



Strategisches
Kompetenz-Management



Jan Brinckmann

Competence of Top Management Teams and Success of New Technology-Based Firms

A Theoretical and Empirical
Analysis Concerning Competencies
of Entrepreneurial Teams and the
Development of Their Ventures



GABLER EDITION WISSENSCHAFT

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Strategisches Kompetenz-Management



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Der Resource-based View und – in enger Verbindung dazu – das Management von (Kern-)Kompetenzen haben in den vergangenen Jahren die Unternehmensführung nachhaltig beeinflusst. Wissenschaft und Praxis beteiligen sich gleichermaßen an Fragen der ressourcenorientierten Unternehmensführung und des Knowledge Managements. Die Schriftenreihe greift diese Entwicklung auf und schafft ein Forum für wissenschaftliche Beiträge und Diskussionen.

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With a foreword by Prof. Dr. Hans-Georg Gemünden

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Foreword

Research on the creation and development of new firms has gained substantial prominence over the past ten years - especially in the German-speaking countries, where many new entrepreneurship chairs have been created in universities. Despite the surge in interest, short-comings in the research domain remain. These shortcomings primarily concern the lack of solid empirical research that reflects the state of the art of management science. Based on psychological theories, explanations of the founding of a firm and its subsequent success have been made frequently in terms of character traits and attitudes. Yet these studies explain little about a new firm's success. Their usefulness was especially limited concerning team-based ventures, which represent the majority of technology-based ventures.

Other more recent approaches focus on entrepreneurial activities and how they impact new venture development. In this stream of research, the competence perspective has special importance as competencies of founders determine which activities they undertake, and how they perform these activities. A key question has been raised often by entrepreneurs, researchers and educators with respect to competencies of the founders: What are the critical competencies needed to create and grow a new firm? Although this is a fundamental question of entrepreneurship research, this question has hardly been investigated empirically.

The dissertation of Dr. Jan Brinckmann analyzes how competencies of founding teams of new technology based firms affect the development of the new firms. In order to identify the critical competencies needed to create and grow a firm, Dr. Brinckmann reviewed entrepreneurship and management literature in depth and conducted interviews with entrepreneurs. The resulting competence concept comprises three areas of competencies: general entrepreneurial, social, and functional competencies. The general entrepreneurial competencies consist of conceptual, innovative, and execution competencies. The social competencies are comprised of teamwork, leadership, and network competencies. The functional competencies analyzed in his work include technology-management, marketing management, and financial management competencies.

Prior to determining the success relevance of these different competencies, Dr. Brinckmann offers a detailed overview of the current state of the art of prior empirical findings in competence-related entrepreneurship research. This provides an excellent overview of how different competencies affect the development of new firms.

Based on his own empirical study, Dr. Brinckmann develops a self-evaluation tool founding teams can use to assess their competencies. 212 executives of German NTBFs assessed their team's competencies using this tool. This data was analyzed to depict the competence profile of new venture teams and to identify the competencies that significantly impact the development of new technology-based firms. In his study, development is a comprehensive concept that integrates activities in the technological, market, and financing domain and includes success-measures in the technology, market and financial domain as well as a venture growth success-measure. Based on an analysis of two stages in the development of a new firm (the start-up stage and a more advanced development stage), his study highlights critical competencies needed to successfully lead a firm at the respective stage.

The detailed analysis of direct and indirect effects of the competencies on the development of new technology-based firms shows that functional competencies of the founding team in the technology, marketing, and financial management domain are important predictors of venture success. The functional competencies significantly impact their respective functional success measures. With regards to growth, the importance of financial management competence of the team, as a direct predictor for growth, is highlighted. Additionally, competence in networking becomes more growth-relevant as the venture evolves. Technology management and marketing management competence have indirect growth implications as they augment technology and market success, which are positively related to venture growth.

Overall, Jan Brinckmann's work excels regarding the validity, specification, and practical relevance. It offers valuable insights for those interested in new ventures such as founders, investors, educators, researchers, students, and consultants. It is a sophisticated, innovative study which fulfills the classic demands of rigor and relevance.

Hans Georg Gemünden

Preface

The arrival of networked economies made me travel the world and get exposed to fascinating people, cultures, and new businesses. My interest grew concerning one central driver behind it all: entrepreneurial people. Throughout my dissertation I was fortunate to dedicate myself to the question of what makes entrepreneurs successful - a question that has fuelled my enthusiasm up to the present day. Looking back at the road travelled so far, I am very grateful for the positive and, at times, challenging moments, for the people I got to meet and their ideas, and for the inspiration they provided.

I want to thank my supervisor Prof. Dr. Hans Georg Gemünden, chair of the Institute of Technology and Innovation Management at the Technical University of Berlin for his support that profoundly shaped my research. Special gratitude also belongs to Prof. Dr. Sören Salomo, chair of the Institute of Technology and Innovation Management at the University of Graz, who strongly fostered my research by being a close advisor throughout the whole research process. During my visiting stays at Cornell University, Stanford University, and Case Western Reserve University, I was fortunate to experience new approaches to entrepreneurship in research and education. To all promoters and supporters of these stays, I want to express my special gratitude: Prof. Dr. Robert Hisrich now at Thunderbird University, Prof. Dr. James Baron now at Yale University, and Prof. Dr. David BenDaniel at Cornell University. Special gratitude and thanks go to Prof. Dr. Gezinus Hidding at Loyola University Chicago whose dedication to improving my dissertation writing is unsurpassed. Additionally, I want to thank Prof. Dr. Günther Faltn whose approach to entrepreneurship has impacted me deeply.

Furthermore, I want express my gratitude to the German Business Foundation (Stiftung der Deutschen Wirtschaft) for its intellectual and financial support. The members of the foundation have been a great source of encouragement and support throughout my academic education.

I also owe special gratitude to the founding teams that supported my research by giving valuable advice and participating in this study.

Preface

Last, yet most-importantly, I want to thank my dear family and friends who have always given me motivation, unconditional support, and affected the way I am.

May all your entrepreneurial efforts - private and professional - be prolific.

Jan Brinckmann

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Index of abbreviations

AGFI	Adjusted goodness of fit index
ANOVA	Analysis of Variance
AMOS	Analysis of Moment Structures
A.o.	Among others
AVE	Average Variance Extracted
Cor.	Correlation
Coe.	Coefficient
EMC	Entrepreneurial-management-competence
E.g.	For example
Et al.	Et altera
Etc.	Et cetera
Fig.	Figure
GEM	Global Entrepreneurship Monitor
GFI	Goodness of Fit Index
H	Hypothesis
High-Tech	High technology
LISREL	Linear Structural Relationships
Max	Maximum
Min	Minimum
N	Sample Size
Nr.	Number
NTBF	New Technology-Based Firms
PLS	Partial Least Square
R&D	Research and Development
SD	Standard Deviation
SME	Small and Medium Sized Firms
SPSS	Superior Performing Software Systems
Tab.	Table
TMT	Top Management Team

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1. Introduction

1.1 Importance of new ventures

Entrepreneurial efforts are a fundamental driving force for the prosperity of modern societies. The Global Entrepreneurship Monitor illustrates that almost half of the differences in economic growth of developed nations can be explained by the level of entrepreneurial activity within these countries.¹ Countries with higher level of entrepreneurial activities experience significantly higher economic welfare.²

In this light the small and especially the young businesses have a profound impact on the economy as a whole. Even in large economies like Germany small and medium sized companies represent 99.7% of all firms, they offer 69.7% of all jobs and educate 80% of the dual work formation positions.³ In Germany about 10% of the total workforce is self-employed. In 2004 1.4 million Germans started their own economic venture either full or part time.⁴ With regards to the USA *Reynolds, P.D. and White, S.B., 1997* find that the appeal of entrepreneurship is not limited to a group of a selected few, but state that as much as 40% of the working population experience spells of self-employment during their lifetime and eventually 4 - 6% actually start a new venture.

In spite of the problems after the new-economy euphoria, the attractiveness of founding a new business has regained attractiveness and is almost back to a pre-crisis level (figure 1).

¹ *Reynolds, P.D., et al., 2000, 11-13.*

² *Baier, W. and Pleschak, F., 1996, 13; Steinle, C. and Schuhmann, K., 2003, 15-16.*

³ *BMWA, 2005.*

⁴ *Hofmann, C., et al., 2005, 3.*

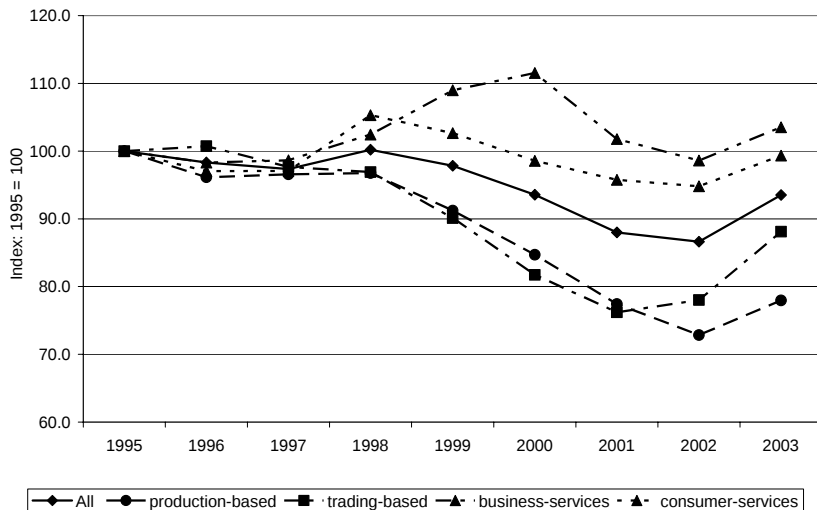


Fig. 1: Founding activity in Germany⁵

Entrepreneurial activities have a variety of positive effects. The most prominent is the creation of employment. The owner of an average German start-up company employs two persons in the first 12 month of existence.⁶ In later stages of development an average German technology-based firm employs 20 people. In the USA, large corporations with more than 500 employees reduced their workforce by 3.8 million people between 1992 and 1996, while companies with less than 20 employees created 9.7 million jobs in the same time frame.⁷ Hofer, C.W., Sandberg, William R., 1987, 11 assess that over 60% of all new jobs created in the US originate in new ventures.

Additionally, with the development and sale of innovative products and services many young companies contribute to the technological advance and competitiveness of the economy. Oftentimes they challenge existing orders initiating economic structural change and evolution.⁸ Entrepreneurial companies provide an environment of intense professional training and learning on the job for their employees and tax

⁵ Own figure. Data kindly provided by Zentrum für Europäische Wirtschaftsforschung, E., 2004, 1.

⁶ Lehnert, N., 2004, 21.

⁷ Comtesse quoted by Meier, A., 1998, 1; Drucker, P.F., 1985 presents similar dynamics. Accordingly, a study of the German labor market conducted by Leicht, R. and Strohmeier, R., 1998, 44-46 shows that between 1977 and 1995 the large German corporations reduced their workforce by 6% while small business with less than 20 employees increased their staff by 4%.

⁸ Schumpeter, J., 1993, Loan-Clarke, J., et al., 176; Wupperfeld, U., 1993, 19-21.

income for the government. Furthermore the positive examples and growth stories of some very successful start-ups stimulate the societal spirit beyond the business sphere. The different effects interact and have positive overall consequences for the prosperity of economies. Especially in times of economic hardship and high unemployment the entrepreneurial function gains importance.⁹

However, the creation of new businesses is a challenging task for their founders. In the USA just about 40% of the newly founded firms survive the first two years and less than 10% of the start-up companies are in existence after the first five years.¹⁰ The survival rate of technology-based businesses is more favorable. In a study of German-government supported young technology ventures the survival rate was about 60% in the first five years.¹¹ *Roberts, E.B., 1991a*, 345 noted that the spin-off companies from the Massachusetts Institute of Technology (M.I.T.) have a survival rate between 70 and 85% within the first five years. *Kennedy, C.R., 1985*, 39 estimates a survival rate for corresponding venture types between 20-40%. *Aldrich, H.E. and Martinez, M.A., 2001*, 42 depict that most of the start-ups achieve only modest success. Many of the young companies can be considered “living dead”, because they fail to achieve the founder’s goals and do not offer an adequate rate of return, but oftentimes are in existence because of a lack of perceived alternatives by the founders or their dislike to admit the failure of the venture.¹²

Many causes have been identified for the overall poor performance of young ventures. These range from outside factors like the general economic environment or the demands of an established industry to internal factors like the pursued strategy or resources limitations.¹³ The human factor is one of the most frequently recognized problems in this context: Founders lack the necessary experience and knowledge to handle the different tasks necessary for establishing and growing their business.¹⁴ A prominent quote from venture capitals proclaims that it is better to invest in a grade-A man with a grade-B idea, than in a grade-B man with a grade-A idea. But what makes a grade-A man?

⁹ *Diensberg, C., 1999*, 54.

¹⁰ *Roberts, E.B., 1991a*, 250; *Timmons, J.A., 1999*. For an overview about different failure studies refer to *Cochran, A.B., 1981, Dickinson, R., 1981*.

¹¹ *Kulicke, M. and al., e., 1993*, 164.

¹² *Kulicke, M. and al., e., 1993*, 164; *Schefczyk, M. and Gerpott, T.J., 2000*, 146.

¹³ *O'Neill, H. and Duker, J., 1986; Dawit, K., 1983*. Also refer to chapter 4.

¹⁴ *Lechler, T. and Gemünden, H.G., 2002; Gartner, W.B., 1985*, 698; *Birley, S., et al., 1987*, 33; *Hansen, E.L. and Bird, B.J., 1997*, 121.

Little is known about the human requirements for starting and running a new venture. *Röpke, J., 2002*, 173 asserts that "in theory and practice of entrepreneurship the aspect of entrepreneurial competence remains diluted, almost invisible (...)." ¹⁵ This research attempts to reduce this deficit from an academic perspective.

There is evidence that there is an important relationship between the founder's characteristics and the overall performance of the firm. Empirical evidence shows that the competence of a founder or management team has a significant performance effect. ¹⁶ A thorough assessment of critical performance factors both needs to take into account the antecedents of entrepreneurial activities (e.g. competencies) and the actual activities. ¹⁷ *Chandler, G.N. and Hanks, S.H., 1994* illustrate the wide ranging implications of this research design when they proclaim that "(...) understanding how business founders interact with the development and performance of their businesses has important implications for business owners, lenders, educators, policy makers, and researchers." ¹⁸ By adopting this perspective, entrepreneurship research follows strategic management research which has a strong tradition of relating top management characteristics to company performance. ¹⁹

1.2 Purpose and delimitation of this study

It seems obvious that the competence of the founders has an impact on the performance of their companies. It can be argued - like in any other field - that the one who is more competent to do a certain task will do the task better than another person with less competence if all other things are equal. If the task is to create and grow a company than the one more competent in this regard will outperform the person who is less competent. Still, several important questions arise concerning the competence of executives in young ventures: What kinds of competencies do exist? How can they be structured? How can they be assessed? Which are the relevant competencies needed to lead a young company? When are the different competencies needed? How do the different competencies effect the development of the

¹⁵ Translation from German *Röpke, J., 2002*, 173; *Driessen, M.R. and Zwart, P.S., 1999*, 5; *Sadler-Smith, E., et al., 2003*; *Man, T.W.Y., et al., 2002*, 123.

¹⁶ *Walter, A., et al., 2003*; *Herron, L., 1994*; *Lorange, P. and Roos, J., 1990*.

¹⁷ *Salomo, S. and Brinckmann, J., 2005*.

¹⁸ *Chandler, G.N. and Hanks, S.H., 1994*, 77.

¹⁹ *Salomo, S., 2001*; *Schrader, S., 1995*.

venture? How do the competencies themselves develop in the start-up and growth process?

These challenging questions outline the research field. This study aims to serve the following five purposes:

First, this study intends to systematically develop a comprehensive yet selective management-competence concept for new technology-based ventures. The goal is to identify relevant contents of competence and to structure them into a coherent concept that is reflecting the exigencies of start-up companies.

Second, this new competence construct needs to be operationalized and validated in order to obtain a competence measurement construct that can be used to empirically assess the executive's abilities to manage a young firm.

The third research goal is to investigate the relationships between the executive team's competence in new firms and the firm's performance. This includes an analysis of immediate and mediated effects of competence.

Fourth, this study intends to shed light on the development of management competence. This concerns the investigation of competence development through learning of the executives, the strengthening of competence by increasing the number of executives or replacing the managers of the team or by drawing on management competence from outside the firm.

The fifth research goal relates to advances of the statistical method applied. Causal relationships between concepts need to be analyzed with adequate statistical methods. This work applies mainly structural equation models. However, the use of formative and reflective construct types and other considerations make the predominant covariance-based methods like LISREL or AMOS less suitable.²⁰ Due to these shortcomings the less-applied Partial Least Square (PLS) approach is chosen. While PLS has gained importance in other management areas, it is less known in the entrepreneurship field. Yet, this

²⁰ Refer to chapter 6.3.

statistical method holds several advantages for entrepreneurship research. The application and spread of PLS in the entrepreneurship field is the fifth research purpose.

New ventures encompass a wide variety of different forms depending on the founding background, the growth ambition, the degree of independence, the degree of innovation, the technological focus and others. In this study the focus will be on high-technology ventures. In recent years many firms have been created to transform technological knowledge into viable products and services and to introduce those offerings to the market. Fertile areas of technological evolution have been the fields of electronics, biotechnology, microtechnology, nanotechnology, and optical technology.²¹ Companies which are active in these technological domains will be subject to this study. These firms are known to have an important impact on the labor market dynamics and the technological competitiveness of an economy. This focus allows more precise conclusions due to the homogeneity of the research subject. At the same time, it can be assumed that the findings will apply to other technological venturing areas and will be insightful for the general new venture landscape.

The competence which exists within a company can be investigated at different levels. The competence of the lead entrepreneur, the competence of the executive team, or the competence at the company's level are possible research objects.²² The technology-focused entrepreneurship research underlines the importance of team-founded ventures.²³ Two thirds of all new technology ventures are lead by two or more persons.²⁴ Teams which initiate ventures can have greater resources, different points of view, checks and balances, and a broader array of ideas and abilities than single founders.²⁵ Accordingly, *Roberts, E.B., 1991a* derives the conclusion that "Finally and most important, successful entrepreneurs of high technology do not go it alone."²⁶ Although team configurations play dominant roles especially in technology-based ventures, paucity remains concerning research on the entrepreneurial team.²⁷ In light of these considerations, this research chooses the executive team as the

²¹ BMBF, 2006; Klocke, B., 2004; Kulicke, M., 1987; Pleschak, F. and Werner, H., 1998.

²² von Krogh, G. and Roos, J., 1995, 66 additionally identify the department and public level of competence. However, these levels are inadequate in light of the research goals and the limited size of the young ventures.

²³ Lechler, T. and Gemünden, H.G., 2002; Müller, T.A., 2003, 109.

²⁴ Mellewig, T. and Späth, J.F., 2001. The experience of this research supports this notion.

²⁵ Watson, W.E., et al., 1995, 394.

²⁶ Roberts, E.B., 1991a, 346.

²⁷ Herron, L., 1994, 27.

relevant object of investigation while acknowledging that other research levels may prove insightful as well.

1.3 Research method and structure of this research

This study proceeds in two steps: First, relevant entrepreneurship theories are reviewed. Because entrepreneurship still is a young, underdeveloped research area in comparison with other business sciences, this work draws decisively from well-established areas like general management theories. These theories are reflected in light of the specific exigencies of the entrepreneurship field. Following this theoretical analysis and an examination of prior empirical evidence a conceptual framework and hypotheses are deducted. Second, the theoretical assumptions are empirically investigated by a quantitative study.

This work consists of a theoretical and an empirical part. In the theoretical part, central terms will be explained and defined, relevant theories will be discussed, and the present state of empirical research will be considered, leading to a conceptual framework that entails constructs and proposed interactions between the constructs which are specified by hypotheses.

In the second part, the applied research process, the empirical method, the sample, and the findings will be presented and discussed. Finally, implications for research, practitioners, and politics will be examined. The following figure illustrates this research approach.

THEORY: DEVELOPMENT OF CONCEPTUAL-FRAMEWORK Chapter 1: Introduction Relevance, purpose, delimitations, research method, structure Chapter 2: Fundamental Terms NTBFs, management, entrepreneurship, competence, top management teams Chapter 3: Theories regarding Competence and Firm Development Competence concepts, development of NTBFs, theories linking competence and NTBF development Chapter 4: Empirical findings regarding competence and firm development Prior empirical findings linking competence and new venture development Chapter 5: Presentation of the conceptual framework Comparative static research design, hypothesis	EMPIRICISM: TESTING OF CONCEPTUAL FRAMEWORK Chapter 6: Research process, sample and method Empirical research process description, sample characteristics, method selection and presentation Chapter 7: Presentation of the measurement model Operationalization of constructs, construct validation Chapter 8: Empirical findings concerning competencies and the development of NTBFs Description of venture and competence development, Presentation of direct/indirect relationships between competence and venture development Chapter 9: Summary, Implications and Outlook Central findings, implications for researchers, entrepreneurs, policy makers and educators, future research suggestions
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Fig. 2: Research structure

In chapter 2, the fundamental terms of this research are presented to allow a common understanding of the research domain. Concepts like new technological companies, management, competence, and the development of young ventures are introduced. This part also serves to further define the research domain.

Chapter 3 presents the theoretical foundations of this research. The theoretical chapter consists of three parts. In the first part, the concept of competence in the context of the young technology-based ventures is developed. The concepts of the ability-oriented literature of entrepreneurship research, the findings of the general management literature, and competence requirements delineated by the entrepreneurship literature are presented and merged to create a proper management-competence concept for the entrepreneurial context. In the second part of chapter 3, theories which concern the development of young companies are presented. In a third part, theoretical approaches which link management competence and the development of companies are reviewed.

In chapter 4, the state of empirical evidence is summarized. Prominent studies investigating the link between competencies and the development of companies as well as research about success factors of new firm development are delineated.

The theoretical contemplations and the empirical findings of chapter 3 and 4 are the basis for the development of the conceptual framework applied in this study. Chapter 5 describes this conceptual framework.

Chapter 6 serves as an introduction to the empirical study of this research project. The research process and the sample are described. Additionally, different possible research methods are discussed which lead to a selection of the partial least square method. Because the PLS-method is little known in the entrepreneurship field, the method is subsequently presented.

In chapter 7, constructs are validated to assure adequate measurement of the latent constructs.

In chapter 8, the development of new technology based ventures and the competence development of their founders are described. Building on this understanding, an investigation of direct and indirect effects of the executive's competence on the development of their ventures follows.

In chapter 9, central findings of this research are summarized, implications are proclaimed, and future research directions are presented.

2. Fundamental research terms

In this chapter, the fundamental terms and concepts of the research are explained and defined. The key requisites for this investigation are the notion of “young companies”, “management”, “teams”, “competence”, and “company development”. This chapter is important to assure a common understanding.²⁸ Especially terms like management can be misleading in the context of young companies and entrepreneurship. Popular terms like “competence”, “management”, and “young companies” often have diverse or even conflicting meaning. In this light, the following sections establish the fundament of the subsequent research.

2.1 New technology-based firms

With the rise of the new economy new technology-based firms (NTBF)²⁹ have gained large public recognition. Media presence was dominated by a few rapidly growing firms. They offered their electronic services to a broad private customer base, became global players within a few years, and achieved spectacular valuations by venture capitalists or at initial public offerings (IPOs). These characteristics have shaped the public perception of NTBFs. Yet, they are misleading images.

The vast majority of NTBFs start small and remain small. The average firm in this study employs about 20 persons after six years.³⁰ Only 10-15% of the NTBFs are offering goods or services to consumers, while the rest is almost exclusively dealing with commercial customers.³¹ Most of the technology ventures are production-based, developing and marketing products which are enhanced by a service offering. Primarily their technology belongs to the field of information- and communication technology, electronics, mechanical engineering, biotechnology, microtechnology, material science, or optical-technology.³² Their business fields are characterized by high degree of change and unpredictability.³³

²⁸ Carland, J.W., et al., 1988b, 36.

²⁹ Other similar terms referring to technology based companies are high-technology company or science based company. Here the term new technology based firms (NTBF) will be applied, which has gained common acceptance in the Anglo-American sphere. Roure, J.B. and Keeley, R.H., 1990, 203.

³⁰ Refer to chapter 6.2. See also Duncan, J.W. and Handler, D.P., 1994.

³¹ Kulicke, M. and al., e., 1993, 73; Picot, A., et al., 1989, 119; Hunsdiek, D., 1987, 57-59.

³² BMBF, 2006; Pleschak, F. and Werner, H., 1998.

