td>
</tr>
<tr>
<td>Industry sector</td>
<td>23.3</td>
<td>3.1</td>
</tr>
<tr>
<td>Construction sector</td>
<td>23.7</td>
<td>2.6</td>
</tr>
<tr>
<td>Service sector</td>
<td>30.4</td>
<td>4.4</td>
</tr>
<tr>
<td>Overall</td>
<td>27.3</td>
<td>3.8</td>
</tr>
</tbody>
</table>

Source: KOF
Appendix C


in millions of CHF


in millions of CHF

Appendices

Appendix D

Annual Expenses for Information and Communication Technology: an International Comparison, 2003

Per inhabitant (in Euro)

- Switzerland
- United States
- Denmark
- Sweden
- Norway
- United Kingdom
- Japan
- Finland
- Austria
- Germany
- France
- Italy
- Spain
- Portugal

Source: EITO (2004)
Appendix E

Number of Companies and Employees in the Swiss Software Industry:\footnote{124}{Internal IT departments are not included in the statistics.}

<table>
<thead>
<tr>
<th></th>
<th># companies (1)</th>
<th># employees (2)</th>
<th>Average ((2)/(1))</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Trade</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wholesale trade</td>
<td>119</td>
<td>1387</td>
<td>11.7</td>
</tr>
<tr>
<td>Retail trade</td>
<td>1462</td>
<td>7112</td>
<td>4.9</td>
</tr>
<tr>
<td><strong>Services</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Software development and consultancy</td>
<td>9748</td>
<td>54902</td>
<td>5.6</td>
</tr>
</tbody>
</table>

\textit{Source: ICTswitzerland (2004)}
Appendices

Appendix F

Success and Failure Rates in Software Projects:

![Pie chart showing success and failure rates.](chart.png)

**Definitions:**

Successful projects are those that are completed on time, on budget and on specification (with all features and functions implemented as initially specified).

Challenged projects are those that are completed, but over time, over budget and/or with fewer features and functions than originally specified.

Cancelled projects are those that are stopped at some point during the development process.

*Source: The Standish Group (2005)*
Appendix G

The NASDAQ Index (1994-2004):

The heavily technology-exposed NASDAQ IXIC index peaked in March 2000, reflecting the high point of the dot-com bubble.
Appendix H

Growth Rates of the Swiss Gross Domestic Product (GDP), 1994-2003:

Curriculum Vitae

Matthäus Urwyler Email: matthaeus.urwyler@unisg.ch

Zugerbergstrasse 18 Date of Birth: January 13, 1973

CH – 6314 Unterägeri Nationality: Swiss

+41 78 709 21 73 Marital Status: Married

Education

2003 SINTEF (The Foundation for Scientific and Industrial Research at the Norwegian Institute of Technology), Trondheim, Norway

(4 months) Visiting doctoral student, Institute of Industrial Management, Knowledge and Strategy Department, Research director: Reidar Gjersvik

Qualitative research and investigation of a knowledge based perspective in entrepreneurship

2003 University of Pennsylvania (UPenn), Wharton School, USA

(8 months) Visiting doctoral student, Sol C. Snider Entrepreneurial Research Center, Department of Prof. Ian C. MacMillan

Courses in multiple regression, logistic regression, structural equation models and event history analysis held by Prof. Paul Allison, using the SAS statistical software

Courses in strategic entrepreneurship held by Prof. Anne Marie Knott

2000-2005 University of St. Gallen (HSG), Switzerland

Doctoral studies in strategic management, Department of Prof. G. von Krogh.


1999 University of St. Gallen (HSG), Switzerland

International Study Program (ISP), Educational program for international MBA students

Courses in strategic management, finance, microeconomics and law of the European Union
1998-2000  *University of St. Gallen (HSG), Switzerland*
Graduate studies in business administration (lic.oec.HSG), Major: ‘Strategy and Organizations’
Thesis: “Dominante Logik als Erklärung von Performanceunterschieden in Märkten im Umbruch: Der Fall des Europäischen Strommarktes”

1996-1997  *University of Kingston-Upon-Hull (UK)*
(8 months)
Exchange student
Courses in microeconomics, game theory, management of natural resources, operations management and business English

1994-1996  *University of Basel*
Bachelor of science, Major: Economics

**Work Experience**

2006-  *Hilti Corporation, Switzerland*
Business Analyst Marketing & Sales

2000-2005  *University of St. Gallen (HSG), Switzerland*
Research associate at the department of Prof. G. von Krogh, Institute of Management
Research areas: Strategic management, entrepreneurship, knowledge management

2001 -  *University of St. Gallen (HSG), Switzerland*
Founding member and researcher of RISE (Research Center for Innovation, Strategy and Entrepreneurship)

2002 -  *BPS Division at Academy of Management (AOM)*
Reviewer of submitted conference papers

2000-2002  “*Mergers and Acquisitions Review*”
Editor for the electric utility industry

2000-2002  *University of St. Gallen (HSG), Switzerland*
Teaching assistant at the department of Prof. G. von Krogh, Institute of Management

1999-2000  *University of St. Gallen (HSG), Switzerland*
Student assistant at the department of Prof. G. von Krogh, Institute of Management
1999-2000  
*Rhetoric Center at the University of St. Gallen*  
Teacher in rhetoric seminars

1998  
*UBS Basel*  
(3 months)  
Credit department corporate clients

1997-1998  
*Hoffmann – La Roche AG Basel*  
(8 months)  
Logistics and planning