³³ Taylor, G.S. and Banks, M.C., 1992, 25; Aldrich, H.E. and Martinez, M.A., 2001, 44; Alvarez, S.A. and Busenitz, L.W., 2001, 758.

The average founder of a technology start-up has a high educational level. 80-90% of the founders in the technology field have received special technological education as part of their bachelor, master, or PhD-studies.³⁴ This high level of education especially in the executive position of the ventures, is in contrast to the otherwise limited resource dispositions.³⁵ Due to the nature of an extensive research and development process, which precedes the first significant sales by two to three years, the young technology ventures incorporate financial requirements that generally exceed the possibilities of self-financing or financing via personal savings of the founders.³⁶ In general banks offer limited credits to the new ventures due to a lack of viable information and missing collateral. Additionally, most technology ventures do not meet the requirements of venture capitalists or do not want to subject themselves to the demanding conditions of this form of financing. Accordingly, founders depend on personal savings, the limited company's cash-flow, governmental support, and restricted bank credits. This implies significant resource restrictions.³⁷

Besides the resource restrictions, NTBFs face several characteristic internal and external challenges. Internally, the founders have to create and refine their products or services, establish a functioning organization, deal with human resource issues, and administrative duties. Externally, they have to deal with the "liability of newness", the "liability of smallness"³⁸, and general market entry barriers. Their products and services are not known to the market, their performance ability is uncertain, their innovative products demand special information, and imply costs of adoption. This causes potential customers to perceive an increased risk.³⁹

An additional important characteristic of NTBFs is the use of technology. These companies focus on research and development to turn new scientific findings into innovative offerings and process innovations.⁴⁰ There are different ways to assess the technological orientation of the companies. *Kulicke, M. and al., e., 1993*, 15 suggest that spending on a bigger R&D project is a suitable indicator for technological-based ventures. Another input-related measure could be the percentage of

³⁴ Samson, K.J., 1991, 79; Maisberger, P., 1998, 22; Hunsdiek, D., 1987, 63; Kulicke, M., 1987, 146; Baaken, T., 1990, 15.

³⁵ Aldrich, H.E. and Martinez, M.A., 2001, 46; Kollmann, T. and Kuckertz, A., 2003, 7. In a study by Maisberger, P., 1998, 56 about half of the surveyed founders assess that financing is a problem for the company.

³⁶ Ravasi, D. and Turati, C., 2005, 138; Wupperfeld, U., 1993, 9.

³⁷ Maisberger, P., 1998, 59.

³⁸ Stinchcombe, A.L., 1965.

³⁹ Wupperfeld, U., 1993, 9.

⁴⁰ Dreier, C., 2001, 30-31.

employees working in R&D. Next to these input-focused factors, the degree of innovativeness of the offerings or patents and technology trademarks could serve as output indicators. However, companies can be technology-based without pursuing a high degree of innovativeness. Other companies might not legally protect their products and service due to the financial costs implied and their limited possibilities to enforce their intellectual property rights.⁴¹ Input indicators in turn have their limitations when we consider efficiency aspects. For this study the main indicators of a technological-based firm will be the attribution of its activities to certain technological fields and the fit of a special process model including own R&D activities, own prototype and production process development, as well as the own marketing of their offerings.⁴²

Another academic controversy deals with the maximum age when a company still can be considered young or new. Underlying this discourse is the generally accepted scientific perception that there is a development process that leads from a new to an established or mature company involving different stages and critical milestones.⁴³ Dealing with the controversy of the maximum age *Fallgatter, M.J., 2002*, 28-29 postulates at least a perennial perspective. Still, the ceiling age, depending on the research subject of the companies investigated, varies widely between 2 and 25 years.⁴⁴ For this work the age itself seems to be a limited quantitative measure for distinguishing young from established companies.⁴⁵ In this study it is proposed that the distinction should take special qualitative issues into account. These refer to inside and outside activities of the firm and furthermore can distinguish between new companies. It is assumed that primary activities change as the firm develops. This development will be described in this study. A corresponding process model will be conceived and applied. Due to practical research considerations, however, it is reasonable to apply an additional maximum age. This should be set to an age, when it can be confidentially assumed that any firm under investigation is no longer young, but well established. The overall age limit of the firms investigated in this research is

⁴¹ Just about 50% of the innovations developed in new ventures are protected by patents or trademarks *Kulicke, M., 1987*, 225; *Hunsdiek, D., 1987*, 59.

⁴² This definition includes input- and output oriented aspects as suggested by other definitions as well. *Baaken, T., 1989*; *Steinkühler, R.H., 1993*, 9; *Dietz, J.W., 1989*, 110. *Scheidt, B., 1995*, 31. The affiliation to high technology fields is another wide-used principle to distinguish high technology ventures. *Nerlinger, E.A., 1998*, 75-77; *Scheidt, B., 1995*, 31. Concerning limitations of this measure refer to *Kulicke, M. and al., e., 1993*, 15.

⁴³ Refer to chapter 3.3.

⁴⁴ *Rüggeberg, H., 1997*; *Bantel, K.A., 1998*; *Müller, T.A., 2003*, 120; *Herron, L. and Sapienza, H.J., 1992*, 8; *Hansen, E.L. and Bird, B.J., 1997*, 116; *Klocke, B., 2004*; *Little, A.D., 1977*.

⁴⁵ *Herron, L., 1994*, 19.

set to 15 years. This provides an extended time frame which allows modeling the progress through different stages. Additionally, it accounts for the special situation in the German venturing field due to the reunification.

2.2 Management and entrepreneurship

Introducing the term management to the entrepreneurship area appears to be provocative, because there has been a tradition of differentiating the entrepreneur from the manager, entrepreneurship from management, and management research from the entrepreneurship discipline.⁴⁶

Entrepreneur and Entrepreneurship

The etymologic origins of the term entrepreneurship can be traced to the French verb “entreprendre”, which means “(...) to undertake, to attempt, to try in hand, to contract for; or, to adventure (...).”⁴⁷ In the 18th century Richard Cantillon introduced the term to science by describing an entrepreneur as the person who assumes risks by buying goods for known prices and selling them for uncertain prices.⁴⁸ In the 19th century the word combined with the suffix “ship” gained popularity in the Anglo-American sphere. In Germany the expression was introduced in the 18th century, but became popular in recent years with the rise of the new economy.⁴⁹

In spite of the long tradition of the term, *Gartner, W.B., 1990* asserts that “(...) when we talk about entrepreneurship we carry around a wide range of beliefs.”⁵⁰ In a meta-analysis of the scientific entrepreneurship literature he identifies the following entrepreneurship tasks:⁵¹

⁴⁶ Refer to Taylor, G.S. and Banks, M.C., 1992, 25; Fallgatter, M.J., 2002, 25; Man, T.W.Y., et al., , 129; Bygrave, W.D. and Hofer, C.W., 1991, 13; Bygrave, W.D., 1989, 7.

⁴⁷ Carland, J.W., et al., 1988b, 33; Ripsas, S., 1997.

⁴⁸ Herron, L. and Robinson, R.B.J., 1993, 285.

⁴⁹ For a more detailed presentation of the Entrepreneur refer to Bretz, H., 1991, 277-278.; Ripsas, S., 1997, 3-4, Lackner, S., 2002, 8-9.

⁵⁰ Gartner, W.B., 1990, 28; Konrad, E.D., 2000, 28.

⁵¹ Gartner, W.B., 1985, 699-700.

1. The entrepreneur locates a business opportunity.
2. The entrepreneur accumulates resources.
3. The entrepreneur builds an organization.
4. The entrepreneur produces the product.
5. The entrepreneur markets products and services.
6. The entrepreneur responds to government and society.

According to the prominent task-oriented definition by *Bygrave, W.D. and Hofer, C.W., 1991* “an entrepreneur is someone who perceives an opportunity and creates the organization to pursue it.”⁵² *Stevenson, H.H. and Jarillo, J.C., 1990* define that “entrepreneurship is a process by which individuals - either on their own or inside an organization - pursue opportunities without regard to the resources they currently control.”⁵³ Several authors distinguish small business ownership from entrepreneurship by underling that entrepreneurial companies possess an orientation towards growth and innovation.⁵⁴ In subsequent studies initial empirical evidence indicates that entrepreneurial founders follow different strategies, they have different behavioral preferences, and they incorporate different personal characteristics when compared with general small business owners.⁵⁵

Overall, these definitions entail a common understanding. Thus, entrepreneurship is perceived as an active process of identifying business opportunities and sizing these opportunities by gathering and controlling resources to create an organization that can offer goods and services to the market involving an innovation and growth perspective.⁵⁶ However, whether this formed organization can exist within a larger organizational context is controversial.⁵⁷

Manager and Management

The etymologic origins of management are uncertain. According to the interpretation of *Braverman, H., 1974* it derives from the Latin expression “manus agree” which

⁵² *Bygrave, W.D. and Hofer, C.W., 1991, 12.*

⁵³ *Stevenson, H.H. and Jarillo, J.C., 1990, 23.*

⁵⁴ *Carland, J.W., et al., 1984; Carland, J.W., et al., 1988a, 34.*

⁵⁵ *Carland, J.W., et al., 1988a.*

⁵⁶ For a detailed discussion about the competence requirements delineated by entrepreneurship literature please refer to chapter 3.1.1.

⁵⁷ E.g. *Stevenson, H.H. and Jarillo, J.C., 1990, 17; Carland, J.W., et al., 1988b, 36.*

means to lead by hand and which is referring to train a horse in distinct gaits. Another possible origin is the Latin phrase “mansionem agree”, which coins the servicing of a house for its owner.⁵⁸ The use of the term management in the Anglo-American sphere dates back to the 19th century when it was first used in England and soon afterwards spread in the USA. In Germany the expression gained popularity after the Second World War with the translation of Burnham's “The Managerial Revolution.”⁵⁹

The modern use of the term management carries two possible reference spheres, a functional and an institutional interpretation.⁶⁰ According to the managerial functions approach, the term management delineates “processes and functions, which arise in organizations with division of labor like planning, organization, leadership and control.”⁶¹ In the managerial roles approach, the term management describes the institutions that perform the management task, which can be persons or groups.⁶² In general, management institutions are characterized in a hierarchical manner. This structure distinguishes between upper, middle, and lower management. *Steinmann, H. and Schreyögg, G., 2000* assert that management refers to all persons who are in a superior function at all management levels. This concept is including the owner-manager. In institutional economics, however, there is a common distinction between the manager who is employed by the owners and the owners of the firm themselves.⁶³

Dingle, J., 1995 defines managers as “(...) persons who are responsible for carrying out the “management task” of organizing the optimal use of resources so as to earn at least the profit required for the organizations' continued survival.”⁶⁴ *Koreimann, D.S., 1992* stresses that management implies the empowerment to give instructions, which is either given by another person or manifested in a self-authorized way. He defines the managers as “executive persons of a company, who participate in the goal-achievement with a division of labor and who are provided with different

⁵⁸ Staehle, W., 1999, 71.

⁵⁹ Staehle, W., 1999, 71; Steinmann, H. and Schreyögg, G., 2000, 37.

⁶⁰ Steinmann, H. and Schreyögg, G., 2000, 6.

⁶¹ Translated from German: Staehle, W., 1999, 71; Fayol, H., 1916; Terry, G.R., 1982, 38.

⁶² Staehle, W., 1999, 71.

⁶³ Steinmann, H. and Schreyögg, G., 2000, 6.

⁶⁴ Dingle, J., 1995, 31. According to Fallgatter's Theory of Entrepreneurship the management of scarce resources is a key entrepreneurial element. Fallgatter, M.J., 2002, 76.

authorities.”⁶⁵ Included in his definition of the manager is the outline of three decisions spaces which managers face:⁶⁶

1. Decisions concerning the goals of the company
2. Decisions concerning the employees
3. Decisions concerning the resources of the company

By applying an institutional, a functional, and a process perspective, the management concept can be introduced to the entrepreneurship field:

From an institutional perspective, the above considerations manifest that the term management can apply to all hierarchical levels including middle and lower management. In contrast, the term entrepreneur generally refers to the highest level of the emergent company. Since this investigation is focused on the executive team, the upper management level or entrepreneurial organizational level will be relevant while middle and lower management levels will be disregarded.

From a functional perspective, the distinction between the different roles of an entrepreneur and a manager can be insightful. They help to shape the characteristics of each role and to specify the contingencies of each domain. A popular differentiation is discerning the functions of the lead-entrepreneur and a management team. In this concept the lead-entrepreneur conceives and develops the business-model and acts as a networker bringing together the necessary resources and people. Meanwhile, a management-team is responsible for the realization of the business-model by heading day-to-day operations.⁶⁷

To achieve success in the venturing process there is a general consensus that both the entrepreneurial and the management functions are required to be fulfilled. Managers and entrepreneurs also fulfill many roles alike. These are e.g. the basic functions like analyzing, planning, execution, and controlling. Due to legal requirements various management responsibilities need to be fulfilled starting from the first day of the formal founding of the firm. Because founders generally lack the necessary

⁶⁵ Translation from German. Koreimann, D.S., 1992, 11-12.

⁶⁶ Koreimann, D.S., 1992, 12.

⁶⁷ Ensley, M.D., et al., 2000; Faltin, G., 1999, 5.

resources to hire experienced managers or unwilling to yield this core task to others, they carry out the management tasks themselves. Therefore the academic conceptual differentiation of the functions in practice oftentimes is carried out by the same person or team lacking an institutional division of the functional roles. The functional relatedness of entrepreneurship and management is also described by Timmons in "Converging on the Entrepreneurial Manager". According to his literature review, the leader of a new venture can be titled an entrepreneurial manager and has to fulfill special entrepreneurial and managerial tasks.⁶⁸ An analysis of the managerial literature provides as well strong indications of the close relation of entrepreneurial and management tasks. *Penrose, E.T., 1996* presents a close functional understanding of entrepreneurs and management.⁶⁹ The concept of *Stevenson, H.H. and Jarillo, J.C., 1990* understands entrepreneurial management as processes, methods, and styles which established companies need to realize in order to act entrepreneurially.

From a process perspective, a wide-spread assumption is that early stages of a company require different competencies from the founders than heading a more established firm due to the different tasks that need to be fulfilled. If founders lack the competencies of managers and they are unable to acquire the different skill-set fast enough they would limit firm development.

Rubenson, G.C. and Gupta, A.K., 1997 investigate three shifts in the development of a company which have implications for the adequacy of entrepreneurs or managers to head a venture: First, a functional shift from creation-oriented activities to exploitation-oriented activities needs to be achieved. Second, founders need to change from passionate commitment to a more managerial approach of dispassionate objectivity. Third, managerial control needs to change. In early stages direct personal control is adequate, but in later stages executives need to introduce indirect impersonal control mechanism through organizational systems. However, their study showed that especially in slow-growing firms entrepreneurs are able to fulfill the management tasks as well. In the entrepreneurial process, entrepreneurs can develop to become managers. The authors illustrate that there is a functional shift in

⁶⁸ Timmons, J.A., 1999, 239-240.

⁶⁹ Penrose, E.T., 1996, 44-49.

the founding process with a gradual mix of entrepreneurial and management roles the executives carry out rather than a binary personal decision of a manager replacing a misfit entrepreneur.⁷⁰

By illustrating functional requirements from a process perspective the strict entrepreneurship and management divide seems questionable. The distinction between entrepreneurial and managerial functions must rather be understood as a gradual shift with a close interaction of both functions in the process. Since the entrepreneurial task begins before the founding of the firm with the scanning and identification of market opportunities, it precedes the management role, which commences within an established organization.

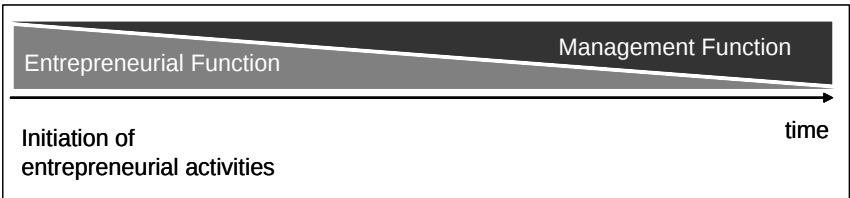


Fig. 3: Functional demands of the entrepreneurial process

Figure 3 illustrates the development of the two functions in a process model. Initially the founders are almost entirely fulfilling entrepreneurial functions, but with the establishment and growth of the organization management functions gain importance. Since their overall time capacity is limited the management functions replace their time allotment devoted to entrepreneurial roles. However, in theory and practice the distinction between tasks that are strictly entrepreneurial and other tasks which are purely managerial remains difficult.

Thus, from an institutional, functional, and process perspective, the separation of management and entrepreneurship appears uncertain. Instead, given the research goals of this investigation, it seems insightful to combine the scientific advances and

⁷⁰ Other studies also question the need for change from the entrepreneur to the manager being an either/or decision. Olson, P.D., 1985.

functional roles delineated by each research domain to gain a comprehensive understanding of the functions carried out by the executive team in NTBF and the competencies needed to fulfill them. This synthesis of the management and entrepreneurship areas has been demanded different times, but has hardly been pursued.⁷¹ This work will attempt to reduce this shortcoming by combining the insights of management research concerning competencies and the competence research of the entrepreneurial field. From an institutional perspective, the term management in this work is applied to refer to the executive level of the young companies. From a functional perspective, entrepreneurial management is conceived as an overarching concept combining entrepreneurial and classical management functions. From a process perspective, this study intends to understand the evolution of the entrepreneurial-management role in the development of NTBFs.

2.4 Competence

In the entrepreneurship literature, two major streams of research can be identified which investigate the characteristics of the founder or the executive team in young ventures. The first aims to identify success-related character-traits of the entrepreneur, while the second research stream intends to explain the success of the entrepreneurial companies based on competence oriented concepts.

The traits-oriented approach of entrepreneurship research uses character traits to explain the success of entrepreneurs and their ventures. Characteristics like “risk-taking propensity”, “locus of control”, “need for power”, “need for achievement”, “need for affiliation”, “need for autonomy”, “tolerance of ambiguity”, or “endurance” are popular traits, which are suspected to influence the decision of a person to create a venture and which are supposed to impact the development of the new firm in the process.⁷² Some of these traits-oriented studies illustrated a positive relationship between certain character-traits like a high need-for-achievement in combination with a moderate “need-for-power” and the success of the venture.⁷³ However, in general the findings in this area are contradictory and critically viewed.⁷⁴ Besides the lack of

⁷¹ Sadler-Smith, E., et al., 2003, 48; Katz, J.A., et al., 2000, 7; Röpcke, J., 2002, 173.

⁷² McClelland, D., 1961; McClelland, D. and Winter, D.G., 1969; Begley, T.M. and Boyd, D.P., 1986; Stewart, W.H.J., et al., 2003.

⁷³ Roberts, E.B., 1991a 256-259; Driessen, M.R. and Zwart, P.S., 1999 19-21.

⁷⁴ Begley, T.M. and Boyd, D.P., 1986; Brockhaus, R.H. and Horwitz, P.S., 1986 42-43; Herron, L., 1994, 19-23; Walter, A., et al., 2003, 685; Chandler, G.N. and Hanks, S.H., 1994, 77; Sapienza, H.J. and Grimm, C.M., 1997, 7.

precision and methodological weaknesses, it can be argued that the intended findings offer limited possibilities to improve the new venture management practice, since traits are defined to be attitudes or pre-dispositions of persons, which are fairly persistent and oftentimes can only be influenced with difficulty.⁷⁵

The competence approach of entrepreneurship is taking a broader perspective by investigating competencies as antecedents of venture success. The Latin term *competentia* carries a meaning of coincidence, legitimacy, appropriateness or adequacy and conveying a notion of fit.⁷⁶ Thus, competence can be regarded as the degree of fit between the ability requirements of a certain task and the corresponding abilities possessed.⁷⁷ *Boyatzis, R.E., 1982* conceives that "certain abilities or characteristics of the person that enable him to demonstrate appropriate actions can be called competencies."⁷⁸ In the entrepreneurship field *Man, T.W.Y., et al., 2002* understand competencies "(...) as higher level characteristics representing the ability of the entrepreneur to perform a job role successfully."⁷⁹

Inherent to most of the prominent definitions of competence is the reference to the potential of a person or a group.⁸⁰ In this light *Gutenberg, E., 1983* distinguishes between the realized and the latent aptitude. The realized aptitude is the part currently used for the work in a company. The latent aptitude is not used, but can be applied at any time. The latent aptitude also refers to the ability which can be obtained by training over time.⁸¹ In another conception *Becker, F., 1991* distinguishes between the current and the future qualification potential. According to his model the current potential consists of the qualifications currently applied in the present working position and the current latent potential, which is present, but not used. The future potential is the prospective ability which can be acquired by time through self- or externally initiated training efforts.⁸²

⁷⁵ *Herron, L., 1994, 11; Driessen, M.R. and Zwart, P.S., 1999.* However, there is also some literature delineating that traits do evolve over time and can be altered. E.g. *Lepisto, L., 1985; Ninot, G., et al., 2005.*

⁷⁶ *Erpenbeck, J. and von Rosenstiel, L., 2003a, von Krogh, G. and Roos, J., 1995, 62.*

⁷⁷ *Competencia (Latin)* refers to the conformity of skills and task. *von Krogh, G. and Roos, J., 1995.*

⁷⁸ *Boyatzis, R.E., 1982, 12.*

⁷⁹ *Man, T.W.Y., et al., 2002, 133.*

⁸⁰ E.g. *Boyatzis, R.E., 1982, 12; Loan-Clarke, J., et al., , 177; Stuart, R. and Lindsay, P., 1997, 28; Erpenbeck, J. and von Rosenstiel, L., 2003a, XI.*

⁸¹ *Gutenberg, E., 1983, 12-13.*

⁸² *Becker, F., 1991, 65-66.*

The investigation of competence development is a primary aim of this study. The term competence in this work refers to the actual potential, either realized or latent which will be assessed at different points in time. To avoid distortion effects a competence level which currently does not exist will not be included when assessing the competence sphere. The level of competence refers to the degree of fit of the abilities demanded by the task and the actual abilities present.⁸³ In this regard competencies are viewed as indirect success antecedents, which influence success-related activities.

According to *Pickett, L., 1998* competencies are "(...) the sum of our experiences and the knowledge, skills, values, and attitudes we have acquired during our lifetime."⁸⁴ These experiences consist in different forms. A common distinction refers to the environment they were obtained in. They can be either academic or practical experiences.⁸⁵ Major variables which influence the competence level are experience, training, education, family background, and other demographic factors.⁸⁶

Due to the popularity of competence concepts and a wide range of application there are many terms used synonymously inhibiting a precise understanding of competence.⁸⁷ A prominent related term is the concept of qualification. Qualification can be defined as positions of a mechanically demanded performance in test environments in form of knowledge and skill positions.⁸⁸ According to *Erpenbeck, J. and von Rosenstiel, L., 2003a* the main difference between competence and qualification is environment in which they are assessed. While competence is generally evaluated according to real-life or real-life simulations, qualifications are assessed in separate and standardized examination environments yielding certified outcomes of the present knowledge.⁸⁹ This illustrates the academic relatedness of qualifications. In turn, competence not only includes academically acquired knowledge, but reflects largely practical acquired skills and knowledge. Though there are some approaches to certify competence in the workplace, competence remains less standardized and

⁸³ Rowe proposes that competence manifests itself in two distinct states: competence and non-competence. *Rowe, C., 1995*. However, this investigation does not support this view. A competence concept as well as the measurement itself can be designed to allow a more detailed assessment. A corresponding concept and measurement model will be presented in the course of this work. This allows a better analysis than a dichotomous conception of competence.

⁸⁴ *Pickett, L., 1998, 103.*

⁸⁵ *Robotham, D. and Jubb, R., 1996.*

⁸⁶ *Man, T.W.Y., et al., 2002, 133; Herron, L. and Robinson, R.B.J., 1993; Bird, B., 1995.*

⁸⁷ *Robotham, D. and Jubb, R., 1996, 26f.*

⁸⁸ *Erpenbeck, J. and von Rosenstiel, L., 2003a, XI.*

⁸⁹ *Erpenbeck, J. and von Rosenstiel, L., 2003a, XI.*

certifiable.⁹⁰ Diverse managerial and organizational studies apply a range of terms for competencies such as management process, roles, skills, attributes, personal characteristics, and demands.⁹¹ Though a variety of different terms has been used, the term competence is now used more widely to refer to managerial requirements.⁹²

According to *Boyatzis, R.E., 1982*, 12 traits are also part of the competence space. Apparently, character-traits e.g. diligence, persistence, or self-confidence impact the activities of persons or groups and indicate success. Therefore traits are conceived to be part of competence.

Next to the oftentimes persistent traits, competence mainly embraces abilities which can be altered, developed, and trained.⁹³ Because competencies are assumed to determine the actions of management, they offer possibilities to improve the management process and eventually will influence the outcomes of management actions in the form of company success.⁹⁴ In this light, the competence approach entails advantages compared to the traits approach for educators and practitioners in the entrepreneurial field.

Assessing competence imposes certain difficulties due to the inwardly, partly latent, potential-oriented, and task-related nature of competence.⁹⁵ *Erpenbeck, J. and von Rosenstiel, L., 2003a*, XI assert that competence is always an attribution based on a judgment of the assessor. Due to the physical and mental self-organized actuation and behavior, the observer attributes a certain disposition in form of competence.⁹⁶ The authors view two extreme scientific notions with regards to the possibilities to assess competencies. On one side there are efforts to measure competence like natural sciences. Drawing from the advances in cognitive or social psychology, measurement theory and statistics, this study-approach intends to establish causal and statistically proven relationships. The search is focused on objective measurement procedures in the form of external assessments, thus, excluding self assessments. On the other side are research approaches which follow the paradigm that

⁹⁰ *Smith, A., et al., 1999*, 557. However, there are as well other authors who view close relationships between the qualification and competence concepts. *Gerig, V., 1998*, 83.

⁹¹ *Gilmore, A. and Carson, D., 1996*.

⁹² *Carson, D. and Gilmore, A., 2000*, 365.

⁹³ *Robotham, D. and Jubb, R., 1996*, 27; *Man, T.W.Y., et al., 2002*, 133.

⁹⁴ *Norburn, D. and Birley, S., 1988*, 225-226; *Man, T.W.Y., et al., 2002*, 133.

⁹⁵ *Robotham, D. and Jubb, R., 1996*; *Erpenbeck, J. and von Rosenstiel, L., 2003a*, XIX.

⁹⁶ *Erpenbeck, J. and von Rosenstiel, L., 2003a*, XI.

objectivity can not be achieved in social sciences. Inherent obstructions to objectivity exist in the domain of the assessed, the interaction between assessor and assessed, and the assessor himself.⁹⁷ These are characterized by perception biases, interference biases, and interpretation problems. The applied research methods of this domain are characterized by subjective competence description and evaluation techniques. Self-assessed and external evaluations attain equal importance.⁹⁸ This study reflects a position between the two extremes. While the intention is to develop a quantitative measurement model and to investigate causal relationships of competence with other domains, the inherent impossibility of objective competence evaluation is acknowledged. Still, the aim of this research is to provide a validated competence assessment.

2.5 Executive teams

In the business environment a managerial group is commonly referred to as a 'team'.⁹⁹ Especially on the executive level of a company the term team is applied, if the management consists of more than one individual.¹⁰⁰ But the plurality on the executive level is not sufficient to use the term team. Högl, M., 1998 and Wurst, K., 2001 propose the following five attributes to define a team:¹⁰¹

1. A social unit consisting of several individuals
2. who work face-to-face together over an extensive period of time
3. who have interdependent tasks and a common responsibility for the result of their work
4. who are active within an super-ordinate organization (context)
5. whose members can be identified as such from the outside and whose members perceive themselves as such (identity)

The minimum size of a team is disputable. Some authors believe that the minimum number should at least be three to allow the formation of coalitions and alliances within the team.¹⁰² Setting the minimum requirement to four would allow non-isolated

⁹⁷ Wunderer presents a variety of sources for misevaluations in the practitioner's field. Wunderer, R., 2000, 390-394.

⁹⁸ Erpenbeck, J. and von Rosenstiel, L., 2003a, XIX.

⁹⁹ Penrose, E.T., 1996, 46.

¹⁰⁰ Kamm, J.B., et al., 1990, 7; Watson, W.E., et al., 1995, 393; Wicher, H., 1994, 1003.

¹⁰¹ Wurst, K., 2001, 8; Högl, M., 1998, 10-12; Cohen, S.G. and Bailey, D.E., 1996, 4.

¹⁰² Högl, M., 1998, 10; Helfert, G., 1998.

minority fractions.¹⁰³ The researchers which include two-member groups in the team definition argue that complex social interactions exist already in a dyadic relationship considering as well interactions with persons or groups outside the team.¹⁰⁴ In this study the executive leaders of new ventures are the research objects.¹⁰⁵ Generally a new venture which is not lead by a single founder is headed by two to three persons.¹⁰⁶ Excluding two-member teams would severely limit the research field and disregard an important founding configuration. A qualitative difference exists between single-person and two-persons led companies due to communication, coordination, power-allocation, and knowledge sharing necessity to head the firm. The same fundamental difference does not apply to the differentiation between two and three person led ventures.¹⁰⁷ Accordingly, *Kamm, J.B., et al., 1990* define the founding team being "(...) two or more individuals who jointly establish a business in which they have an equity (financial) interest."¹⁰⁸ This work adopts this view by considering those configurations teams which at least consist of two persons.

Concerning the equity interest *Cooney, T.M. and O'Driscoll, A., 1999* argue that an equal equity share or an active participation in the founding process are not prerequisites of founding team members. They proclaim that persons should be considered team members, if their significant participation in the creation and development of the firm and their financial engagement occurred after the legal registration of the firm. Additionally, *Nathusius, K., 1994*, 13 stresses the responsibility for the formation of business goals and business management as well as the bearing of an entrepreneurial risk due to a personal financial engagement as constitutive elements for entrepreneurial team membership. This work does not specifically demand ownership rights as prerequisites for team-membership. Rather it is important that the executives who take the top level decisions also bear the risk involved in taking those decisions. However, in general this implies ownership status.

¹⁰³ Guzzo, R.A. and Shea, G.P., 1992, 272-273; Levine, J.M. and Moreland, R.L., 1990.

¹⁰⁴ Dreier, C., 2001, 23-27; Müller, T.A., 2003, 15.

¹⁰⁵ Other terms used referring to the executive team in a new firm are 'venture team' *Ochani, M., 1996* or 'founding team' or 'entrepreneurial founding team' *Ensley, M.D., 1997; Ensley, M.D., 1999; Teal, E.J., 1998*. In this study the terms top management team or executive team are predominantly used to refer to the group heading the new venture.

¹⁰⁶ Refer to chapter 6.2.

¹⁰⁷ *Watson, W.E., et al., 1995*, 397. For an analysis of the interaction within small groups refer to *Schneider, H.D., 1975*.

¹⁰⁸ *Kamm, J.B., et al., 1990*, 7; *Watson, W.E., et al., 1995*. In most studies the maximum limit of the team-size is numerically specified, but indicated by the terminus "face-to-face"-cooperation. Therefore teams exceeding 12 members are unlikely to work closely together, but will probably form sub-teams. *Högl, M., 1998*, 10-11; *Hackman, J.R., 1987*, 327; *Goodman, P.S., et al., 1986*, 16.

In total, the general requirements as well as the specific exigencies of founding teams demanded above are commonly met by the executive team of the new venture. According to the definition underlying this study, a top management team (TMT) is formed by those persons who collectively manage the new company, who take the decisions at the highest level of the company, and who bear the responsibility for those decisions.

3. Theories regarding entrepreneurial and management competencies and the development of new technology-based firms

After defining the basic concepts of this study, this chapter serves to discuss theoretical approaches which investigate 1) entrepreneurial management competencies in the context of young technological ventures, 2) new venture development models, and 3) the relationship between entrepreneurial management competencies and the development of NTBFs.

3.1 Development of the competence concept for new technology based firms

In the management literature, many works conceptualize competence of managers. However, the competence discussion in the entrepreneurship literature remains in its infancy. The division of the two research areas, as presented in chapter 2, has impeded the transfer of theoretical advances of the competence research in the management field to the entrepreneurship field. However, from an institutional, functional, and process perspective, the division hinders valuable insights. Therefore, this study specifically combines the two research areas. After deriving the basic domains of the competence concept in this chapter, it is further specified in the subsequent chapter.

The development of the competence construct proceeds in four steps: First, the present state of entrepreneurial competence concepts is presented. These concepts offer a first understanding of competence research in the entrepreneurial field. Second, the extensive management literature on competence is reviewed, which supplies a general structure for the conceptualization of competence. Third, other prerequisites of the founder's competence concept, which are demanded by entrepreneurship literature, are presented in order to enhance and detail the competence domains as well as to adopt the general competence dimensions to the exigencies of the entrepreneurial context. Fourth, an entrepreneurial-management competence concept is presented as a synthesis of both the management and the entrepreneurial research areas.

3.1.1 Competence concepts in entrepreneurship science

Following an extensive literature study, different works were encountered which investigate elements pertaining to the founder's competence space. Only few competence concepts, however, could be identified which specifically present a

comprehensive concept of competence.¹⁰⁹ This supports the assertion of *Driessen, M.R. and Zwart, P.S., 1999* that a comprehensive analysis of the contents of competence in the entrepreneurial domain, which could be the basis for competence evaluation and promotion, is scarcely intended.¹¹⁰ The few prominent competence concepts of entrepreneurship will be briefly illustrated before analyzing structural parallels among them.

Guiding their quantitative empirical study *Chandler, G.N. and Hanks, S.H., 1994* propose three roles of founders to lead a venture successfully. These are the entrepreneurial, the managerial and the technical-functional-role. The entrepreneurial role has two aspects: First, it is referring to the ability to recognize high-quality business opportunities in the market and to envision ways of taking advantage of these opportunities. Second, the entrepreneurial role is characterized by the "(...) drive to see firm creation through to fruition, which requires the willingness and capacity to generate intense effort for long, hard hours."¹¹¹ The managerial role is containing three dimensions. First, conceptual competence proposed as the mental ability to coordinate all organizational efforts. Second, human competence is distinguished which refers to the interaction with other people and groups. Third, the managerial role contains political competence which is defined as an ability to establish a power base and right connections within the organizational and extra-organizational network. The technical-functional role is not subdivided but conceived as the ability to use tools, procedures, and techniques of a specialized field. The required technical skills are determined by the industry in which the founders enter.¹¹²

¹⁰⁹ In order to obtain an understanding of the present state of research on competence in the entrepreneurial field literature databases have been investigated for terms like 'competence', 'competency', 'ability' etc. in connection with 'management', 'entrepreneur', 'founder' etc. Additionally prominent works of the entrepreneurial domain have been included in the search. In a second step the findings have been revised to extract those, which a) present discussions on the content of competence, which b) specifically refer to new ventures, which c) incorporate a sufficiently detailed explanation of the competence domains and which d) at least involve some theoretical or conceptual foundation. The condition of offering 'a sufficiently detailed explanation' was important, because the goal of this research step was to identify literature, which could support the development of a grid for structuring competence domains. Though different studies analyze elements of competence (e.g. *Walter, A., et al., 2003; Schefczyk, M. and Gerpott, T.J., 2000, 67; Szyperski, N. and Nathusius, K., 1977, 38-41; Brüderl, J., et al., 1996, 121-131; Olson, P.D., 1985, 25; Davidsson, P. and Honig, B., 2003, S. 302; Snell, R., Lau, A., 1994*), these studies do not primarily intend to conceptualize competence. They are reconsidered at a later stage to detail the understanding of the competence domains.

¹¹⁰ *Driessen, M.R. and Zwart, P.S., 1999; Röpcke, J., 2002; Herron, L., 1994, 28.*

¹¹¹ *Chandler, G.N. and Jansen, E., 1992, 225.*

¹¹² *Chandler, G.N. and Jansen, E., 1992, 225-226. Chandler, G.N. and Hanks, S.H., 1994* use the entrepreneurial and managerial competence as moderating constructs to assess the effects organizational resources and the quality of the business opportunity have on venture performance.

The conception of *Herron, L., 1994* presents seven dimensions to form his skill-model for profitable entrepreneurship. The first three skill domains are technical-based skills. They relate to skills for designing products and services, skills for controlling and evaluating organizations, and skills for acting within a certain industry milieu. Leadership and networking skill are two social skills identified. Additionally *Herron, L., 1994* adopts *Katz, R.L., 1974* administrative skill in the form of comprehensive and detailed planning as well as entrepreneurial skill referring to the conception of business opportunities.

The competence-approaches by *Snell, R., Lau, A., 1994* and *Man, T.W.Y., et al., 2002* are primarily empirically derived. *Snell, R., Lau, A., 1994* group competencies identified by entrepreneurs into eight competence domains. These eight competence domains are:

1. Readiness to seize relevant opportunities
2. Global-oriented outlook
3. Analytical market approach
4. Systematic financial management
5. Vivid vision/purpose/mission/dream for the company
6. Ability to conceptualize/formulate company strategy
7. Strategic approach to human resource development
8. Promoting a learning culture

The clustering of competence domains causes a diverse content of each domain. The diversity and roughness of the labeling might be illustrated by the contents forming the 'readiness to seize relevant opportunities'. This domain incorporates the adaptation to changes in circumstances, a pragmatic attitude, and flexibility in raising financial capital as well as the capitalization on good circumstances, while specifically excluding the capitalization on synergies in product/service synergies, the willingness to absorb information at the top or the formalization of market research.

The competence domains identified by *Man, T.W.Y., et al., 2002* in their meta-analysis of empirical entrepreneurial competence studies are the followings:

1. Opportunity competencies (recognizing and developing market opportunities)
2. Relationship competencies (social interactions with individuals or groups)
3. Conceptual competencies (e.g. analytic and decision skills, risk-taking and innovativeness)
4. Organizing competencies (organizing human, physical, financial and technological resources)
5. Strategic competencies (setting, evaluating and implementing the firm's strategies)
6. Commitment competencies (drive to move ahead with business)

According to the authors, these domains encompass all the competence areas which were identified in their underlying studies.

Obviously, the prevailing competence concepts of entrepreneurship research are diverse. Still, some central competence dimensions can be identified which are commonly presented. The three proposed dimensions, which reflect important competence domains for founders, are 'entrepreneurial', 'social' and 'functional' competencies.¹¹³ Table 1 presents an overview of the different constructs and their fit with these three basic competence dimensions. Due to lacking content specifications, not all of the presented competence contents can be classified into the three competence domains.¹¹⁴ Additionally, not all competence constructs cover all of these basic dimensions.

¹¹³ The differentiation of three competence dimensions follows from the entrepreneurial-management competence model which is developed in this work.

¹¹⁴ Most competence contents in the constructs presented above are only roughly outlined: Partly, only one item operationalizations are applied to specify them. See e.g. *Herron, L., 1994*.

Theoretical foundation

<i>Chandler, G.N. and Jansen, E., 1992</i>	Entrepreneurial Role • Ability to identify business-opportunities and to develop concepts which take advantage of these opportunities • Drive to make the venture succeed		Technical-Functional Role • Ability to apply instruments, procedures and techniques of a task area • Industry specific skills		Managerial Role • Conceptual competence, to coordinate interests and activities within an organization • Human competence to understand, motivate and cooperate with other persons • Political competence to improve the own position and to create a power base and networks			
<i>Herron, L., 1994</i>	Entrepre- neurial Skill Identification of profitable business opportunities	Administrative Skill Planning and administration of business activities	Technical Product/ Service Skill Detailed conception of products and services	Technical Organiza- tional Skill Evaluation of the functions within an organization	Technical Industry Skill Understanding of the industry and the impact of change	Networking Skill Influence persons outside of the organization	Leadership Skill Motivation / Inducement of the behavior of employees	
<i>Snell, R., Lau, A., 1994</i>	Global oriented outlook	Readiness to seize relevant opportunities	Vision, purpose, mission for the company	Ability to conceptualize/ formulate strategies	Analytical market approach	Systematic financial management	Strategic approach to HR-Management	Promotion of a learning culture
<i>Man, T.W.Y., et al., 2002</i>	Opportunity Competencies • Identification and development of business opportunities	Conceptual Competencies • Learning • Decision-making • Problem-solving • Sustain pressure • Innovation • Risk-taking	Strategic Competencies • Create visions • Goal-setting • Strategy-development	Commitment Competencies • Initiating • Act proactively	Organizing Competencies • Lead • Controlling • Monitoring • Organizing	Social Competencies • Communication • Convincing • Establish internal and external relationships		
	Entrepreneurial Competencies							
	Functional Competencies							
	Social Competencies							

Tab. 1: Competence concepts of entrepreneurship research

All of the entrepreneurship studies identify entrepreneurial and functional competence domains. The entrepreneurial domain covers activities like the identification and the selection of profitable business opportunities, the formulation of goals and strategies as well as attitudes of innovation, proactiveness, and commitment. Functional competencies can be further subdivided according to the area of knowledge into firm external and firm internal functional knowledge. External functional knowledge refers to knowledge concerning the market and industry in which the new venture intends to operate. Internal functional knowledge is primarily concerning task of organizing and administrating the diverse resources which are controlled by the firm as well as ability to develop products and services. The social competence domain is included in all concepts except the work of *Snell, R., Lau, A., 1994*. It comprises interaction skills of the founders with internal or external persons

or groups. In light of the present state of research, it must be asserted that the prevailing concepts entail three major shortcomings:

First, most of the presented works are lacking collective comprehensiveness of the competence domains and sub-domains. Snell/Lau entirely ignore the social skill domain, while *Man, T.W.Y., et al., 2002* present only a limited functional competence domain. *Herron, L., 1994* conceives the entrepreneurial role only in the form of identifying market opportunities, while leaving aside the initiative dimensions proposed by the other authors. Concerning the concept by *Herron, L., 1994*, doubts are raised whether the entrepreneurial skills entirely reflect the conceptual skills delineated by *Katz, R.L., 1974* which were conceived as general skills and not limited to the area of conceiving market opportunities.¹¹⁵

Second, the mutual exclusiveness of the different competence domains and sub-domains is questionable. *Man, T.W.Y., et al., 2002* define opportunity, conceptual, and strategic competencies. However, the identification of opportunities is difficult to differentiate from conceptual competencies like problem-solving and decision-making. The development of goals and visions also involves the identification of market opportunities. The entrepreneurial and managerial roles proposed by *Chandler, G.N. and Hanks, S.H., 1994* contain overlaps since the managerial role includes conceptual skills and the entrepreneurial role explicitly pertains conceiving opportunities. The formation of strategies in their concept is part of the entrepreneurial role, while in general management science this function is a task of management.¹¹⁶ A similar overlap can be perceived between the entrepreneurial and administrative skill domains described by *Herron, L., 1994*.

Third, the difficulties with the competence concept arise to a large extent from their vague and ad-hoc conception. The rationale which underlies their structures is hardly reported and theoretical references are fairly absent. The descriptions of the domains are only drafted or operationalized uni-dimensional.

¹¹⁵ *Herron, L., 1994* operationalizes his competence dimensions with one item. This hinders the interpretation of the dimensions. For a discussion on Katz's management skill concept refer to chapter 3.1.2.

¹¹⁶ *Ansoff, H.I., 1965; Bleicher, K., 1994; Porter, M.E., 2004; Eschenbach, R., 2003.*

Additionally, the brief descriptions and ad-hoc presentations neglect the insights of management science to a large extent.¹¹⁷ Only *Herron, L., 1994* and *Chandler, G.N. and Jansen, E., 1992* explicitly refer to approaches of competence in management research.

Overall, the presented studies of competence in the entrepreneurship literature offer a first understanding and a rough common structure, however, with various shortcomings. In order to enhance the quality of the competence concept applied in this research, further competence related literature of entrepreneurship and the extensive management literature on competence concepts will be reviewed.

3.1.2 Competence concepts in management literature

In the management literature, the theoretical investigation of competence has a long tradition.¹¹⁸ There are diverse streams of research and prominent theories which specifically address the relationship between competence-related input variables and performance-related output variables. Extensive literature dealing with competence concepts can be identified. These competence-oriented approaches intend to systematically structure the diverse competence contents into coherent constructs which allow competence evaluation and development. Table 2 presents an overview of major competence concepts mainly from German-speaking and Anglo-American research.¹¹⁹

¹¹⁷ For early works about management competence refer to *Katz, R.L., 1974* or *Dahrendorf, R., 1956*.

¹¹⁸ *Penrose, E.T., 1996; Dahrendorf, R., 1956; Gutenberg, E., 1983; Katz, R.L., 1974*.

¹¹⁹ While there is a vast number of other competence constructs, this illustration is believed to provide an adequate representation of the theoretical conception state. For further competence concepts refer to e.g. *Erpenbeck, J. and von Rosenstiel, L., 2003b*.

Authors	Functional competencies	Social competencies			Conceptual competencies			
Katz, R.L., 1974	Technical skills - Expert-knowledge - Special knowledge - Functional abilities - Specific tools and techniques in a discipline	Human Skills - Teamwork - Co-operation - Leadership - Personal development - empathy - communication			Conceptual Skills - Holistic thinking - Identification of complex relationships - Creativity - Reflecting interests - awareness of change - Impact assessment			
Dahrendorf, R., 1956	Functional skills - Functional Know-how - Expertise in an area	Extra-functional skills - Responsibility for resources and products - Meta-technical skill independent of functional domain						
Jeserich, W., 1981		Control of social processes	Expression skills		Systematic thinking		Activity	
Kotter, J.P., 1982		Network Building - development of internal and external relations - leadership of employees			Agenda Setting - goal setting - developing strategies - planning		Execution - Enforcement of agenda by using social networks, budgets etc.	
Thornton, G.C. and Byham, W.C., 1982	Technological Knowledge	Communications	Supervision	HR	Decision making	Understanding rules & systems	Management	External awareness and sensitivity
Szilagyi, A.D.J. and Schweiger, D.M., 1984	Knowledge skills - Knowledge in specific area - Functional knowledge	Integrative Skills - information analysis - teamwork - leadership - network relations			Administrative Skills - development of goals, strategies, priorities - create innovations - control and assure flexibility - create incentive systems			
Huber, A., 1992	Qualifications in an area	Social attributes			Cognitive skills	Personal skills		General-education
Meffert, H. and Wagner, H., 1992	Functional Skills	Social Skills			Conceptual skills			
Bunk, G.P., 1994	Functional competence - specific knowledge - expertise - job/task/industry related - job enlarging - firm specific	Social competence Inner personal: - enthusiasm - adaptability Inter personal: - cooperation - fairness - honesty - team-spirit			Methodical competence - variable work processes - problem solving - independent work - adaptability		Participation-competence - coordination - organization - combination - decision making - responsibility - leadership	
Thommen, J.-P., 1995	Functional competence - abilities related to the chain of value creation - specific knowledge	Social competence - autonomic and self-confident actuation - ability to cooperate - responsibility - development of a social system			System competence Understanding of - complexity - interdependence - dynamism		Methodical competence - Understanding of general business practices / processes - problem solving - decisional skills	

Authors	Functional competencies	Social competencies		Conceptual competencies	
Heyse, V. and Erpenbeck, J., 1997	Task/ methodical competence - Cost/benefit analysis - Innovation - Flexibility - Technology-orientation	Social competence - leadership - co-determination - employee orientation - Information - Communication - customer orientation - public relations - learning/education		Personal competence - mission - corporate culture - public appearance - image perceived by customers	Actuation competence (Problem solving competence) - ability to act in problematic and complex situations
Gerig, V., 1998	Functional qualifications - functional skills - technical skills - task specific skills	Social competence - self-esteem - communicational skills - interaction and cooperation skills - sensibility - conflict solving		Innovation-competence - creativity - scenario thinking - originality - problem-solving	Management competence - conceptual qualification - methodical qualification
Kauffeld, S. and Grote, S., 2002	Functional skills: Knowledge concerning: - the organization - procedures - machines - know-how references - relationships	Social competence - encouragement - mutual support - understanding - positive working environment - mutual responsibility		Self-competence - embracing change - responsibility - willingness to design - planning of implementation - proactiveness	Methodical competence - structuring - priorities - task sharing - time management
Jeserich, W., 2000	Functional skills	Social competence - cooperation	Intrapersonal competence - image development - actuation - resilience - self-esteem	Conceptual and planning competence way of doing the work	Activity, achievement/ leadership-orientation - activity level - self-motivation - enforcement skills
Grunwald, W., 2000	Functional qualification - know-how/ methods of an area - work-experience in an area - Initiative to learn in an area	Communication qualification - inner state - development of own personality - inter personal relationships	Social responsibility - human ethics - corporate ethics - leadership ethics	Conceptual qualification - complex thinking - strategic thinking - prioritizing - dealing with insecurity - future orientation	Methodical qualification - individual methods of working - decision skills - creativity techniques - team work techniques
Salomo, S., 2001	Functional competence - functional skills - know-how - expertise - firm-specific knowledge	Social competence - ways of actuation - communication abilities - willingness and ability to co-operate		Methodical competence - analytical skills - flexibility - information processing - conceptual skills	Actuation competence - decision making - dynamism - risk-taking
	Functional, social and conceptual related competencies				
	Actuation and execution related competencies				

Tab. 2: Competence oriented concepts of management science

Overall, the listed competence concepts incorporate different competence structures. In spite of these differences, a remarkable consensus can be identified. All works propose that general competence can be divided into a few, central competence domains. These competence domains¹²⁰ propose an umbrella for a variety of sub-competencies which fit in the respective domain.¹²¹ A prominent distinction is the division of competence into functional, social, and conceptual skills which Katz, R.L., 1974 proposed in 1955.¹²² In order to analyze the presented studies, this work follows the basic differentiation suggested by Katz, R.L., 1974. Almost all studies¹²³ separate functional from non-functional competencies.¹²⁴

Functional Competencies

The *functional competencies* refer to knowledge and domination of special methods, procedures, techniques, and practices in a certain area.¹²⁵ Other popular terms used in literature like 'technical skill', 'knowledge skill', or 'functional-area-competence' convey a common understanding. In general these terms refer to abilities which relate to a specific task or functional field within the company or which are industry-specific. Katz, R.L., 1974 defines the functional competence as an "understanding of, and proficiency in a specific kind of activity (...)".¹²⁶ In order to illustrate his definition he refers to the skills of a surgeon, a musician or accountant. The direct relationship of the ability to a very specialized task or area of activity is a fundamental characteristic of this type of competence. However, as the literature on competence proposes, functional competencies are not sufficient to successfully act in working environments due to the complex nature and social embedding of the working processes. Rather, further competencies are required to fulfill a job role successfully.

¹²⁰ Other terms used are "Types of Competencies" Boyatzis, R.E., 1982, 25 or "Competency Domains" Stuart, R. and Lindsay, P., 1997, 28.

¹²¹ Herron, L., 1994, 48; Touet, M., 1997, 80.

¹²² Katz, R.L., 1974.

¹²³ An exemption is Jeserich, who does not refer to functional skills Jeserich, W., 1981.

¹²⁴ A wide-spread synonym for labeling functional competence is technical skill. Katz, R.L., 1974, 91. In this light it is obvious that the task-related competence is just a part of the overall competence and can not be applied synonymously for competence.

¹²⁵ Gerig, V., 1998, 86.

¹²⁶ Katz, R.L., 1974, 91.

General Competencies

The *general competencies*, which are also labeled key competencies¹²⁷ or extra-functional skills,¹²⁸ represent the entirety of all abilities, which do not belong to the functional domain.¹²⁹ Contrary to the functional competencies they do not refer exclusively to certain processes, but can be applied across functions, tasks or contexts. While a commonly accepted categorization does not exist, the general competencies mainly incorporate social and conceptual ability domains.

Social Competence

*Social competence*¹³⁰ designates the ability of a person to interact effectively with other persons. Katz, R.L., 1974, 91 highlights the ability to cooperate in a team as well as the ability to lead in a managerial function as important task-domains, which he labels 'human skill'. The 'integrative skills' termed by Szilagyi, A.D.J. and Schweiger, D.M., 1984 present a broader understanding. Next to the interaction with persons, they include the processing of information and extend the perspective to include networking partners who are external to the firm. According to Thommen, J.-P., 1995, the social competence encompasses the development of a personality as well as the ability to act jointly, to bear responsibility and develop the social system. However, this broad definition is not generally accepted. Though the development of a personality is closely related to social competence, the term social competence refers to an interaction between persons or groups. The internally orientated development of a person's character or personality does not meet this criterion.

Conceptual Competence

Next to the functional and social competencies, the managerial competence research delineates another competence area. Abilities in this domain are termed conceptual, holistic, reflecting, strategic, goal-forming, prioritizing, and methodical. If conception is

¹²⁷ The term key competence the most prominent term to label these skills. However, because it conveys a normative connotation the term, general competencies is given preference in this work.

¹²⁸ Dahrendorf, R., 1956, 549-451.

¹²⁹ Klein, R. and Körzel, R., 1993, 158; Gerig, V., 1998, 85; Touet, M., 1997, 82-85; Rummier, H.-M., 1991, 31-33. Authors distinguish between general and specific human capital. General capital refers to overall education and practical experiences. Specific human capital refers to the education and practical experiences with a limited scope of application. Dimov, D.P. and Shepherd, D.A., 2005; Gimeno, J., et al., 1997. Thus, the basic distinction between general and specific abilities is similar, but not equal. It has to be noted that the general competencies in this work are related to an overall task of heading the venture, but not to specific functional domains or sub-tasks. The general competencies in human capital approaches are broader in concept, since they are not necessarily supposed to relate to the task of founding and/or managing a business. Dimov, D.P. and Shepherd, D.A., 2005, 7.

¹³⁰ Gerig, V., 1998, 232 proposes social skills.

defined as a 'mental plan, these abilities can be subsumed under the term '*conceptual competence*'.

In addition to the three delineated prominent competence dimensions, some authors identify other competence fields which go beyond the presented systematic. In this regard 'execution' (Kotter, J.P., 1982), 'activity' (Jeserich, W., 1981; Salomo, S., 2001), 'participation' (Bunk, G.P., 1994), and 'actuation' (Heyse, V. and Erpenbeck, J., 1997) are forming an additional competence domain. These competence areas differ from the presented areas since they focus on the incentive or the ability to act which is linked to the conception sphere. In a process analysis these action-focused abilities follow conceptual skills.

Additionally, some approaches to managerial ability highlight the innovation domain as a specific and important competence area. Gerig, V., 1998 explicitly defines the ability to innovate as a prerequisite for entrepreneurial actuation within an established organization. However, this domain entails different intersections with the wide spanning conceptual competence sphere which has been presented by other authors.¹³¹ Because it is an aim of this work to develop the competence concept for new technology-based firms, the innovation domain gains special relevance. This becomes apparent when considering additional competence related requirements which are proposed by the entrepreneurship literature.

3.1.3 Additional competence requirements demanded by entrepreneurship science

The presented competence concepts of the entrepreneurial and managerial field provide a fundamental structure to organize the different competence domains and capture the complex phenomenon of competence. However, beyond these concepts, the entrepreneurship literature offers further theoretical insights into competencies required for entrepreneurship. In this light, the following review intends to identify additional competence related requirements and to specify the content of the competence domains outlined above. Thereby the general framework of managerial competence is adapted to the specific requirements of the entrepreneurial task.

¹³¹ Szilagyi, A.D.J. and Schweiger, D.M., 1984 identifies the ability to innovate, Katz, R.L., 1974 demands creative skills, and Grunwald, W., 2000 suggests techniques for creativity.

Since the origin of entrepreneurial study, the entrepreneur, his/her attributes and his/her function have been investigated.¹³² Depending on the approach, the entrepreneur was classically treated as a person who assumes certain risks (Cantillon, Liefmann), who employs capital (Turgot, Smith, Marx), who combines factors of production and resources (Say, Rodbertus, Walras, Clark, Hawley, Brentano), who strives for profits (Mataja), who is a "captain of industry" (Walker, Marshall, Sombart, Pohle) or who is delivering innovations to the market (Schumpeter).¹³³ Especially, the concept of *Schumpeter, J., 1993* impacts current research profoundly.¹³⁴

According to *Schumpeter, J., 1993* the entrepreneur is the driving force of the development of economies. In his concept of 'creative destruction' he envisaged the entrepreneurial function as a disruption of established market structures through the introduction of new combinations to the market. The entrepreneur loses his essential characteristic of entrepreneurial innovativeness, when he heads his business in a circular manner. The person then should be considered an administrator.¹³⁵ The invention function precedes the innovation function of the entrepreneur and has to be differentiated. The entrepreneurial function does not concern the invention. It is focused on bringing the existing knowledge to life and into the market.¹³⁶ In order to deliver the innovations to the market, the entrepreneur has to overcome several internal and external resistances. Thus, the entrepreneur has to have certain abilities. *Schumpeter, J., 1946* asserts that "to navigate confidently outside the fairway demands abilities, which are just possessed by a small fraction of the whole population and which constitute the entrepreneur as well as the entrepreneurial function."¹³⁷ The demanded implementation or enforcement competence – being a critical competence for entrepreneurs – has been adopted by the current entrepreneurship literature in concepts like 'entrepreneurial posture' or 'entrepreneurial orientation'.¹³⁸

¹³² Konrad, E.D., 2000, 28.

¹³³ Turin, G., 1947.

¹³⁴ Gerig, V., 1998, 38; Hauschildt, J., 2004; Bygrave, W.D. and Hofer, C.W., 1991, 14.

¹³⁵ Schumpeter, J., 1912, 127; Faltn, G., 1999, 2.

¹³⁶ Schumpeter, J., 1993, 128-129.

¹³⁷ Translation from German. Schumpeter, J., 1946, 215.

¹³⁸ Lumpkin, G.T. and Dess, G.G., 1996, 142; Wiklund, J., 1999, 37.

The concept of entrepreneurial orientation was developed by strategy-centered literature to distinguish a certain managerial approach for leading a company and analyzing its success implications.¹³⁹ Starting with eleven strategic dimensions *Miller, D., 1983* reduced the characteristics of an entrepreneurial firm to three critical dimensions: "[An entrepreneurial firm] (...) which engages in product market innovation, undertakes somewhat risky ventures, and is first to come up with 'proactive' innovations, beating competitors to the punch."¹⁴⁰ This understanding is adapted by the prominent works of *Covin, J.G. and Slevin, D.P., 1989* who assert an entrepreneurial strategic posture to those management practices which reflected the three dimensions of 'innovation', 'proactiveness', and 'risk-taking'.¹⁴¹ Different authors proclaim that these three dimensions constitute the central concept of entrepreneurship.¹⁴² Together with two additional characteristics 'autonomy' and 'competitive aggressiveness', which are reflected by the expression "beating competitors to the punch", these dimensions constitute the entrepreneurial orientation construct which has been extensively researched.¹⁴³

- (1) *Innovativeness* characterizes the divergence from existing and well-established practices and offerings in order to introduce new products, services and processes to the market. *Lumpkin, G.T. and Dess, G.G., 1996*, 142 define innovativeness as "(...) a firm's tendency to engage in and support new ideas, novelty, experimentation, and creative processes that may result in new products, services, or technological processes." There are several ways of classifying innovations. These can encompass technical, organizational, business related, or social innovations.¹⁴⁴ The extent to which a new solution departs from the current state-of-the art in a particular field is rated to the concept of 'degree of innovativeness'.¹⁴⁵
- (2) *Proactiveness* can be understood as the actuation based on anticipated developments. The proactive characteristic is displayed when, instead of a 'wait-and-see' approach, the subject actively pursues the identified

¹³⁹ Lumpkin, G.T. and Dess, G.G., 1996, 139.

¹⁴⁰ Miller, D., 1983, 771.

¹⁴¹ Covin, J.G. and Slevin, D.P., 1989; Covin, J.G. and Slevin, D.P., 1991, 10.

¹⁴² Morris, M.H. and Paul, G.W., 1987; Morris, M.H., et al., 2001, 4.

¹⁴³ Lumpkin, G.T. and Dess, G.G., 1996, 139; Lyon, D.W., et al., 2000.

¹⁴⁴ Hauschildt, J., 2004, 12-13.

¹⁴⁵ Schlaak, T.M., 1999; Hauschildt, J., 2004, 14-21.

business opportunities as soon as possible. In this light, the proactiveness expresses itself by a high degree of activity over a long period of time reflecting firmness and persistence in spite of possible setbacks. Furthermore, proactiveness is the focus to obtain a position of a forerunner and to enjoy the benefits of being 'first-to-market'.

- (3) *Autonomy* encompasses the willingness and ability to pursue the identified opportunities in an independent manner disregarding certain restrictions others might perceive. This does not imply that persons or teams who act autonomous do not evaluate their disposable resources or do not use network connections they are integrated in. Rather it highlights the self-directedness in the pursuit of opportunities and the ability to act free of stifling constraints.
- (4) The dimension of *Risk-Taking* refers to the inclination of a person, team or company to pursue promising alternatives though these might entail special risks and far-reaching consequences. The attitude should not be interpreted as disregard or ambiguous dealing with risks. Instead it conveys the notion of dealing with risks in an aware and rational way. Still, risk-takers confidentially assume risks if the expected rewards compensate fairly for the perceived risks.
- (5) The *Competitive Aggressiveness* dimension of the entrepreneurial orientation concept represents an attitude of challenging well-established competitors and directly focusing on their weakness in order to develop a competitive advantage in the market. Rather than to avoid competition and conflict, the aim of competitive aggressiveness is to undo competitors and outperform the rivals.

Jointly, these five factors express themselves in decision making activity, processes, practices, and reflect the specific strategic direction of a firm. According to Lumpkin, G.T. and Dess, G.G., 1996, 136 an entrepreneurial orientation is a prerequisite for the launch of a new venture. Since the dimensions of the entrepreneurial orientation

are closely related to competence, they provide additional indications of relevant competencies within the entrepreneurial domain.

3.1.4 Synthesis: entrepreneurial-management-competence

The management competence literature presents competence to consist of three fundamental domains: functional, social, and conceptual. Together with the actuation focused competencies delineated by some studies, these three domains form a comprehensive competence framework.¹⁴⁶ This general managerial competence framework has to be adapted to the entrepreneurial context. The entrepreneurial literature presents various insights on how to specify the general competence domains and how to constitute a comprehensive concept for the entrepreneurial field. In this light, tasks like the search, identification and development of business opportunities, the conception of visions, strategies and operational plans, the innovative function, risk-taking and the proactive pursuit of opportunities are proposed to comprise the core of entrepreneurship.¹⁴⁷ They should be reflected by competencies, which are relevant for the success of entrepreneurial teams. Thus, these issues complement and deepen the understanding of the conception and actuation related competencies. They can be summarized under a domain labeled general entrepreneurial competence. Accordingly, the entrepreneurial-management concept for NTBFs is defined to consist of three fundamental dimensions: functional, social, and general entrepreneurial competencies. Each of these basic domains can be split into central sub-domains (figure 4).

¹⁴⁶ The importance to develop a comprehensive competence concept for the entrepreneurial context is underlined by researchers proposing the 'Jack-of-all-trades' Lazear, E.P., 2002 or Carson, D. and Gilmore, A., 2000, 366.

¹⁴⁷ Refer also to Gemünden, H.G. and Konrad, E.D., 2000.

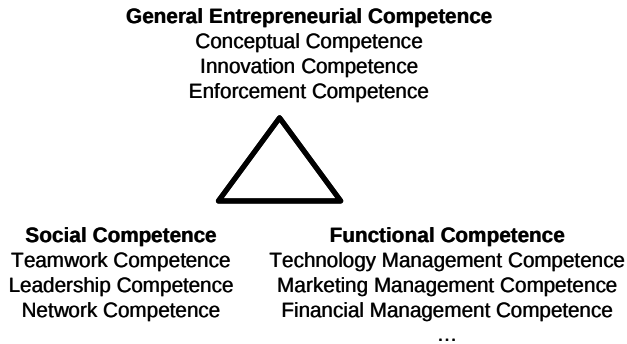


Fig. 4: Entrepreneurial-management-competence Domains

The functional competencies are relating to specific tasks in a certain field of action. The social competencies comprise abilities which are needed in the interaction with others. The general entrepreneurial competencies refer to the conception of innovative plans of action and the ability to implement those plans. The dimensions of this construct are specified in greater detail in the following chapter.

3.2 Specification of the entrepreneurial management construct

3.2.1 General entrepreneurial competencies

The general entrepreneurial competencies are constituted of fundamental elements of the conceptual and actuation oriented competencies. According to the entrepreneurship literature, both areas can be attributed to entrepreneurial activity. The hybrid understanding of entrepreneurial competence domains is reflected by Boyatzis empirical-based typology of managers who identifies a 'Goal and Action Management'-cluster, which is characterized by efficiency orientation, proactiveness, diagnostic use of concepts, and a concern for impact.¹⁴⁸ These two dimensions have to be enhanced by a third dimension, which is presented to be at the core of entrepreneurship: the ability to innovate. Together the three subdomains - conceptual, innovation and enforcement oriented abilities – constitute general entrepreneurial competencies (see figure 4). They reflect the ability to conceive a plan of action, to proactively pursue and enforce this plan and to give these planning and plan-enactment an innovative orientation. These three characteristics are also presented

¹⁴⁸ Boyatzis, R.E., 1982 94.

by three roles of entrepreneurial actuation. Accordingly, an entrepreneur has to be a problem-solver, a promoter, and a pioneer.¹⁴⁹

3.2.1.1 Conceptual competencies

The conceptual competence describes the ability to create business models, establish goals, strategies, priorities, and operational plans.¹⁵⁰ In general, it refers to the ability to systematically develop adequate solutions in light of complex challenges. With regard to firms, conceptual competence manifests itself in visions, strategies, and operational measures. The conceptual competence does not necessarily imply a high degree of innovativeness, but must be understood as a methodically structured and planned proceeding. *Kotter, J.P., 1999* labels this domain 'agenda setting'.¹⁵¹ Accordingly, *Smart, D.T. and Conant, J.S., 1994* define the conceptual competence as the "tendency to engage in strategic planning activities".¹⁵² The entrepreneurial skills defined by authors like *Chandler, G.N. and Jansen, E., 1992*, *Herron, L., 1994* or *Chandler, G.N. and Hanks, S.H., 1994* are related, but different. Their concept of entrepreneurial skill specifically includes the innovativeness. In the model presented here, innovativeness is a separate dimension. While plans can be systematically developed, they do not have to contain a high-degree of innovativeness. A systematically developed plan can state that it is advantageous to enter a market with an adaptive approach. Separating the planning style and the degree of innovativeness therefore offers more degrees of freedom in the analysis of competence.

Faltin, G., 1999, 7 proposes the stages of 'idea development' and 'idea refinement' in which a business model is developed systematically. The stage of the 'idea development' is characterized by the generation of promising business ideas and to broadening and enlarging them. The abilities needed to carry out this task belong to the innovation subdomain. In the stage of 'idea refinement', the developed innovative ideas undergo a critical reality check in order to identify problems and opportunities to improve the concept thereby transforming it from a business idea to a business model. The ability demanded for 'idea refinement' are assumed to be methodical and systematic therefore belonging to the conceptual domain.

¹⁴⁹ *Little, A.D., 1988* 64.

¹⁵⁰ *Faltin, G., 1999*, 7-9; *Eggers, J.H., 1999*, 77; *Bartlett, C.A. and Ghoshal, S., 1997*, 97.

¹⁵¹ *Kotter, J.P., 1999*, 148-149; *Kotter, J.P., 1982*.

¹⁵² However, the "ability to identify new opportunities" is part of a separate dimension in this work which is labeled innovation competence.

3.2.1.2 Innovation competencies

As presented above the innovative competence is not treated as a separate competence domain, but oftentimes implicitly included.¹⁵³ Still, in entrepreneurship research the importance of innovativeness as a separate dimension and core characteristic of entrepreneurship is highlighted.¹⁵⁴ It refers to the ability to choose and follow new, innovative ways of action. With regard to the business model, innovative competence will lead to an innovative orientation.¹⁵⁵ The pioneering role, which is characterized by divergent and unconventional thinking, imaginativeness, novelty and originality, includes innovative skills.¹⁵⁶ Because innovativeness implies a new combination of purpose and means, insecurity and risks concerning the new technology or new market are inherent issues of innovativeness. The degree of risk varies with the degree of innovativeness. Generally however, it can be claimed that innovative actions demand innovative skills including the ability to take up and sustain risky endeavors.¹⁵⁷ *Morris, M.H., et al., 2001* propose that entrepreneurship is not about taking extreme or uncontrollable risks, but to opt for manageable and calculated risks.¹⁵⁸ Additionally, the autonomy dimension of the entrepreneurial orientation concept reflects an integral part of innovative skills.

3.2.1.3 Enforcement competencies

The creation and systematic development of innovative business plans is not sufficient to encompass entrepreneurial behavior. In addition to the conception of innovative plans, it is necessary that those plans are implemented in order to speak of entrepreneurial actuation. Thus, enforcement competence represents another core part of entrepreneurial competence.

The definition of entrepreneurship by *Bygrave, W.D. and Hofer, C.W., 1991* presented in chapter 2.2 identifies the perception of an opportunity and the creation of an organization as two essential sides of entrepreneurship. The creation of an organization refers to the implementation dimension. Certainly, the implementation of an entrepreneurial business model demands more than just the formal creation of an

¹⁵³ Szilagyi, A.D.J. and Schweiger, D.M., 1984; Katz, R.L., 1974; Grunwald, W., 2000.

¹⁵⁴ Schumpeter, J., 1993.

¹⁵⁵ Mintzberg, H., 1989, 191; Bygrave, W.D., 1989, 10-11.

¹⁵⁶ Little, A.D., 1988, 64.

¹⁵⁷ Smart, D.T. and Conant, J.S., 1994; Lumpkin, G.T. and Dess, G.G., 1996.

¹⁵⁸ Morris, M.H., et al., 2001, 4.

organization. Especially the establishment of external relations with network-partners to create innovative means of production as well as innovative products and services represents a challenging task. In order to tackle the challenges and continue the efforts in spite of resistances and set-backs a special ability is needed, which is labeled enforcement competence. It refers as well to the initiative which is needed to enact a plan.¹⁵⁹

Besides the willingness to implement plans the enforcement dimension also encompasses the intensity of the actuation and assertiveness in the process of realizing plans in spite of the resistances which are encountered. Thus, the enforcement competence refers to the persistence which favors implementation. This component is reflected by the proactiveness dimension of the entrepreneurial orientation construct. It specifically states that proactiveness is not to wait for things to happen, but to take the initiative and make things happen.¹⁶⁰

Another characteristic of enforcement competence is captured by the 'competitive aggressiveness'-dimension of the entrepreneurial orientation. Affronting important competitors implies harder challenges and an increased level of persistence to overcome the competitive barriers. Overall, the enforcement competence encompasses abilities needed to initiate actions, to pursue identified business opportunities, and implement the plans in spite of diverse hindrances and set-backs, to manifest high levels of firmness and persistence, and not to be afraid of confrontations with established competitors.

3.2.2. Social competencies

Social competence refers to the ability of social interaction. At the centre of the ability of social interaction are information and communication competencies.¹⁶¹ Social competence facilitates constructive conflict solving¹⁶² and coordination of interaction partners to achieve intended goals. Mutual support can be another sign of social competence.¹⁶³ With regard to the social competence of executive teams in NTBFs three areas of interaction can be differentiated which imply specific competencies.

¹⁵⁹ Auer, M., 2000, 46 differentiates entrepreneurial activities of initializing, combining, and enforcing.

¹⁶⁰ Covin, J.G. and Slevin, D.P., 1989; Carson, D., et al., 1995, 159.

¹⁶¹ Gerig, V., 1998; Bunk, G.P., 1994.

¹⁶² Gerig, V., 1998.

¹⁶³ Kauffeld, S. and Grote, S., 2002.

The interaction of team members among themselves demands teamwork-competence; the interaction of the executive team members with other members of the firm depends on leadership competence while the interaction of the members of the team with persons or organizations outside the firm refers to network competence.¹⁶⁴ These three domains offer a comprehensive yet selective substructure of the overarching social competence sphere (see fig. 15).

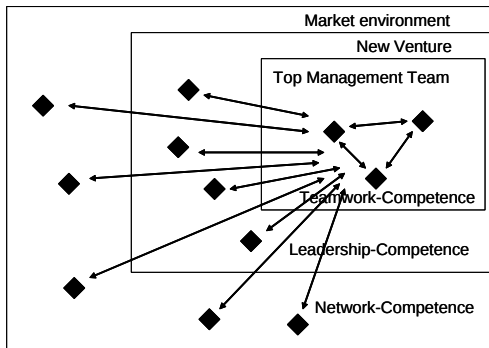


Fig. 5: Interaction partners and respective social competencies

3.2.2.1 Teamwork competencies

The definition of executive teams has been presented in chapter 2.5. Here central elements of the teamwork concept are drafted. Teamwork competence reflects the ability of a team to work together effectively and efficiently. The specification of teamwork-competence can be based upon the teamwork-quality construct.

Teamwork quality is a recognized concept of team-focused research and describes the quality of cooperation within a team.¹⁶⁵ Müller, T.A., 2003 defines that teamwork quality in entrepreneurial teams is determined by the quality of communication, the level of mutual support, close cooperation and precise coordination.¹⁶⁶ Additionally, conflict resolution, cohesion of the team members and equal sharing of tasks within the team are further well-established indicators of teamwork quality.¹⁶⁷ Thus, teamwork quality presents a teamwork-process conception. It refers to procedural

¹⁶⁴ A similar structure is presented by Szilagyi, A.D.J. and Schweiger, D.M., 1984.

¹⁶⁵ Drejer, A., 2000; Lechler, T. and Gemünden, H.G., 2002; Högl, M. and Gemünden, H.G., 2001; Müller, T.A., 2003.

¹⁶⁶ Müller, T.A., 2003, 112.

¹⁶⁷ These dimensions reflect the teamwork quality of R&D teams Högl, M. and Gemünden, H.G., 2001.

aspects of teamwork.¹⁶⁸ Marks, M.A., et al., 2001, 357 define team processes as the members' interdependent acts that convert inputs into outcomes through cognitive, verbal, and behavioral activities directed toward organizing task to achieve collective goals.

Closely related to the teamwork process, another teamwork dimension can be identified, which refers to emergent states within the team. These can be understood as fluid, evolving and context-dependent psychosocial states of the groups.¹⁶⁹ Sub-domains are trust, cohesion, affect, cognition, and potency.¹⁷⁰ These sub-domains are influenced by and influence the teamwork process. This is exemplified by a central concept of teamwork - trust.¹⁷¹ At an individual level, trust can be defined as a psychological state comprising the intention to accept vulnerability based on positive expectations of the intentions or behaviors of another.¹⁷² The degree of trust influences the communication, decision-making, conflict resolution, etc. of the team-members. In turn, positive team-working along the procedural dimensions builds trust. Thus, by focusing on the teamwork aspects, the emergent states within a team are reflected as well.

In sum, the procedural dimensions offer an understanding of the quality of the teamwork within the executive team. If team members possess the ability to perform adequately with regard to these dimensions, then this signals overall high teamwork competence. Because the procedural perspective is based on activities, dimensions of the teamwork quality construct imply competence requirements for the team-members, while the emergent states of teamwork can only be applied indirectly to illustrate competence requirements.

3.2.2.2 Leadership competencies

The social competence of the members of the executive team with members of the firm who do not belong to the team can be labeled leadership competence. Leadership competence generally implies a subordinate hierarchical relationship between the executive team members and the other firm members. An interaction with partners at the same hierarchical level refers to teamwork or network compe-

¹⁶⁸ Kiffin-Petersen, S., 2004, 40.

¹⁶⁹ Marks, M.A., et al., 2001, 358; Kiffin-Petersen, S., 2004, 39.

¹⁷⁰ Kiffin-Petersen, S., 2004, 40.

¹⁷¹ Kiffin-Petersen, S., 2004.

¹⁷² Rousseau, D.M., et al., 1998, 394.

tence depending on the degree and the closeness of interaction. Examples are interactions with members of the advisory board or company owners who do not participate actively in the management of the firm. If there is a close interaction between the executive team and the partners inside the firm, e.g. like the closely involved advisory board, then the competence of interaction needed is reflected by teamwork-competence. If the interaction form is loose, e.g. like it is the case with a scarcely involved supervisory board, the respective competence is rather covered by network competence.¹⁷³ Thus, leadership competence is the specific social competence which is characterized by the way of communication and interaction of the executive team with subordinate firm members.¹⁷⁴

The concept of leadership has various understandings.¹⁷⁵ It can be differentiated from related concepts like authority and social power.¹⁷⁶ As a result of a review of diverse leadership definitions Jago, A.G., 1982, 315, define leadership both as a process and as a property:

“The *process* of leadership is the use of non-coercive influence to direct and coordinate the activities of the members of an organized group toward the accomplishment of group objectives. As a *property*, leadership is the set of qualities or characteristics attributed to those who are perceived to successfully employ such influence.”

This definition and conception of leadership is adopted in this work. From a process perspective, leadership is indicated if the executive team is able to align the individual goals of the employees with the overall company goals.¹⁷⁷ If the executive team achieves these objectives, leadership competence is attributed to the team. This leadership concept focuses on the outcome of the activities to lead the employees. The approach is selected because it meets specifically the defined requirements. Other research on leadership focuses more on the activity dimension of leadership. This research aims to identify leadership styles like transactional or transformational leadership which characterize the competent leader. However, the findings of this

¹⁷³ Different types of supervisory boards are presented by Gerum, E., 1991.

¹⁷⁴ Kotter, J.P., 1982.

¹⁷⁵ Stogdill, R.M., 1974, 7; Baumgartel, H., 1957.

¹⁷⁶ Kochan, T.A., et al., 1975.

¹⁷⁷ Steinmann, H. and Schreyögg, G., 2000, 548; Scholz, C., 1991, 321.

research have been contradictory.¹⁷⁸ The effects of a certain leadership style might largely depend on a variety of context variables like the task, position, organizational factors or be gender specific.¹⁷⁹

Thus, the degree of achievement in influencing the employees in the intended way indicates leadership competence on a general level.¹⁸⁰ Along with the ability to coordinate the efforts of subordinates, leadership competence expresses itself by a positive attitude of the employees towards.¹⁸¹

3.2.2.3 Network competencies

In a social context, a network can be defined as a finite quantity of structurally dependent relationships between certain actors.¹⁸² In this study network competence refers to the ability of social interaction of the executive team with individuals or groups outside the organization.¹⁸³ These can be interactions with diverse stakeholders like other firms especially suppliers, distribution firms, research institutions, advisors, governmental support institutions etc.¹⁸⁴ Network competence can be defined as the ability to build, use, and develop networks by means of social interaction. Especially in young companies these activities are carried out by the executive team whose members are the interface to network partners like investors, technology or marketing-partners.¹⁸⁵ Klocke, B., 2004 illustrates how networks of NTBFs change from along with the primary tasks of the firm at different stages of firm development.¹⁸⁶

Networks of a firm can be classified along different dimensions. Popular distinctions are those regarding geographical extension (local, regional, national or international), its primary function (R&D networks, production networks, marketing networks, etc.), its formal strength (cooperation, alliances, joint-ventures, etc.) or participant characteristics (private vs. public networks, SMEs vs. large corporations, etc.).¹⁸⁷

¹⁷⁸ Chandler, G.N., 2000a; Jago, A.G., 1982; Shea, C.M., 1999; Kuhnert, K.W. and Lewis, P., 1987.

¹⁷⁹ Jung, D.I. and B.J., A., 1999; Hersey, P. and Blanchard, K.H., 1982; Hopfe, M.W., 1970; Utecht, R.E. and Heier, W.D., 1976; Chapman, J.B., 1975; Gibson, C.B., 1995.

¹⁸⁰ Gerig, V., 1998, 255.

¹⁸¹ Mintzberg, H., 1973, 60 describes the role of leadership from the employee perspective: "The organization looks to its formal head for guidance and motivation."

¹⁸² Klocke, B., 2004, 45.

¹⁸³ Refer to Gemünden, H.G. and Ritter, T., 1997.

¹⁸⁴ Fombrun, J.C., 1982, 280 proposes that network actors can be any individuals or any form of aggregation of individuals like groups, organizations, communities, or even nations.

¹⁸⁵ Boyatzis, R.E., 1982, 155-156; Schefczyk, M. and Gerpott, T.J., 2000, 145.

¹⁸⁶ Also refer to Klocke, B., et al., 2003.

¹⁸⁷ E.g. Klocke, B., 2004, 41-42; Human, S.E. and Provan, K.G., 1997; Osborn, R.N. and Hagedoorn, J., 1997.

In order to specify the contents of network competence, the well-established network competence construct can be used.¹⁸⁸ While it was developed for an assessment of the networking ability at the company-level, it as well can be applied to the executive-team-level. *Ritter, T., et al., 2002*, 120 define the degree of network competence as "(...) the degree of network management task execution and the degree of network management qualification possessed by the people handling a company's relationships." This definition illustrates that conceptually network competence according to *Gemünden, H.G. and Ritter, T., 1997* is characterized by two elements: First, it refers to the qualification level of the executive team with regards to the management of networks. Second, it describes the actual configuration and use of the firm's network.¹⁸⁹

3.2.3 Functional competencies

The third dimension of the entrepreneurial-management competence construct is formed by functional competencies.¹⁹⁰ A variety of relevant functional competencies can be identified, depending e.g. on the industry, business-model or strategic orientation. They encompass task or function-specific abilities, which are also labeled "specialized knowledge".¹⁹¹

The functional competencies can be structured in different ways. Functional structures could be based e.g. on classical functional units of the organization, the corporate cube developed by *Steinle, C. and Bruch, H., 2003*, or the value chain concept proposed by *Porter, M.E., 2004*. In order to exemplify a possibility of a comprehensive functional structuring Porter's prominent concept is used. Porter distinguishes fundamentally between primary and secondary functions or activities.¹⁹² The primary functions are directly involved in the value creation process. Those are inbound logistics, operations as well as marketing and sales. The secondary activities are not directly involved in value creation, but support it. The secondary functions are infrastructure, human resource management, technology development, and procurement. In order to comprehensively cover these areas, the executive team needs to possess competence in all of these areas.

¹⁸⁸ *Gemünden, H.G. and Ritter, T., 1997; Ritter, T., 1999; Ritter, T., et al., 2002.*

¹⁸⁹ *Ritter, T., et al., 2002*, 120.

¹⁹⁰ *Boyatzis, R.E., 1982*, 17; *Hills, G.E. and LaForge, R.W., 1992*, 33-34.

¹⁹¹ *Boyatzis, R.E., 1982*, 27.

¹⁹² *Porter, M.E., 2004*.

Based on classical functions of production based companies, the relevant functional competencies could be divided according to finance and accounting, human-resources, procurement, logistics, production as well as sales and marketing.¹⁹³

Due to the multitude of functional competencies, it is almost impossible to thoroughly investigate all functional competencies in one study. Yet, not all of functional competencies have the same relevance. Thus, instead of including all possible functional competencies, it seems reasonable to focus on a selective set of central functional competencies and investigate those in detail.

The importance of functional competencies varies depending on diverse factors.¹⁹⁴ Young companies differentiate themselves with regards to the type of their goals, their industry, their size, and others. Relative to these characteristics, the importance of functional competencies changes.

As long as the organizations under investigation are 'for-profit' institutions, market-related activities are essential regardless of the specific business-model or strategy pursued. In this light, the marketing function always represents a central functional competence. Accordingly, *Narver, J.C. and Slater, S.F., 1990*, 21 and others provide strong indications that the market-orientation of a company positively affects the success of a firm.¹⁹⁵ Especially for NTBFs, market-related functions are important, because they have to establish themselves in the market – faced by the liability of newness.¹⁹⁶ Due to their limited resource assets, problems in marketing imply an imminent risk for them. A central characteristic of the markets in which the NTBFs operate is their dynamism. A market-oriented management as well as special marketing and sales abilities of the executive team in the new ventures are indispensable. Thus, the marketing competence represents a central functional competence area.

¹⁹³ Jost, P.-J., 2000, 460; Schierenbeck, H., 1998, 10.

¹⁹⁴ Meier, A., 1998, 31.

¹⁹⁵ Refer also to Day, G.S., 1992; Jaworski, B.J. and Kohli, A.K., 1993.

¹⁹⁶ Salomo, S., et al., 2003 illustrate in their study that market-orientation in highly innovative projects indicates success. Since highly innovative projects have several parallels to new venture settings, these findings underline the importance of market-related abilities.

In addition to the relevance of marketing, the entrepreneurial literature emphasizes the importance of a competent financial management for new ventures.¹⁹⁷ In a first step of the establishment of a new venture financial resources need to be acquired. In a second step these financial resources have to be put in use effectively and efficiently. Especially the development of high-technology products requires an increased amount of financial resources.¹⁹⁸ In order to assure adequate financial resources for the venture and a successful utilization of these financial resources, financial management skills are important requirements.¹⁹⁹ Besides this economic argument, the importance of financial management is underlined by legal requirements, which have to be met by young companies. The first paragraph of the German commercial law (HGB) attributes certain obligations to every person who is running a business.²⁰⁰ Among these is the obligation to provide proper accounting, an inventory statement, a profit/loss statement, and a balance sheet. Hence, the executive team is required to possess the respective competencies or acquire them externally. If the team relies on external financial management expertise, it still requires some financial knowledge to cooperate efficiently with the external financial management partners and to carry out controlling functions.

The third functional competence which is important is the technology management competence. In contrast to the marketing and financial management competence, the technology management competence may not be necessary for all new ventures. Still, the technology management competence is of special relevance when products and production-processes depend in large part on high-technology.²⁰¹ By definition this is the case in young technology-based ventures.²⁰² Underlying sciences like bio- or nanotechnology are characterized by rapid advances. In order to assure the ability to offer technological products and services, a well-functioning production chain, an up-to-date technological know-how, as well as technological management knowledge is indispensable. However, it has to be underlined that the technology management

¹⁹⁷ Brinckmann, J., et al., 2005. See also Roberts, E.B., 1991a, 347-348; Lussier, R.N. and Pfeifer, S., 2001, 231; Becherer, R.C. and Maurer, J.G., 1997, 55; Wupperfeld, U., 1993, 31-34; Rüggeberg, H., 1997, 115; Hisrich, R.D., 1992.

¹⁹⁸ Roberts, E.B., 1991a, 188.

¹⁹⁹ Ziegler, W., 1984.

²⁰⁰ HGB, 2005.

²⁰¹ McCarthy, D.J., et al., 1987, 315; Roberts, E.B., 1991a, 346.

²⁰² Refer to definition of NTBF in chapter 2.1.

competence is not referring to the degree of expertise in specific technological areas,²⁰³ but to the ability to manage vital activities in the technological field.

Based on these considerations marketing management, financial-management, and technological-management competence are selected to be central functional competence domains in the proposed concept of entrepreneurial-management-competence of the TMT in NTBF. Their relevance for the entrepreneurial context will be further investigated in chapter 5.3. First, however a clear concept of these functional competencies must be developed.

The conceptualization of these three functional competencies proceeds in two steps: a general structure of competence is presented first. Second, the specific content of this structure is illustrated with reference to literature of the respective functional domain.

An analysis of the competence-related literature shows that functional competencies are central management competencies.²⁰⁴ However, a systematic approach to structure functional competencies is lacking. In the marketing domain, some authors use competence-related concepts in empirical studies.²⁰⁵ However, these authors hardly propose a comprehensive yet selective conceptual framing. In general they focus on marketing-related key activities²⁰⁶ or measure marketing competence with a single output measure like 'market-share'²⁰⁷ or with a single input measure like 'advertising intensity'.²⁰⁸

In order to conceive a general structure for the functional competencies, two systematic approaches can be identified in management literature. The first holistic approach uses a hierarchical structure and differentiates normative, strategic, and operational domains. The second approach adopts a procedural perspective and classifies stages of managerial focus (e.g. analysis, planning, implementation, and control).

²⁰³ E.g. Walsh, S. and Linton, J.D., 2002 propose a technology competence concept for the semi-conductor industry.

²⁰⁴ All of the presented studies differentiate between functional competencies and other managerial competencies (refer to chapter 3.1).

²⁰⁵ Shipley, D., et al., 1998; Prasad, V.K., et al., 2001; Moorman, C. and Slotegraaf, R.J., 1999; Fahy, J., et al., 2000; Conant, J.S., et al., 1990.

²⁰⁶ Shipley, D., et al., 1998; Conant, J.S., et al., 1990.

²⁰⁷ Moorman, C. and Slotegraaf, R.J., 1999.

²⁰⁸ Kotabe, M., et al., 2002.

The holistic management approach which consists of a normative, strategic, and operational dimension can be attributed to the St. Galler school of thought.²⁰⁹ A fundamental assumption of this approach is that firms which operate in complex environments must adopt a holistic management understanding. Isolated activities in a single area are not sufficient to ensure a firm's survival. Three domains must be skillfully managed: the normative domain, the strategic domain, and the operational domain. The normative domain is dealing with and defining "(...) the overall purpose of the firm, with norms and rules, which are intended to ensure the ability of a firm to live and develop."²¹⁰ On the strategic management level ways to achieve the normative objectives are conceived. Strategic management implies long range planning.²¹¹ The vast strategic literature outlines different dimensions which need to be considered on the strategic level.²¹² Finally, the operational level refers to the implementation of strategies. Thus, the comprehensive St. Gallen approach suggests a structure of different hierarchical levels of managerial activity, each implying different competence requirements.

An alternative approach applied in diverse managerial settings is process oriented. While there is some difference about the exact labeling basic managerial processes are conceived to consist of analysis, planning, implementation, and control.²¹³ The term analysis refers to the gathering and interpretation of relevant information. In the planning stage goals are defined and strategies as well action plans are designed. In the next step plans are executed. The management cycle finalizes with the controlling of the management efforts. Again, the different tasks have competence implications.

The combination of these two fundamental management approaches yields a matrix which comprehensively identifies relevant activities and which can be applied to various functional areas (see figure 6). Each field in the matrix identifies competence

²⁰⁹ The St. Galler Management Model has evolved into a third generation. The origins of the St. Galler Management Model were laid by Hans Ulrich promoting a) a holistic approach in light of complexity, b) practical relevance of management theory, and c) the interaction of normative, strategic, and operational management levels. *Ulrich, H., 2001; Ulrich, H. and Krieg, W., 1973.* Other researchers have enhanced this concept. *Bleicher, K., 1994; Bleicher, K., 2004; Rüegg-Stürm, J., 2002.*

²¹⁰ *Bleicher, K., 1994, 73.*

²¹¹ *Leontiades, M., 1982, 46.*

²¹² Several major journals promote strategic thought e.g. Strategic Management Journal or Academy of Management publications.

²¹³ *Schierenbeck, H., 1998, 83.*

requirements. The adequacy of this matrix is highlighted by diverse functional concepts which largely draw on process or hierarchical understandings.²¹⁴ Thus, this matrix is a general guideline for the conceptualization of the functional competence domains in this study and is adopted according to the specific demands of each domain.

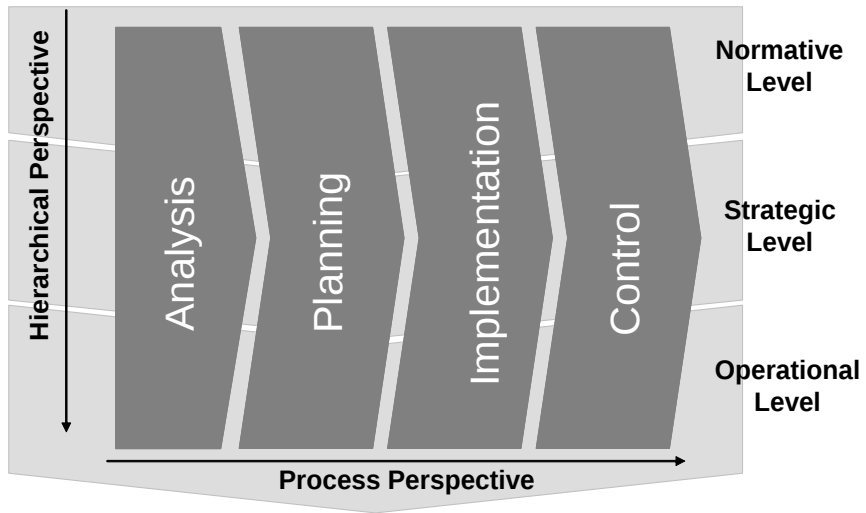


Fig. 6: Structure for the analysis of functional competencies

3.2.3.1 Technology management competencies

The term technology is of Greek origin and conveys a notion of procedure or method.²¹⁵ According to *Tschirky, H., 1990, 9*, technologies are special knowledge, skills, methods, and/or devices to utilize scientific relationships in the technical field.²¹⁶ Technology-management is the effort which is directed towards the creation and utilization of technologies in order to create and sustain a competitive advantage.²¹⁷

²¹⁴ Procedural conceptions of technology-management are presented by Kramer, Bullinger, Badawy, Brockhoff, McMillian/McGrath etc. Procedural conceptions of marketing-management are presented by *Meffert, H., 2000; Kotler, P., 1972, etc.* Procedural conceptions of financial management are presented by *Perridon/Steiner, Hauschildt, J., et al., 1981.* Hierarchical conceptions of technology-management are presented by *Tschirky, Luggen/Tschirky, etc.* Hierarchical conceptions of marketing-management are presented by *Nieschlag, R., et al., 2002, Bruhn, M., 2004, etc.* Hierarchical conceptions of financial-management are presented by *Hauschildt, J., et al., 1981.*

²¹⁵ *Zahn, E., 1995, 4.*

²¹⁶ Also refer to *Zahn, E., 1995, 4.*

²¹⁷ *Tschirky, H., 1990, 12-14.*

A related yet different concept of technology management is innovation management. Both are dedicated to ensure competitiveness. However, while innovation management is focused on novel technologies, technology management focuses also on those technologies which are not innovative.²¹⁸

The normative domain of technology management involves awareness about continuous technological change, acknowledging the importance of technology management for the welfare of ventures, anchoring technology management in the company's vision, mission, goals, and values as well as communicating these to employees.²¹⁹ However, most concepts of technology management lack the normative dimension.

Closely linked to the normative domain is the strategic approach to technology management. The strategic technology management is directed at safeguarding technological competitiveness.²²⁰ Fundamental strategic decisions concern the pursuit of different technology types e.g. product/process-technologies, key technologies, support technologies, or basic technologies.²²¹ Further strategic decisions concern how advances in these fields are to be exploited (e.g. by a leadership, follower, or co-operations-strategy). Strategic technology management involves as well the strategic questions of 'make or buy' or 'keep or sell'. Strategic technology management methods are e.g. technological road-mapping, scenario planning, SWOT-analysis.²²² In addition to a profound appreciation of the importance of technology-management the competent TMT needs abilities in formulating adequate strategies and abilities to use strategic tools.²²³

Strategic technology decisions should be based on an analysis of technology-related information. Luggen, 2004 calls this domain technological intelligence. It refers to the acquisition, preparation, interpretation, and distribution of information in the technological domain. Beyond the evaluation of the present situation, the TMT has to be able to evaluate future technological developments like opportunities and threats

²¹⁸ Hauschildt, J., 2004, 31.

²¹⁹ Luggen, M. and Savioz, P., 2003, 3-6. Luggen, M. and Tschirky, H., 2003, 38.

²²⁰ Hauschildt, J., 2004, 31-32.

²²¹ Luggen, M. and Savioz, P., 2003, 9; Tschirky, H., 1998, 294.

²²² Probert, D.R., et al., 2003.

²²³ Gemünden, H.G. and Heydebreck, P., 1995.

in the technological area. *Hauschildt, J., 2004* identifies the future-oriented tasks of technology-prognosis, technology evaluation, and an assessment of the technological consequences. *Rifkin, K.I., et al., 1999* highlight a central skills set for technical managers which refers to evaluating technical information for management purposes. The ability of the TMT to evaluate developments in the technological field is labeled competence in technological analysis.

Based on the technological analysis and strategy formulation, technologies need to be developed. This can either be achieved through internal and/or external development. Internal technological development is the creation of a technological potential through a firm's own resources, which is mainly done through technology development projects. The technological development takes place along two dimensions. First, technological development is aimed at developing a superior product. Second, the production process for this product needs to be established.

Building a technological potential inside the firm can also be achieved by external technological acquisition. In this context the term acquisition does not exclusively imply a monetary compensation. Examples of monetary forms of external technological acquisition are the buying of patents, licensing of technologies, or hiring persons with technological expertise. Other forms, which generally involve less money, are learning about technologies from workshops with customers or suppliers, learning at industrial fairs, or studying technology publications.²²⁴ Additional ways to increase the technological potential are through knowledge transfer from outside the firm, e.g. technological development co-operations with research institutions or companies.

After the creation of a technological potential comes the utilization of this potential. With regards to the actors involved in the utilization of the technological potential, three fundamental forms can be distinguished. These are internally oriented use of technology, externally oriented use of technology, and a joint use of technology. Internal use implies that the firm's members utilize the technology e.g. to improve the production process or to develop superior products. External use refers to actors outside the organization who make use of the firm's technology e.g. by licensing patents from the firm. Joint use represents intermediate forms; internal and external

²²⁴ *Isusi, I. and Corral, A., No Year.*

actors are involved in the commercialization of the technology. Typical forms are joint-ventures and alliances.

Another aspect of technology management that demands special abilities is the protection of the technology. There are two major risks concerning the loss of technological competitiveness. They can be distinguished by the human factor transfer involved. First, there is a risk that a NTBF's employee with specialized knowledge leaves the firm and either is employed by a competitor or engages in other markets. In either case, the NTBF loses technological potential. A second risk is that competitors gain access to a firm's technological potential without an employee transfer, e.g. by copying technological procedures or obtaining codified knowledge. If the TMT is competent in technological protection, it is aware of these risks and has procedures in place to reduce the risks. The development of protection measures to confront the risks reflects central abilities of technology protection. Accordingly, TMT should be able to bind key technological personnel to the firm, secure that technological knowledge is not exclusive to individuals who are at high risks of leaving the firm, and to protect technological potential legally, e.g. through patents or trade-marks. If the technology can not be legally protected or if the legal protection is not economical, the TMT must be familiar with procedures to assure a prudent handling of the technology.

Since the technological development process is complex, a thorough controlling is important. Technological controlling concerns the gathering and interpretation of information to support decision making in the technological domain. The aim of technology controlling is to ensure the accomplishment of the NTBFs technology related-goals on the normative, strategic, and operational level. *Luggen, M., 2004, 8* identifies two functions of technology management controlling in new ventures. The first function is to guarantee a clear project definition which is based on strategic management. Thus, in order to enable controlling, goals and processes to reach these goals need to be defined. The second function concerns the provision of an independent controlling system, e.g. through organizational routines, incentive systems, information systems.

3.2.3.2 Marketing management competencies

The popularity of the marketing field has caused a multitude of conceptions and definitions.²²⁵ According to the *American-Marketing-Association, 2006* "Marketing is an organizational function and a set of processes for creating, communicating, and delivering value to customers and for managing customer relationships in ways that benefit the organization and its stakeholders." Marketing management according to *Kotler, P. and Keller, K.L., 2006*, 6 is "(...) the art and science of choosing target markets and getting, keeping, and growing customers through creating, delivering, and communicating superior customer value." The marketing process consists of the analysis of market opportunities, the ascertainment and selection of target markets, the conception of marketing strategies, the planning of tactical marketing programs, as well as the organization, implementation, and controlling of marketing activities.²²⁶ In this study marketing competence consists of abilities concerning marketing research, normative/strategic marketing, transactional and relationship marketing.

The fundament of the marketing-management process is information.²²⁷ The objective of marketing research is to provide relevant information for decision making in the marketing area. In a comprehensive setting, it comprises internal and external information about the firm and its environment (customer, suppliers, distribution partners, public, media etc.).²²⁸ Central information aspects of marketing research concern the identification of chances and risks in the firm's environment, the discovery of strengths and weaknesses of the firm, information about possibilities to employ marketing instruments, and information about the market reactions to different marketing strategies and tactics.²²⁹

Similar to the technological domain, normative marketing management involves awareness about the continuous market change, acknowledging the importance of marketing management for the welfare of ventures, and anchoring the market-oriented values in a company's visions, missions, goals, culture, and identity.²³⁰ *Nieschlag, R., et al., 2002* propose that the normative task of management is to make

²²⁵ Kotler, P., 1972; Meffert, H., 2000; Nieschlag, R., et al., 2002; Coviello, N.E., et al., 2000; Fahy, J., et al., 2000; Morris, M.H., et al., 2001; Meier, A., 1998, 19.

²²⁶ Meffert, H., 2000, 13-15; Rüggeberg, H., 1997 20-21.

²²⁷ Kirchgeorg, M., 2001, 408.

²²⁸ Meffert, H., 2000, 28-31; Nieschlag, R., et al., 2002, 607.

²²⁹ Kirchgeorg, M., 2001, 408.

²³⁰ Luggen, M. and Savioz, P., 2003, 3-6. Luggen, M. and Tschirky, H., 2003, 38.

marketing a maxim of the firm.²³¹ Narver, J.C. and Slater, S.F., 1990 declare that market orientation encompasses customer and competitor orientation as well as the internal perspective of interfunctional coordination.²³² These dimensions highlight important focal objects of the marketing effort. Thus, marketing should be directed towards customers, competitors, and to the inside of a firm.²³³ On a normative level, a competent TMT will have an elevated level of awareness about the importance of marketing for the development of the firm, conceive business goals that reflect a marketing orientation, and communicate the market orientation internally and externally.

A firm's normative setting is the basis for a strategic marketing approach.²³⁴ Strategic marketing management involves long-term marketing decisions of utmost importance.²³⁵ Strategic marketing decisions primarily concern questions regarding the selection of markets, the definition of offerings, and the conception of ways to achieving a competitive advantage.²³⁶ Beyond these core decisions, a wide array of strategic choices exists which concerns the different participants in the market (buyer, competition, distribution partners etc.) and other stakeholders (governmental institutions, societal organizations etc.).²³⁷ Becker, J., 1998, 147-148 classifies various strategic choices in four groups: the market field (strategies relating to product-market combinations), market stimulation (strategies relating to way of acting in the market), market partialization (strategies relating to degree of differentiation of the marketing approach), and market-area (strategies relating to geographic extent of the marketing effort).

On an operational level, marketing management is primarily concerned with the coordination of the marketing mix.²³⁸ The marketing mix refers to the management of product, price, place, and promotion (four Ps of Marketing).²³⁹ The classical approach of transaction marketing is to configure these elements in order to present an

²³¹ Nieschlag, R., et al., 2002.

²³² Narver, J.C. and Slater, S.F., 1990, 21.

²³³ Other authors proclaim that the marketing effort has to be directed towards a wider range of stakeholders by illustrating a network or society marketing approach. Wiedmann, K.P., 1993; Achrol, R.A. and Kotler, P., 1999.

²³⁴ Becker, J., 1998, 137.

²³⁵ Scheuch, F., 1996, 124.

²³⁶ Meffert, H., 2000, 233; Becker, J., 1998, 147.

²³⁷ For a selection of strategic choices in the marketing domain refer to Meffert, H., 2000, 233-301.

²³⁸ Kirchgeorg, M., 2001, 408.

²³⁹ Kotler, P., n.y., 1964.

attractive value to the customer and foster the exchange of goods. Abilities in this domain are labeled transaction competence.

Current marketing approaches enhance the transactional approach by adding a relationship marketing dimension. Relationship marketing competence refers to the ability to develop relationships with the customers.²⁴⁰ In the context of new ventures, relationship marketing competence refers to abilities directed towards the initiation and strengthening of customer relationships.²⁴¹

3.2.3.3 Financial management competencies

The term finance refers to the monetary resources available to individuals or organizations and the management of these resources.²⁴² Financial management can be defined as "(...) the acquisition, management, and financing of resources for firms by means of money, with due regard for prices in external economic markets."²⁴³ In order to operate, a new venture needs to acquire resources and utilize these resources effectively and efficiently.²⁴⁴ The ability of managing the acquisition of financial resources, and of using them economically, is labeled financial management competence. Financial management competence is formed by a bundle of related skill areas. These include strategic financial management competence, competence in financing the venture, skills concerning the management of liquidity, and financial accounting skills. This conception is based on the financial management tasks of the treasurer (management of fund-flows and capital) and the controller (management of information flows, planning and control-process).²⁴⁵ Financial management includes normative, strategic, and operational financial management aspects. It incorporates also a procedural understanding as it proposes a financial management cycle to commence with planning activities, which are followed by the acquisition of funds, the subsequent management of these funds, and a final controlling of the financial management process.

²⁴⁰ Meffert, H., 2000, 25-26. In a broader sense relationship marketing addresses all internal and external stake-holders. Meffert, H., 2000, 25. The marketing paradigm evolved to competitive marketing, society marketing and network marketing. Wiedmann, K.P., 1993; Achrol, R.A. and Kotler, P., 1999. However, in the new venture context a prime focus of the marketing efforts on direct market partners appears to be more appropriate considering the limited resources of a new firm.

²⁴¹ Bruhn, M., 2001, 642.

²⁴² Pinches, G.E., 1992, 4.

²⁴³ Pinches, G.E., 1992, 4.

²⁴⁴ Brinckmann, J., et al., 2005.

²⁴⁵ Hauschildt, J., et al., 1981; Süchting, J., 1995, 4.

Similar to the other functional domains, strategic financial management involves the setting of long-term financial goals and the development and selection of strategies in the financial domain to achieve these goals.²⁴⁶ Walker, E.W., 1978 perceives that “the long-run goal of the finance function [for SMEs] is to assure management that it has the correct amount of each type of funds so that all other factors of production produce at their optimum.”²⁴⁷ Next to the liquidity dimension, financial goals can concern profitability, the level of assumed financial risk, the capital structure, the degree of financial dependence etc. The financial strategies of ventures are a function of its goals.²⁴⁸ They reflect the long-term plan about how to achieve the financial goals. Due to the unique nature of new ventures, financial strategies can be expected to diverge from the financial strategies followed by larger established companies. The bigger firms commonly have larger sources of finance and are less endangered by periods of losses.²⁴⁹

Based on the normative and strategic goals, the TMT has to evaluate the amount of financial resources needed and to acquire those financial resources. Financing has to assure that the amount of financial resources, the scheduling, and the cost of financing are in accordance with the strategic framework of the firm.²⁵⁰ Basic financing alternatives are internal and external financing.²⁵¹ Due to the time lag between product development expenses and first sales, the NTBFs generally have to rely on significant external funding. In Germany these are mainly bank loans and funds from governmental programs, while venture capital is a marginal phenomenon.²⁵² Thus, financing competence in NTBFs refers to the ability of managing the acquisition of financial resources under these specific circumstances.

Beyond the initial acquisition of financial resources, the TMT needs to assure a correct level of financial resources to avoid insolvency as a prime goal and to maximize the economic value as a secondary objective.²⁵³ This implies liquidity management. According to Gallinger, G.W. and Healey, P.B., 1991, 3 “(...) liquidity

²⁴⁶ Bierman, H.J., 1980 2-14.

²⁴⁷ Walker, E.W., 1978, 32.

²⁴⁸ Walker, E.W., 1978, 35.

²⁴⁹ Walker, E.W., 1978, 33-35 describes that strategic choices that imply periods of large losses are less viable for SMEs than for larger firms. At the same time strategies which mean more fluctuating profits might be more attractive for smaller private held firms than for large publicly traded corporations.

²⁵⁰ Eillenberger, G., 2003, 11.

²⁵¹ Peridon, L. and Steiner, M., 2002, XVIII-XIX.

²⁵² Maisberger, P., 1998.

²⁵³ Gallinger, G.W. and Healey, P.B., 1991, 6.

management is the allocation of liquid resources over time for payment of obligations due and for various investments that management undertakes to maximize shareholder wealth". Liquidity depends on the cash positions as well as the cash-flows in a respective period.²⁵⁴ Thus, the efficient management of cash-positions and cash-flows in the short, middle, and long term is reflecting liquidity management competence.

The term accounting refers to "(...) the preparation and communication to users of financial and economic information."²⁵⁵ This quantitative information is used for decision making for managers and external stakeholders. The accounting system can be understood as a part of an overall information system to "(...) record, classify, and summarize the financial information."²⁵⁶ Three accounting systems can be differentiated according to the target audience. First, financial accounting is mainly designed to assist the decision making of investors and creditors. Second, management accounting is aimed at facilitating the decision making of the management of a firm. Third, tax accounting primarily aims at fiscal institutions to determine the tax obligations.²⁵⁷ However, because investors' decisions as well as tax obligations affect the firm, all accounting systems are relevant for management decision making. The TMT of NTBFs has to be competent in all of these areas in order to make investment decisions, to obtain external funding, and to report their financial situation to fiscal authorities. Figure 7 depicts the three functional domains and their subdomains in an overview.

²⁵⁴ Walker, E.W., 1978, 82.

²⁵⁵ Meigs, R.F., et al., 1995, 4-5.

²⁵⁶ Diamond, M.A., 1996, 4.

²⁵⁷ Meigs, R.F., et al., 1995, 4-5.

	Financial-Management	Marketing-Management	Technology-Management
Focus	Finances	Market	Technology
Normative / Strategic-Level	Strive for financial competitiveness: • Norm./Strat. Financial Management	Strive for market competitiveness • Norm./Strat. Marketing Management	Strive for technological competitiveness • Norm./Strat. Technology Management
Operative-Level	• Financing • Liquidity Management • Accounting	• Market-Analysis • Transaction-Marketing • Relationship-Marketing	• Tech.-Analysis • Internal Tech. Development • Ext. Tech. acquisition • Tech. Protection • Tech. Utilization • Tech. Controlling

Fig. 7: Subdomains of the functional competencies

3.3 Theoretical approaches to the development of new firms

There is a widespread scientific notion that the life of a company follows a characteristic development in analogy to the biological life cycle.²⁵⁸ A large variety of models exist which intend to illustrate the early part of a firm's life.²⁵⁹ The theoretical modeling and especially the distinction of discrete stages are controversial.²⁶⁰ Major differences relate to 1) the linearity and order of the firm development process, 2) the comprehensiveness of the modeling, 3) origins and causes of the change in development characteristics, and 4) the methodology for conceiving the models:

1.) Characteristics of the firm's development process

The modeling of the development process proposes diverse challenges. A fundamental debate concerns the linearity of the development process.²⁶¹ While many authors believe that new ventures follow a generally linear and largely sequential process, others view the development rather like a marker-based, loop-like, or stochastic process.²⁶² Some models combine different

²⁵⁸ Kazanjian, R.K., 1988, 257.

²⁵⁹ For overviews of different development models refer to Montanari, J.R., et al., ; Meier, A., 1998; Klocke, B., 2004, 11-15; Hartl, M., 2001, 5-8; Rüggeberg, H., 1997, 11.

²⁶⁰ Montanari, J.R., et al., ; 59; Gartner, W.B., 1985; Hansen, E.L. and Bird, B.J., 1997.

²⁶¹ Reynolds, P. and Miller, B., 1992; Hansen, E.L. and Bird, B.J., 1997; Gartner, W.B., 1985.

²⁶² Hansen, E.L. and Bird, B.J., 1997, 111. Linear perceptions are presented by Galbraith, J., 1982; Kazanjian, R.K. and Drazin, R., 1990; Roure, J.B. and Keeley, R.H., 1990. Marker based understandings are represented by Hansen, E.L. and Bird,

approaches by incorporating stages, markers, and loop-like concepts.²⁶³ Different linear models incorporate different number of stages and different time lengths of the overall development period which is covered by the model.²⁶⁴ The number of the stages varies widely between three to more than five stages.²⁶⁵ The stages stretch from pre-founding stage to stages labeled maturity, rational administration, later growth, or decline.²⁶⁶ Overall, the empirical validation concerning the existence, the grouping of activities and the order presents substantial difficulties.²⁶⁷

2.) Comprehensiveness of modeling

In the literature about the development of the firm, there are general and partial models. The partial models focus on specific aspects of a firm's development. They are mainly related to functions or activities which are prime tasks at the relevant stage.²⁶⁸ These models formulate a largely chronological sequence of activities which new ventures have to pass through. The general models identify broad labels for a firm's development stage and use different domains to illustrate the stage. General models are presented by *Galbraith, J., 1982, Kazanjian, R.K. and Drazin, R., 1989, or Miller, D. and Friesen, P.H., 1984.*

3.) Causes of firm development

Many models lack theoretical explicitness on the causes of the proposed development.²⁶⁹ Other propose distinct causes for the development. *Chandler, A.D.J., 1962* and *Scott, B., 1970* identify the search for new growth opportunities as the central driver for change in development stages. Others scholars attribute the developmental advances to external factors like a change in industry structure.²⁷⁰ *Greiner, L.E., 1972* identifies the overcoming of crisis as a main driver for organizational advance.²⁷¹ In general, a close relationship be-

B.J., 1997 and Katz, J.A. and Gartner, W.B., 1988. Loop-like concepts are proposed by *Klocke, B., 2004.* Stochastic views are presented by *Gartner, W.B., 1985; Katz, J.A., 1993; Katz, J.A. and Gartner, W.B., 1988; Gersick, C., 1989; Reynolds, P. and Miller, B., 1992.*

²⁶³ *Klocke, B., 2004, Galbraith, J., 1982.*

²⁶⁴ The number of the stages varies widely between three to more than five stages. *Kazanjian, R.K. and Drazin, R., 1989, 1489.*

²⁶⁵ *Kazanjian, R.K. and Drazin, R., 1989, 1489.*

²⁶⁶ *Montanari, J.R., et al., n.y., 60.*

²⁶⁷ *Kazanjian, R.K. and Drazin, R., 1989; Klocke, B., 2004; Hansen, E.L. and Bird, B.J., 1997.*

²⁶⁸ *Hanks, S.H. and Chandler, G., 1994; Klocke, B., 2004, Montanari, J.R., et al., , Torbert, W.R., 1974.*

²⁶⁹ *Kazanjian, R.K., 1988, 258.*

²⁷⁰ *Moore, W.L. and Tushman, M.L., 1982; Channon, D., 1973.*

²⁷¹ *Greiner, L.E., 1972.*

tween the development stages and the logic explaining the causes for change can be observed. Many development models focus on prime activities in each development stage. They implicitly or explicitly propose the successful fulfillment of these tasks to be the main driver of advance.

4.) Methodology for conceiving the models

The methodology used to develop the models and their validation varies substantially. In different studies the process of theoretical development is not well documented. Other authors review a number of other works and extract their own development model based on theoretical arguments.²⁷² Some of these theoretically derived models are then validated by empirical evidence.²⁷³ The methodically most advanced models draw from different theoretical foundations and use qualitative as well as a quantitative empirical research approach to develop and validate their models.²⁷⁴ Their conceptual process can be best described by grounded theorizing.²⁷⁵

The variety of models and the ongoing controversy are due to the fact that the phenomenon of venture creation involves a vast variety of different types of ventures. These can be classified according to their founding background (e.g. independent ventures, spin-offs, or joint-ventures), the industries in which they are active (e.g. trading, service, or production-based businesses), or development goals and growth ambitions of their founders (e.g. self-sustaining business or 'born-globals'). Deriving one general development model which fits most of the new ventures and provides meaningful information appears impossible. Accordingly, reviewing development models *Gartner, W.B., 1985* observes an over-generalization of the founding process.²⁷⁶ Thus, in order to obtain a viable development model it is essential to focus on particular types of new ventures. This research is devoted to production-based high-technology companies which apply technologies that are closely related. Next, three development models are presented, which specifically focus on this respective type of founding. These serve to represent current theoretical approaches to new venture development. After a brief presentation and critical review of these

²⁷² Hanks, S.H. and Chandler, G., 1994; Quinn, R.E. and Cameron, K., 1983.

²⁷³ Miller, D. and Friesen, P.H., 1984; Hansen, E.L. and Bird, B.J., 1997.

²⁷⁴ Kazanjian, R.K., 1988; Klocke, B., 2004.

²⁷⁵ Glaser, B.G. and Strauss, A.L., 1967.

²⁷⁶ For similar critiques refer to Tornatzky, L.G., et al., 1983; Hansen, E.L. and Bird, B.J., 1997; Miller, D., 1981.

models, an extended model for the development of NTBFs based on one of these models is presented.

3.3.1 Galbraith stages of growth model

To capture the development of high-technology ventures *Galbraith, J., 1982* develops a model based on theoretical discussions and practical experience. He describes how functions are typically added as the venture evolves. Parallel to the functional development, central elements of the organization develop. These central elements are task, people, rewards, processes, structure, and leadership. The evolution of these areas is depicted in tab. 3. Five stages are identified.

	Proof of Principle / Prototype	Model Shop	Start-up Volume Production	Natural Growth	Strategic Maneuvering
Task	Invent and make it	Make it well & Test it	Make it and volume distribution	Make it profitable	Dominate a niche
People	„jack-of-all trades“ risk takers	Jacks and special risk takers	Specialists non-tech. start-up types	Business people; planners	Planners and strategists
Process	Informal; face to face	Informal; personal contact; meetings	Formal systems and procedures; budgets	Formal control; planning and budget; information systems	Five year planning, profit centers; multi-dimensional plan
Rewards	Equity; non-bureaucratic climate, make a mark	Nonbureaucratic climate, ground floor advancement	Ground floor advancement; career	Career, salary	Career, salary, bonus
Structure	Informal	Functions and hierarchy begin	Functional organization; Division of labor	Functional with overlays; Division of labor	Matrix; profit centre; decentralize
Leader	Quarterback	Player/Coach	Coach	Manager	Strategist
Nr. of Employees	1-5 20-30	< 100	> 100	-	-

Tab. 3: Galbraith Organization Development Model²⁷⁷

The first stage can be subdivided into two fairly similar stages. The first sub-stage is the proof of principle stage. The entrepreneur and technical partners are involved in R&D. The entrepreneur's intent is to develop a device or proprietary technology. In the second sub-stage the technological concept is transferred into a prototype and a production process is established. In the model-shop stage, the production process is

²⁷⁷ *Galbraith, J., 1982, 74.* The employee numbers were added based on the author's description.

working and different models are tested in the market. After the product has been improved, volume production initiates in the start-up stage. The firm transfers to the natural growth stage when it assumes the normal growth of the market. A primary goal in the natural growth stage is to make the venture profitable. The initial product is modified and second-generation products are launched. Ventures enter into an advanced stage when strategic maneuvering occurs. This refers to the choice and pursuit of strategic development directions in order to dominate a niche market. Possible strategic options are internationalization, entry in new national markets, or acquisitions of firms.

Parallel to the advance in focal tasks, all other factors of the organization evolve. The changes in these factors illustrate how the generalist abilities need to transform into functionally specialized competencies, while the organizations are adopting more formal control systems and functional divisions. Galbraight defines the early quarterback role of leadership as active doing, inventing, and team-leading. In later stages, leadership is characterized by typical management issues. In order to understand the model, it is important to reflect the development dynamics as highlighted by the number of employees. Only a tiny fraction of ventures can achieve these high-growth dynamics.²⁷⁸

3.3.2 Kazanjian stages of growth model

Kazanjian, R.K., 1988 develops his model of stages of growth based on two case studies and validates it with 105 venture capital backed NTBFs. The author distinguishes four development stages which new ventures traverse and categorizes the development with regards to primary tasks and organizational issues:

1. Conception and development

Main tasks of the first stage are product development, securing financial resources, and developing the market. This stage involves creating an organizational setting and task-group attributes.

²⁷⁸ Refer to chapter 6.2. Also refer to Müller, T.A., 2003; Klocke, B., 2004; Baier, W. and Pleschak, F., 1996.

2. Commercialization

The company has a product and first sales, but is not established in the market. Only at the end of the stage the product is publicly announced. The organization does not apply a functional division. Informal, direct communication and central leadership by few founders characterize the firm.

3. Growth

The firm experiences high sales and employment growth, while profitability is still a goal. Prime management tasks are the improvement of the production process, sale, and distribution process. A division of functions and formalization emerges.

4. Stability

The product offering is fundamentally overhauled. New product generations, product lines, and/or markets are entered. Securing new growth funding is a major task. The venture operates with formal structures, rules, and procedures.

The validation of his model, however, only supports stage one and three. The shift in tasks is only partially illustrated, as some tasks like strategic positioning or sales/marketing receive the highest valuations in all stages. Other tasks fluctuate but do not change their importance fundamentally in relation to the peer functions. The research indicates that stages are not tight nor discrete, but fluid with overlaps.²⁷⁹

3.3.3 Klocke model

The model of *Klocke, B., 2004* delineates firm development for ventures in the nanotechnology field. Following organizational learning theory,²⁸⁰ *Klocke, B., 2004* fundamentally distinguishes two sequential activity domains - exploration and exploitation. Exploration activities concern the discovering and gaining of new knowledge, while exploitation activities relate to the application of the knowledge in order to benefit from it.

²⁷⁹ Kazanjian, R.K., 1988, 279.

²⁸⁰ March, J.G., 1991; He, Z.L. and Wong, P.K., 2004; Rothaermel, F. and Deeds, D.L., 2004.

This fundamental distinction is then applied to technological as well as market-oriented activities. The author identifies specific activities in each of the technological and market-oriented activity domains. The two functional activity domains are linked to form a five stage process model which reflects the general development of nanotechnology companies (see fig. 8).

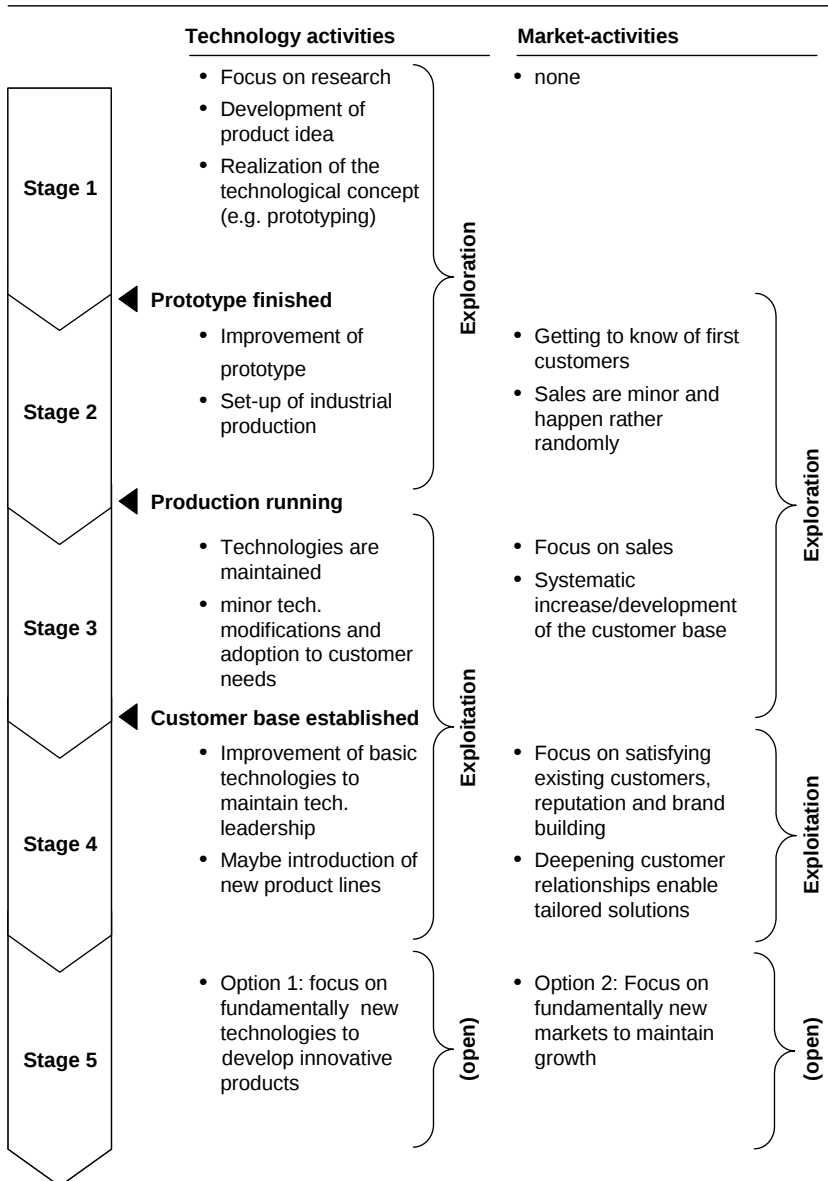


Fig. 8: Klocke Model of development stages²⁸¹

²⁸¹ Klocke, B., 2004, 119.

As presented in figure 8, the technological activities such as research and development, the conception of an innovative product-idea, and the transfer of the concept into a prototype precede initial marketing activities. With the development of a prototype, firms commence marketing research while setting up a production process. When the production process is running, the firms focus on acquiring customers. Once a customer base is established, technologies are reviewed and enhanced. The relationship with the customers is deepened and reputation-building gains importance. The companies enter a new stage when they focus on fundamentally new technologies and/or markets.

Three marker events are highlighted in the Klocke-model. These are the completion of a prototype, a running production process, and the establishment of a customer base. Two of the marker events gain special importance since they manifest the change from exploration to exploitation activities in the two functional domains. In the technology domain, the exploration stage changes to the exploitation stage with a functioning production process. In the market-related domain, the critical marker that divides exploration and exploitation activities is the establishment of a customer base.

The quantitative validation of the Klocke-model supports the finding of *Kazanjian, R.K., 1988* that certain activities remain constant. *Klocke, B., 2004* shows that exploration activities are not related to the development stage, while exploitation activities increase linearly with the firm's development.

3.3.4 Development concept for production based NTBFs

The three-stage models presented above share a common understanding that NTBFs generally follow a fairly predictable path that can be captured by a limited number of stages as depicted in tab. 4. This path leads them from basic R&D, prototype development, product and market-testing to commercial production and large scale marketing efforts. An inherent assumption is that technology ventures start with a single product offering that is enhanced by upgrades, product-differentiation or an introduction to new markets at advanced stages. All three models assume that ventures grow. The amount of this growth varies fundamentally. Galbraith's model applies only to firms with very strong employment growth. *Kazanjian, R.K., 1988* proclaims "(...) if a product is technically feasible and achieves

market acceptance, a period of high growth will typically result.”²⁸² His expected growth-financing-need reflects this assumption.²⁸³ *Klocke, B., 2004* is more moderate, because he focuses on qualitative aspects of activities which do not depend on high-growth assumptions.

	<i>Galbraith, J., 1982</i>	<i>Kazanjan, R.K., 1988</i>	<i>Klocke, B., 2004</i>
Fundamental process characteristics	5 stages (2 sub-stages in first stage)	4 stages	5 stages 3 marker events
Comprehensiveness of modeling	Prime tasks, type of people needed, Offered Rewards, Processes, Structure, Leadership Style	Focus on technology, market and financial activities as well as organizational characteristics	Focus on technology – and market related activities
Causes of firm development	Primary task, task-completion & Shift of focus	Primary task, task-completion & Shift of focus	Primary task, task-completion & Shift of focus
Research methods	Theoretical Qualitative (not specified)	Theoretical Qualitative (2 firms) Quantitative (105 firms) MANOVA, Factor Analysis	Theoretical Qualitative (18 firms) Quantitative (42 firms) Correlation/Regression
Technology	High-technology	Technology-based	Nano-technology
Assumptions	- Predicable growth pattern - Stages - Linearity of development - Single product base - Very high-growth assumption	- Predicable growth pattern - Stages - Linearity of development - Demand conditions are not limiting - Single product base - high-growth assumption	- Predicable growth pattern - Stages - Linearity of development - Single product base - moderate growth assumption

Tab. 4: Comparison of NTBFs development models

The validation of the models shows their limitations. These models refer to a standard development path. Yet, there might be firm developments that diverge from the suggested models. In practice, development stages might not necessarily be as distinct, especially when they combine different development dimensions. Some firms might advance faster in some dimensions in relation to their suggested peer stages.²⁸⁴ Combining the use of stage descriptions and the use of marker events can support classification. While *Kazanjan, R.K., 1988* and *Klocke, B., 2004* find evidence for developments that are not captured by their models, none of the authors

²⁸² *Kazanjan, R.K., 1988*, 264.

²⁸³ *Kazanjan, R.K., 1988*, 279.

²⁸⁴ *Kazanjan, R.K., 1988*, 276; *Kazanjan, R.K. and Drazin, R., 1989*, 1498; *Hansen, E.L. and Bird, B.J., 1997*, 111; *Miller, D. and Friesen, P.H., 1984*, 1161; *Miller, D., 1981*.

uses their quantitative research to evaluate if the proposed combination of activities reflects the most frequently represented configuration by measuring the dimensions separately.²⁸⁵ The number of dimensions of the presented models varies substantially. The central tasks all authors elucidate are technological and market-related. Additionally, *Kazanjian, R.K., 1988* introduces financing necessities. If the wide variety of firm developments in practice is to be integrated in one concept, the models have to focus on a very limited amount of dimensions.

It is expected that some NTBFs follow a standard development path, while others will diverge from the standard development. The standard development will evolve along technology and market-related activities which are proposed by all authors. The combination of these activities is expected to reflect the model presented and validated by *Klocke, B., 2004*. The Klocke model is selected, because it offers the most specific process model for companies in the technology fields. It can be used for all firms beyond high growth ventures. An additional advantage of the Klocke model is its theoretical grounding in learning theory. Competence and learning are closely related concepts, because an improvement of the competence level reflects the learning that took place. Thus, the theory underlying the Klocke model does integrate well in the theoretical framework of this study.

However, it is expected that many firms do not follow the standard path. The development activities are related, but do not necessarily evolve in the same way in all firms. Broader categories and specific marker events may be necessary to specifically categorize the NTBFs, to reflect a vast majority of firms, and to obtain specific insights about these firms.

Next to the technological and the market dimension which are captured by the Klocke model, a third functional dimension is added. This dimension refers to the task of obtaining financing. This dimension is present in the Kazanjian model. It also relates to the central competence domain of financial management competence. Thus, all three functional competencies have a corresponding domain in the development model.

²⁸⁵ Klocke uses an overall assessment of the adequacy of the combination of dimensions. Kazanjian does not test if an alternative combination of activities has a better fit with the data.

Parallel to the advance in marketing and technology, NTBFs explore and exploit the financing dimension. *Kazanjian, R.K., 1988* identified the early need to secure financing.²⁸⁶ However, first the NTBFs need to learn about their financing needs and different financing alternatives. After exploring possible financing alternatives, the executive team has to establish a relationship with financial partners.²⁸⁷ The executive team needs to prepare the venture for the financing community.²⁸⁸ Presentations need to be made in order to obtain financing.²⁸⁹ Financing partners might be reluctant to fund the very early stage, because the associated risk is higher.²⁹⁰ They might demand first results like a proof of concept in form of a functional prototype, first market contacts, and - favorably - initial sales. As the NTBF secures its financing, the volume production can be completed. Hence, the marker event of securing financing is expected to coincide with or slightly precede the market event of a running production process. The proceeds from the financing can then be used to support the production process completion and a strong sales effort. After the new firm has secured financial resources, it changes from exploration to exploitation activities. It then has to improve its investor relations and reporting practices.²⁹¹ Figure 9 presents the expected development.²⁹²

²⁸⁶ *Kazanjian, R.K., 1988.*

²⁸⁷ *Shane, S. and Cable, D., 2002.*

²⁸⁸ *Roberts, E.B., 1991b.*

²⁸⁹ *Hisrich, R.D. and Peters, M.P., 2002.*

²⁹⁰ *Deakins, D. and Hussain, G., 1994; Hisrich, R.D. and Peters, M.P., 2002.*

²⁹¹ *Cassar, G., 2004; Jain, B.A., 2001.*

²⁹² Next to the theoretical development the third dimensions the conception was based on interviews with team executives in NTBFs, academics experts and from personal consulting experiences.

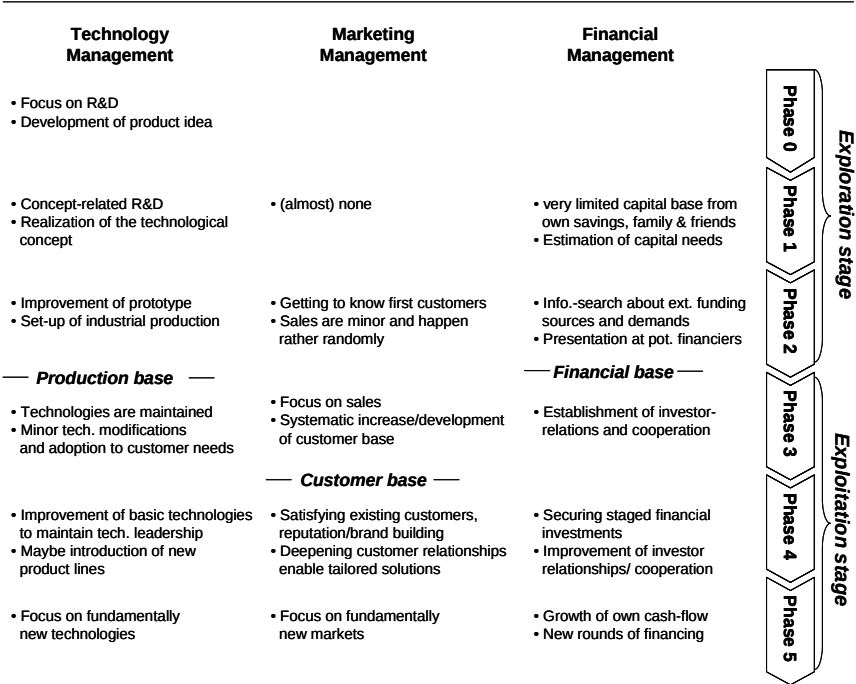


Fig. 9: Three dimensional development model of NTBFs

However, the financing dimension does not apply to all firms. Some ventures might be able to finance their development from cash-flow. Others might rely on very limited resources without the intention to raise external funds. Thus, the financing dimension does only apply to those NTBFs which seek external funding.²⁹³

3.4 Theories linking competence and the development of firms

The preceding discussion on the development of NTBFs illustrates that firms evolve in diverse ways. Many factors influence the development of ventures. Development is understood as progress in the status of the firm in accordance with the executive's goals. Thus, it is a broad concept comprising the organizational development as well as other success dimensions like technological advance, the market, or financing.

²⁹³ Refer to chapter 8.1.2.1.

This study proposes that the competence of the TMT is a central driver for this development.

The following theoretical approaches highlight the importance of abilities of management for the development of NTBFs. They depict how competence transforms into venture development. Figure 10 presents the four theoretical streams of arguments which are selected to explain the relationship between the entrepreneurial-management-competence and the development of the firms. These are the theory of the growth of the firm, the resource-based view of strategy, the dynamic capability approach, and the human-capital approach.

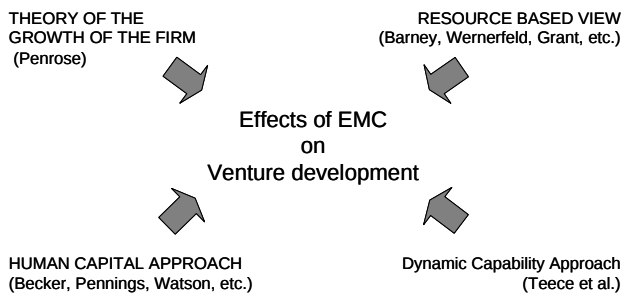


Fig. 10: Theoretical links between competence and venture development

3.4.1 Theory of the growth of the firm

A fundamental assumption of the theory of the growth of the firm is that a firm's growth does not occur automatically, but planning is necessary to conceive and execute expansion.²⁹⁴ This important task of business development planning is the work of the executive team in a company.²⁹⁵

Because "(...) there is plainly a physical maximum to the number of things any individual or group of individuals can do, there is clearly some sort of limit to (...) expansion."²⁹⁶ She argues that even if there would be an infinite number of profitable business opportunities, the executive team could not pursue all its perceived

²⁹⁴ Penrose, E. T., 1996.

²⁹⁵ Penrose, E. T., 1996, 44.

²⁹⁶ Penrose, E. T., 1996, 45.

opportunities, because the expansion efforts would require at least some form of knowledge and approval by the executive officials. Even the use of external managerial resources in form of consultants or advisors would absorb management capacity due to the information, direction, and coordination efforts necessary between the internal and external actors. In a dynamic perspective, *Penrose, E.T., 1996* determines two limiting managerial aspects. First, the existing managerial group limits the amount of expansion activity which can be planned at the any given time. Second, the amount of expansion activity limits the number of new managers who "(...) can be profitably absorbed in the next period."²⁹⁷ Thus, the growth potential of a firm is restricted by the managerial capacity of the founding executives of the firm.

Exceeding the growth limit imposed by the managerial limit, will question "(...) the very nature of the firm as an administrative and planning organization (...)".²⁹⁸ In consequence the disorganized expansion leads to inefficacies and inefficiencies, which might not be affordable due to market conditions. *Penrose, E.T., 1996* strongly emphasizes that "(...) a firm's managerial group plays a crucial role in the process of expansion, for the process by which the experience is gained is properly treated as a process creating new productive services to the firm."²⁹⁹ The extensive planning requires knowledge, confidence, and co-operation of the executive team members. Therefore, experience in working together is an essential part of leading business growth. Newly hired executives do not have this requisite experience.

There are diverse implications of the theory of the growth of the firm for the understanding of the relationship between top management competence and the development of the entrepreneurial venture.

First, the kind of acumen determining the managerial capacity is illustrated. It is not only an explicit form of knowledge, like information or factual knowledge, that is essential to management, but a largely implicit form of competence and business acumen gained through practical experience. Secondly, the theory expressively focuses on the team as a functioning unit, highlighting the complex interactions which occur in the learning process and which form the base of effective and efficient

²⁹⁷ *Penrose, E.T., 1996, 49.*

²⁹⁸ *Penrose, E.T., 1996, 45.*

²⁹⁹ *Penrose, E.T., 1996, 48.*

management. In this regard, the teamwork of the members is depicted as a crucial element. Third, the close relationship between competence and the areas of managerial activity is illustrated as a two-way interaction. On one side, competence enables activities in the respective field. On the other side, activities within a certain field may lead to the creation of managerial competence. A central element in this interaction is the planning function. Fourth, due to the dynamic analysis, Penrose delineates that already the entrepreneurial management capability at the founding of the company determines the path of development which can be pursued by the growing firm. Fifth, the concept provides strong theoretical support for the indirect and direct effects of the management capability on the success of a new company in the form of the firm's achievable growth rate.

3.4.2 Resource based view of the firm

The resource based view of the firm is building on the theories of *Penrose, E.T., 1996* and *Coase, R.H., 1937*.³⁰⁰ The basic notion underlying this approach is that sustained competitive advantage of companies and their survival depends on the uniqueness of the resources they control.³⁰¹ Resources are conceived to "(...) include all assets, capabilities, organizational processes, firm attributes, information, knowledge etc. controlled by a firm that enable the firm to conceive of and implement strategies that improve its efficiency and effectiveness."³⁰² *Barney, J., 1991* distinguishes three categories of resources which exist within a firm: physical capital resources, organizational capital resources, and human capital resources. "Human capital resources include training, experience, judgment, intelligence, relationships, and insight of individual managers and workers in a firm."³⁰³ The competence of the TMT in a new venture is part of the total human capital of a firm. It can create a sustainable advantage if it meets the four requirements of being valuable, rare, imperfectly imitable, and if it can not be substituted.

The competence of the executive management team in young companies fulfils these conditions. The executive team of a new firm formulates the venture's strategies and

³⁰⁰ *Riess, S., 1998, 100; Penrose, E.T., 1996; Coase, R.H., 1937.*

³⁰¹ *Barney, J., 1991; Wernerfelt, B., 1984; Peteraf, M.A., 1990; Dierickx, I. and Cool, K., 1989; Williams, J.R., 1992; Hall, R., 1992; Nelson, R.R. and Winter, D.G., 1982.*

³⁰² *Barney, J., 1991, 101.*

³⁰³ *Barney, J., 1991, 101.*

translates the strategy into day-to-day operations.³⁰⁴ This illustrates the executives' crucial part concerning the creation of competitive advantage. A lack of competence might hinder the formulation of adequate strategies and influence the effectiveness and efficiency of subsequent actions to creating a productive firm and provide better offerings.³⁰⁵ Thus, the degree of management competence in the entrepreneurial company will determine if the young company will achieve a sustainable competitive advantage.³⁰⁶ Clearly, the competence of the TMT is a rare resource, because the founders who establish their business are not available to competitors.³⁰⁷ Due to the individual characteristics of the executive team, it is impossible to imitate this human resource and its related organizational and extra-organizational ties. It also can be assumed that the resource 'management-capability' on the executive level can hardly be substituted by other resources.

Barney proposes that "One firm resource required in the implementations of almost all strategies is managerial talent."³⁰⁸ *Grant, R.M., 1996* and *Liebeskind, J.P., 1996* also stress the importance of managerial acumen specifically in the form of knowledge for a firm's success.³⁰⁹ They argue that knowledge is a resource of prime importance for success. *Spender, J.C., 1989* conceives two functions a firm must fulfill in order to obtain rents from knowledge: it must generate knowledge and it must apply the knowledge.³¹⁰ Thus, resource generation in the form of knowledge creation or learning is underlined as a productive process.

In order to specifically determine the effects resources have on a company's success *Peteraf, M.A., 1993* uses the Ricardian rent-approach³¹¹ to argue that superior resources create more efficiencies which yield lower costs structures. These lower cost structures in consequence generate earnings in excess of break-even rents. Supranormal profits can be used to further increase the resource stock, yielding increased profits in consecutive periods and propelling growth. If the managerial competence holds special importance for future rent generation, as proposed by

³⁰⁴ *Gemünden, H.G. and Konrad, E.D., 2000; Walter, A. and Gemünden, H.G., 2002.*

³⁰⁵ *Peteraf, M.A., 1993; Also refer to Salomo, S., 2001.*

³⁰⁶ *Gemünden, H.G. and Konrad, E.D., 2000.*

³⁰⁷ *Penrose, E.T., 1996, 47.* Penrose explicitly attributes "uniqueness" and "value" to the management-team which has gained experience from working within the firm. *Penrose, E.T., 1996, 46.*

³⁰⁸ *Barney, J., 1991, 106; Hambrick, 1987.*

³⁰⁹ *Grant, R.M., 1996; Liebeskind, J.P., 1996.*

³¹⁰ Also refer to *Spender, J.C., 1992.*

³¹¹ *Ricardo, D., 1926.* See also to *Liebeskind, J.P., 1996, 94-95.*

various researchers,³¹² then the initial competence endowment of a venture, its learning and skill accumulation will significantly impact its development.

However, *Grant, R.M., 1991*, 119 stresses that an isolated analysis of individual resources yields limited insights, because few resources are productive on their own. A firm's capabilities are formed by the cooperation and coordination of teams of resources. The understanding of the interaction between resources of the firm, its routines and capabilities, and firm success is enriched by the dynamic capability approach.

3.4.3 Dynamic capability approach

The dynamic capabilities approach is especially conceived to reflect the exigencies of high technology markets where time to market, responsiveness to rapid technological change, and flexibility are of utmost importance. *Teece, D., J, et al., 1997*, 339 define dynamic capabilities as "(...) the ability to reconfigure, redirect, transform, and appropriately shape and integrate existing core competencies with external resources and strategic and complementary assets (...)". Core competencies in this definition are a firm's competencies that define the core of business and refer - as well as the dynamic capabilities - to the abilities at the firm level, while the term competence, as introduced earlier in this work, refers to the TMT level. Dynamic capability in turbulent environment implies a firm's ability to continuously obtain innovative forms of competitive advantage.³¹³

According to the dynamic capability approach, a firm's competitive advantage lies with its processes (managerial and organizational routines), its position (e.g. intellectual property, complementary assets, customer base, external relations), and paths (strategic alternatives). The development of a firm's dynamic capability progresses along a path which is determined by prior strategic choices. A challenge for the firm is to remain and renew their competitive advantage through and in spite of these path dependencies and core rigidities.³¹⁴

³¹² Teece, D., J, et al., 1997; Grant, R.M., 1996; Liebeskind, J.P., 1996.

³¹³ Teece, D., J and Pisano, G., 1994.

³¹⁴ Tushman, M.L., et al., 1986.

While the resource-based view uses Ricardian rents to explain competitive advantage, the dynamic capability approach bases the achievement of superior returns on Schumpeterian rents. Supernormal rents result from an innovative combination of different resources, the creation of specific high-performance organizational routines, as well as congruencies and complementarities between diverse organizational routines. These factors determine the overall organizational capability.³¹⁵ The continuous development of core capability in accordance with environmental demands indicates dynamic capabilities. The focus is on the uniqueness and effectiveness of an organization as a whole in a dynamic context rather than on efficiency effects of singular resources at certain points in time.

Applying this approach to the new-venture context, the founders and their initial competence, networks, and strategic plans determine the path of the new firm. As organizational routines are created, resources are obtained and further strategic choices are made, the dynamic capability evolves and determines the competitive advantage and long-term success of the firm. The general lack of processes and resources at founding underlines the importance of the initial competence of the founders' team for the development of the organization as a whole. Their ability in the different functional domains as well as in the social and general entrepreneurial domain will determine the quality of the strategic choices, the managerial and organizational routines, and the asset base. These issues and the interaction among them shape the unique organizational capabilities in the functional domains and for the organizational as a whole.

3.4.4 Human capital approach

The human capital approach was initially developed in the context of labor economics to explain micro- and macroeconomic effects resulting from labor assets.³¹⁶ Entrepreneurship research adopted the concept of human capital in order to specify the human asset of a new venture.³¹⁷ *Pennings, J.M., et al., 1998* define human capital as "(...) the knowledge and skills of its professionals that can be used to

³¹⁵ Teece, D., J and Pisano, G., 1994.

³¹⁶ Sweetland, S.R., 1996; Bowles, S. and Gintis, H., 1975; Cooper, A.C., et al., 1994, Pickett, L., 1998, 103.

³¹⁷ While there is some discussion about accounting of human assets for internal and external purposes, so far these assets are included in accounting practices. Presently, investment in people and human resources expenses are negatively impacting the profit/loss statements. *Flamholtz, E.G., et al., 2002; Abdel-khalik, R.A., 2003.*

produce professional services.”³¹⁸ Human capital derives from two fundamental origins – education and experience.³¹⁹

The dimensions of human capital in content-analytical sense - like presented in chapter 3.1 - are not well elaborated by researchers. *Becker, G.S., 1975* distinguishes two basic forms of human capital. The first is labeled general training. It refers to knowledge and skills that were gained through professional education and industry experience in a certain firm or industry.³²⁰ This kind of capital is equally valuable in different companies and industries, thus offering equal returns. The second form of human capital is firm-specific human capital. This refers to knowledge that uniquely relates to a firm specific context and which has limited value outside this firm. *Becker, G.S., 1975, 40* defines it as “(...) training that has no effect on the productivity of trainees that would be useful in other firms.” Generic levels and demographic factors (e.g. investment in formal education, formal education degrees, years in industry, or years of professional experiences) are generally used to specify human capital.³²¹

Many researchers suppose a direct positive relationship between the human capital available within a firm and its performance.³²² However, *Becker, G.S., 1975* has a more complex understanding of returns from human capital. He illustrates that returns depend on various variables like age, gender, ethnic, capital type, background, types of capital, or ability. High amounts of human capital can even have negative effects on firm development. Since human capital is measured by years of industry or firm experience, a firm is attributed a larger amount of capital as its staff is aging within the firm. If a firm's employees reach retirement age, human capital is at its peak while chances for dissolution of the firm increase significantly. Thus, *Pennings, J.M., et al., 1998* proposes a U-shaped relationship between human capital and firm performance.³²³

³¹⁸ *Pennings, J.M., et al., 1998, 426.*

³¹⁹ *Becker, G.S., 1975, 17-20.*

³²⁰ *Becker, G.S., 1975, 33-40; Pennings, J.M., et al., 1998, 426.*

³²¹ *Pennings, J.M., et al., 1998, 430; Brüderl, J., et al., 1992, 229; Becker, G.S., 1975, 161-251.*

³²² *Dimov, D.P. and Shepherd, D.A., 2005; Watson, W.E., et al., 2003; Brüderl, J., et al., 1996, 43; Wanzenböck, H., 1998.*

³²³ *Pennings, J.M., et al., 1998, 427.*

In most studies the theoretical analysis and arguments of the effects of human capital assets on the performance of the firm are not specified in great detail.³²⁴ Combining the arguments of different researchers three ways can be distinguished in which human capital benefits the development of a new venture.³²⁵

First, already in the pre-founding process, positive selection effects occur with regards to the human capital of the founders. The founder with higher human capital can obtain and use information better resulting in better planning. Founders who possess more human capital also have options available with greater financial rewards than those with less human capital. When deciding if they should pursue a market-opportunity in an entrepreneurial way, they will compare the expected rewards of this option to the rewards of other ways of employment. Therefore, founders with more human capital will opt for more attractive entrepreneurial opportunities than those with less human capital.³²⁶

Second, potential customers of a new venture may use the firm's human capital credentials when choosing between competitors. High human capital may signal an ability to deliver better professional service.³²⁷ Because there is a high risk of failure involved when dealing with new ventures, the human capital endorsement can serve to reduce the perceived risk of business failure. Thus, firms with high human capital attain advantages in their customers' perception in comparison to firms with less capital.

Third, it can be assumed that founders who possess higher human capital can establish more effective and efficient organizations. They can provide better leadership for employees and they are more able to cooperate with external partners, who are crucial for the survival and growth of the company. The improved use of these resources in consequence leads to more business success.³²⁸ In a similar way, different authors argue that human capital within a firm leads to the delivering of consistent high-quality professional services.³²⁹

³²⁴ Brüderl, J., et al., 1992, 228.

³²⁵ Konrad, E.D., 2000, 43-44; Brüderl, J., et al., 1992, 229-230; Pennings, J.M., et al., 1998.

³²⁶ Timmons, J.A., 1999.

³²⁷ Pennings, J.M., et al., 1998, 426.

³²⁸ Konrad, E.D., 2000, 43; Brüderl, J., et al., 1992, 229.

³²⁹ Becker, G.S., 1975; Pennings, J.M., et al., 1998; Mincer, J., 1974.

Some authors specifically investigate the structure of the human capital assets of a venture. One fraction of these researchers argues that discrepancies in the capital structure within TMT can lead to in-group/out-group conflicts, divisiveness and ultimately reduced turnover.³³⁰ Others propose that team heterogeneity can lead to constructive problem-solving and fast decision making.³³¹

While there are some insights into the nature of human capital and its relationship to firm development, the human capital approach of entrepreneurship still lacks a profound theoretical basis.³³²

3.4.5 Summary of theoretical approaches

The presented theoretical approaches - theory of the growth of the firm, the resource-based view, the dynamic capability approach, and the human capital approach - elucidate how competence affects the performance of new ventures by assuming different perspectives. The competence of the TMT is viewed as a critical resource which ultimately results in superior rents for the venture. These rents result from greater effectiveness, efficiencies, and innovativeness. A general line of argument is that superior competence of the TMT causes better managerial actions which shape the organizational processes and routines. The organization, in its parts and as a whole, becomes more effective, efficient and adaptive. This leads to superior returns and growth.

Next to these theoretical arguments there is a large body of empirical research which enhances the understanding of the impact of competence-related attributes on the development of NTBFs. The current state of relevant empirical research in this field is presented next.

³³⁰ Tsui, A.S., et al., 1992; Tsui, A.S. and O'Reilly, C.A., 1989; Jackson, S.E., et al., 1991; Watson, W.E., et al., 2003, 148-151.

³³¹ Eisenhardt, K.M. and Bourgeois, L.J., 1988

³³² A viable theoretical advance could be to draw more explicitly on its economic origin and the works of Becker, G.S., 1975. In this line of argument, capital rents can be used to conceive the consequences of capital employment in analogy to financial capital rents. However, the theoretical advance of the human capital approach is not subject of this study.

4. Empirical evidence about competence and the development of new firms

After presenting theoretical concepts which depict the relationship between competence of the TMT and the development of NTBFs, this chapter serves to highlight empirical evidence concerning this relationship. Different researchers have conducted empirical research in order to identify factors which explain the development of young firms. In this chapter, central studies are presented that relate to the competencies of the executive level in young firms.³³³ The studies are grouped according to the competence dimensions which were presented earlier.³³⁴

Overall, empirical research with regards to competencies in the entrepreneurship context is in its infancy. An empirical study that investigated the impact of competencies with respect to different stages of development could not be identified. Because of the scarcity of empirical competence-based studies in the entrepreneurial context, other studies were also included if they reflected activities which could be interpreted as indicators of related competencies. At the same time, the additional illustration of success-related activities provides indications concerning those antecedent competencies which are needed to be successful. The empirical studies distinguish themselves by the extent of theoretical foundation, the sample, the applied methodology, and the specific success measures used.

With regards to the theoretical foundation, two basic types of studies can be differentiated. In the first type, theoretical arguments are fairly absent and hypotheses are deducted ad-hoc. The studies are mainly carried out by practitioners, consultants, or governmental or non-governmental support institutions. Their aim is to explore and identify success-factors out of a list of diverse variables. A fundamental problem concerning these studies is that the “encountered” relationships might be of arbitrary nature or that causality between the variables is dubious. Yet, these studies are included, because of the general scarcity of alternative studies. The second type of empirical studies draws on theory to explain why and how the input

³³³ In order to obtain an understanding of the present state of empirical research concerning the impact of different competencies on the development of new firms databases have been investigated for terms related to the different competence domains like ‘innovation’, ‘marketing’ etc. in combination with terms like ‘competence’, ‘competency’, ‘ability’ and terms relating to the entrepreneurial context like ‘venture’ or start-up both in the English-speaking and German speaking literature. Additionally, references in prominent entrepreneurial works or other empirical studies were followed. In a second step the findings have been revised to extract those, which present results based on quantitative and qualitative empirical findings. Qualitative studies were only included in those areas that provided limited quantitative evidence.

³³⁴ Refer to chapter 3.2.

variables are relating to success. However, the quality of the theoretical foundations of this type is mixed. Some authors refer to theory that was developed in a distinct context. Other authors present diverse theoretical foundations, vigorously adapt theory to the specific context of new ventures, or even intend to develop new theory. Overall, the first category of exploratory studies is dominating the entrepreneurial research field and empirical studies generally incorporate a theoretical deficit.³³⁵

The samples which are used in the empirical studies can be differentiated by sample size and the industries in which the participating firms are engaging. The sample size varies generally in accordance with the nature of the study. Explorative studies derive their findings based on very few cases. The generalization of these findings is questionable and findings have to be interpreted with caution. Yet, oftentimes they are the only sources for initial empirical evidence. Quantitative studies intend to have large sample sizes to support their findings. However, due to characteristics of the research field or study characteristics (e.g. intensity of research, time constraints of the respondents, lacking incentives, and limited practical relevance of the studies) authors oftentimes face severe problems obtaining adequate sample sizes. Concerning the homogeneity of the sample, the studies can be classified into three basic categories. The first category focuses on a single industry. The second type is drawing from different, yet generally closely related, industries. The third type is directed towards new firms coming from all industries. At times samples contain such diverse firms as high-growth technology ventures and new barber shops. These samples intend to represent all ventures and derive conclusions which can be generalized. At the same time, they incorporate the risk of ignoring important industry effects, if the industry background is not controlled for.

The methods used to identify the success factors in entrepreneurship encompass the whole methodological spectrum. The methods range from settings where the respondent is asked to identify success factors to more advanced statistical methods like structural equation modeling. Because entrepreneurship is still a young research field, the methodical advance is limited. The majority of researchers in the entrepreneurial field apply qualitative techniques or basic statistical methods.

³³⁵ Rüggeberg, H., 1997, 76.

The evaluation of success of a new venture incorporates several problems.³³⁶ The encountered studies apply a variety of success definitions and success operationalizations. Prominent success dimensions are growth, profitability, and market-success. These are either measured by objective data like sales growth, employee growth, return on investments, and return on equity or subjective measures which generally classify the level of satisfaction of the respondent with the respective success dimension. Many studies use a dichotomy for success. These studies attribute success to survival vs. non-survival or exceeding vs. falling below certain sales criteria after a specified/or at times even unspecified time. Due to the alteration of the distinctive attribute, the distinction itself, and in consequence the results can become fairly arbitrary.³³⁷ The limited number of studies and the diverging success measures hinder a quantitative assessment of the effect strength.

4.1 Empirical studies relating to general entrepreneurial competencies

Different studies investigate competence issues at a very general level or in diverse competence domains. These studies are presented followed by findings concerning each subdomain.

Studies show that the founders' general level of education favors business success.³³⁸ Additionally, several studies illustrate that experience which is related to the founding task improves subsequent business performance. Other studies show that prior work experience,³³⁹ self-employment experience,³⁴⁰ management experience,³⁴¹ industry experience,³⁴² start-up experience³⁴³, experience in rapidly growing ventures,³⁴⁴ experience with customers and suppliers,³⁴⁵ or experience in the job role³⁴⁶ favor business success.

³³⁶ Refer to chapter 5.2.

³³⁷ *Roure, J.B. and Maidique, M.A., 1986* classify a founding very successful when it reaches a sales volume of more than 20 million dollar within five years, while *Tyebjee, T.T. and Bruno, A.V., 1982* attribute success to ventures that surpass one million dollar without regarding the age of the new firm. Example taken from *Rüggeberg, H., 1997*, 77.

³³⁸ *Watson, W.E., et al., 2003; Brüderl, J., et al., 1996; Brüderl, J., et al., 1992; Gimeno, J., et al., 1997; Davidsson, P. and Honig, B., 2003; Chandler, G.N. and Jansen, E., 1992.* However, *Schefczyk, M. and Gerpott, T.J., 2000* find the correlations between university degree and business success to be not significant. This could signal that very specific forms of higher education might not be beneficial for venture success as skills are formed that are not needed in the entrepreneurial field.

³³⁹ *Watson, W.E., et al., 2003; Brüderl, J., et al., 1992.*

³⁴⁰ *Brüderl, J., et al., 1992.*

³⁴¹ *Schefczyk, M. and Gerpott, T.J., 2000; Herron, L., 1994; Chandler, G.N. and Jansen, E., 1992.*

³⁴² *Schefczyk, M. and Gerpott, T.J., 2000; Florin, J., et al., 2003; Herron, L., 1994.*

³⁴³ *Florin, J., et al., 2003.*

³⁴⁴ *Roure, J.B. and Maidique, M.A., 1986; Roure, J.B. and Keeley, R.H., 1990.*

³⁴⁵ *Gimeno, J., et al., 1997. Kakati, M., 2003.*

³⁴⁶ *Roure, J.B. and Maidique, M.A., 1986; Roure, J.B. and Keeley, R.H., 1990; Chandler, G.N. and Jansen, E., 1992.*

Turning to competence research, the study of *Chandler, G.N. and Hanks, S.H., 1994* reports significant correlations between performance measures and entrepreneurial competence, which refers to the identification of business opportunities and the drive to lead the venture to success. Managerial competence, representing skills to administer resources and to lead people, is also correlated with business performance. *Erikson, T., 2002* measures entrepreneurial competence as a self-assessed confidence about performing entrepreneurial tasks. He shows that entrepreneurial competence together with goal commitment leads to an increased likeliness to start a venture.

Overall, these studies provide initial support for this research as they indicate that competence based on education and experience has a general positive impact on venture development.

Author/ Year	Input variable(s)	Output variable(s)	Results	Sample	Method
<i>Roure, J.B. and Keeley, R.H., 1990</i>	Experience in rapidly growing firms/ experience concerning the position in the venture a.o.	Return for VC/ founders a.o.	Experience in rapidly growing firms +, experience concerning the position in the venture +	36 NTBFs	Regression
<i>Brüderl, J., et al., 1992</i>	Schooling/ Work experience/ industry specific experience/ self-employment experience a.o.	Months of survival	Schooling + Work experience +, industry specific experience +, self-employment experience +	1849 business founders	Log-Logistic model
<i>Herron, L., 1994</i>	Product/Service design-, Business-, Industry-, Leadership-, Networking-, Administration-, Entrepreneurial skills	Performance	Business +, Industry +, Networking +, Administration +, Entrepreneurial-Skills +, Leadership +/- (depending on industry), Product/Service design +/- (depending on industry).	134 NTBFs, across industries	Regression, factor analysis
<i>Chandler, G.N. and Hanks, S.H., 1994</i>	Entrepreneurial- and Managerial Competence, Organizational Resources and Capabilities, Quality of the opportunity	Performance (Venture growth, business volume)	Entrepreneurial Competence +, Managerial competence +, Entrepreneurial competence and opportunity +/-, Managerial Competence and Resources +/-	155 young and small manufacturing businesses from diverse industries	Correlations, hierarchical moderated regressions
<i>Gimeno, J., et al., 1997</i>	General human capital (education, supervisory experience, management experience)/ Venture-specific human capital (previous experience with suppliers, customers, products) a.o.	Economic performance	General human capital + Venture-specific human capital +	4814 Entrepreneurs	Censored and group data regression
<i>Sapienza, H.J. and Grimm, C.M., 1997</i>	General Education, business courses, industry experience, customer experience, entrepreneurial orientation, pre-planning, start-up capital, outside advice a.o.	Multidimensional subj. goal-achievement measure	Regressions involving the listed variables are not significant.	70 Founders of short-line railroads	Regression

Empirical foundation

<i>West, G.P.I. and Noel, T.W., 2002</i>	Content-specific knowledge about the industry or business type; process-specific knowledge about general management and about creating, building, and harvesting new ventures	Success	Network activity + Business relatedness n.s. Industry relatedness – Previous start-up experience n.s.	1. Study: 32 new ventures 2. Study: 83 new ventures from textile and tobacco industries	Moderated regression
<i>Erikson, T., 2002</i>	Entrepreneurial competence/ Goal commitment	Entrepreneurial capital (likeliness to start a venture)	Additive and multiplicative regression including entrepreneurial competence and goal-commitment on entrepreneurial capital +	65 MBA students	Factor-analysis, regression
<i>Florin, J., et al., 2003</i>	Human resources (industry experience/ start-up experience/ VC directorship) a.o.	Financial capital/ sales growth/ return on sales	Human resources on financial capital +, Human resources on sales growth n.s., Human resources on return on sales +	275 IPO firms with high growth potential	Moderated hierarchical regression
<i>Watson, W.E., et al., 2003</i>	Education, Work-experience, interpersonal process effectiveness (venture synergy/ venture direction)	Growth/ profitability	Education +, Work-experience +, interpersonal process effectiveness (venture synergy) +, interpersonal process effectiveness (venture direction) +	175 small venture dyads	Factor analysis, Hierarchical logistic Regression
<i>Davidson, P. and Honig, B., 2003</i>	Human Capital (Years in higher Education, Venture Seminars, Experience in venturing, professional experience, leadership experience) a.o.	Opportunity Discovery/ Exploitation of opportunity	Human Capital on Opportunity Discovery +, Human Capital on Exploitation +/-	380 Founders	Logistic regression

Tab. 5: General empirical studies relating to Entrepreneurial Management Competence

4.1.1 Empirical studies relating to conceptual competencies

Chandler, G.N. and Jansen, E., 1992 present one of the few studies that investigates competencies which are specifically related to the conceptual competence. Their sample is based on 84 manufacturing and 50 service firms from a wide variety of backgrounds from pottery to medical devices. The sampled firms are SMEs and not new ventures. Yet, since most new ventures start small, it seems appropriate to reflect these findings as well. Applying correlation-, factor-, and canonical discriminant analysis, the authors form two constructs that are related to conceptual skills. The first combines human and conceptual skills. The second combines opportunity recognition skills. Both constructs are positively related to profitability and growth with correlations ranging from .1 to .33.

In a large quantitative analysis, *Ensley, M.D., et al., 2000* investigate firms from INC's database of the fastest growing US firms. They analyze skills that differentiate lead entrepreneurs and their team members and find that planning skills of lead entrepreneurs are higher while opportunity identification skills do not discriminate. Based on a t-test, no support is found that planning or opportunity evaluation scores

of the lead entrepreneurs determine sales growth. An interpretation of this finding could be that conceptually-oriented skill sets are not the main differentiators between hyper-growth and more extreme hyper-growth. The conceptual skills of the other TMT members, which were not included in the study, might also explain the ultimate growth differential.

Lorange, P. and Roos, J., 1990 analyze 143 cooperation ventures which are formed by parent industrial companies that received governmental funding in Sweden and Norway. Based on structural equation modeling, they find that analytic competence positively impacts the goal-achievement of these cooperation ventures in Sweden. The same analysis yields no significant results for ventures in Norway. Thus, there is some indication that analytic competence might be context dependent, although these two Scandinavian countries appear to have similar cultures.

Further studies do not examine the competence domain, but offer insights into related activities. The planning process itself is analyzed with regards to the underlying information base, the level of planning detail, and the planning horizon. The findings concerning the information base stress the importance of drawing on information about business partners like suppliers and customers.³⁴⁷ With regards to the level of detail of planning, prior studies proclaim fairly unanimously that a limited level of detail is beneficiary.³⁴⁸ The *Doutriaux, J., 1992* additionally suggests that the size of the new venture impacts the effect of planning on sales, yet the short timeframe of the sales data from the ventures, which is used as the dependent variable, demands caution. Thus, these studies hint that extensive planning might not be needed.

Overall, the empirical findings only yield very limited insights. There are first indications that conceptual competence might benefit venture development though the impact appears to be weak.

³⁴⁷ Steinkühler, R.H., 1993.

³⁴⁸ Steinkühler, R.H., 1993; Sapienza, H.J. and Grimm, C.M., 1997; Klandt, H. and Kirschbaum, G., 1985. The study by Klandt, H. and Kirschbaum, G., 1985 has to be interpreted with caution due to the limited sample size and the methodical weaknesses of frequency analysis.

Author/ Year	Input-variable(s)	Output-variable(s)	Results	Sample	Method
<i>Lorange, P. and Roos, J., 1990</i>	Analytical-competence a.o. ³⁴⁹	General results/ Planned vs. Present costs/ Planned vs. Present revenues/ personal relationship between project leaders	Analytical-competence in Swedish sample + Analytical-competence in Norwegian sample n.s.	67 firms forming 33 industrial cooperation ventures	Partial Least Square
<i>Ensley, M.D., et al., 2000</i>	Strategic skills (planning/ evaluation skills)/ strong vision (vision/self-efficacy)	Sales Growth Lead entrepreneur/ team member	Planning Skills n.s. Evaluation Skills n.s. Strong Vision + Self efficacy n.s. Lead entrepreneurs have higher planning skills than their team members; opportunity identification skills do not differentiate.	317 und 308 Inc-500-Firms	T-test; logistical regression
<i>Steinkühler, R.H., 1993</i>	Level of detail of concept / Long planning horizon of the development / Information seeking from suppliers a.o.	Sales and employment growth	Limited concept detail + Long planning horizon + Supplier information +	70 NTBFs	Regression / Logit-analysis
<i>Klandt, H. and Kirschbaum, G., 1985</i>	Limited concept detail a.o.	Sales per year and employee	Limited concept detail +	25 software firms 16 Infratest samples	Frequency-analysis
<i>Vivarelli, M., 2004</i>	Diverse	Subj. perception of economic performance/ Income from venture/ profitability relative to competitors)	Large information base +	365 founders	Regression
<i>Sapienza, H.J. and Grimm, C.M., 1997</i>	Pre-planning a.o.	Subj. multi-dimensional goal-achievement measure	Pre-planning n.s.	70 founders of short-line railroads	Regression
<i>Duchesneau, D. and Gartner, W., 1990</i>	Planning in start-up process	Successful/Unsuccessful firms	Spent more time planning (237 hours) than unsuccessful firms (85 hours) + More information from business partners and consultants + Broad planning + Some market research + Clear business idea +	26 small, young firms juice distribution	Uni-variate analysis of variation, correlations
<i>Kulicke, M. and al., e., 1993</i>	Systematic preparation of founding/ Information and controlling system a.o.	Sales, employment and profit growth	Systematic preparation of founding + Information and controlling system +	93 NTBFs	Correlations
<i>Chandler, G.N. and Jansen, E., 1992</i>	Opportunity recognition a.o.	Profitability/ growth	Correlations: On profitability: opportunity recognition +; On growth: opportunity recognition +	134 small manufacturing and service firms	Correlations, Factor analysis, Canonical discriminant analysis

³⁴⁹ A.o. replaces among others.

Doutriaux, J., 1992	Prior business planning	Dichotomy: Small/large ventures according to first year sales	Prior business planning for large start-up ventures + Prior business planning for small start-up ventures n.s.	73 NTBFs	Multivariate
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Tab. 6: Empirical studies relating to conceptual competencies

4.1.2 Empirical studies relating to innovative competencies

The specific ability to innovate has not been investigated in the entrepreneurial context. Only a qualitative study based on 30 SMEs is found where managers rate the competence for technological innovation as the third most important out of 70 possible competence domains. However, this direct self-assessed importance evaluation might be misleading, because the subjectively perceived importance of a competence domain does not necessarily correspond with the objective importance.

The empirical research with regards to the innovation domain is dominated by an analysis of the strategic attitude to innovation at a firm's level and its impact on success measures.³⁵⁰ Generally these studies measure the strategic attitude towards innovation as part of broader constructs of entrepreneurial posture or entrepreneurial orientation. *Becherer, R.C. and Maurer, J.G., 1997* find a positive impact of entrepreneurial posture on profits for SMEs. *Covin, J.G. and Slevin, D.P., 1989* find that the effect of an innovative posture as part of an overall entrepreneurial posture is contingent on environmental settings. In their studies an entrepreneurial posture increases the financial performance in hostile environments, while it has negative effects in benign environments.

Brüderl, J., et al., 1992 find that innovativeness increases the survival-chances of new ventures. *Heunks, F.J., 1998* analyzes the effects of product innovation, process innovation, R&D innovation, and marketing innovation on growth, profitability, and productivity. He finds, based on a sample of 101 small yet not necessarily new firms with 1 to 50 employees, that growth correlates positively with process, marketing, and R&D. A positive correlation is also found between process innovation and productivity, while all other correlations are not significant. In a small sample study, *Hunsdiek, D., 1987* encounters a positive effect of product innovativeness on sales-

³⁵⁰ *Becherer, R.C. and Maurer, J.G., 1997; Covin, J.G. and Slevin, D.P., 1989.*

growth. In a similar vain *Picot, A., et al., 1989* show positive effects of innovativeness on a multi-dimensional success measure.

Reid, G.C. and Smith, J.A., 2000 find a negative effect of the firm's innovativeness and 'new ideas' on new venture success, as measured by a combination of employment growth, the firm's productivity, and the rate of return.

The empirical evidence is too limited to determine any effect of innovation competence on a new firm's development. Most related studies refer to the innovation at the firm level; yet these studies also do not offer conclusive evidence about the likely effects of innovation ability of the TMT on venture success. It remains uncertain if firms benefit from antecedent innovation competence or a subsequent innovation approach at the strategic firm level. Innovation competence of the TMT might result in more innovative business models, more innovative product offerings, or more innovative organizational routines. Yet, it remains unanswered if these more innovative solutions benefit the new firms' development. More innovation in these aspects might also imply bigger challenges concerning issues like product development, market entry, or market development. Additionally, *Covin, J.G. and Slevin, D.P., 1989* suggest that the environmental context influences the impact of an innovation orientation on firm success.

Author/ Year	Input variable(s)	Output variable(s)	Results	Sample	Method
<i>Covin, J.G. and Slevin, D.P., 1999</i>	Entrepreneurial posture (innovativeness/ risk-taking/ proactiveness) a.o.	Subjective financial performance constructs	Entrepreneurial posture in hostile environments + Entrepreneurial posture in benign environments -	161 SME, 25 different industries	Moderated regression
<i>Becherer, R.C. and Maurer, J.G., 1997</i>	Entrepreneurial orientation a.o.	Change in profits	Entrepreneurial posture on profits +	215 SME entrepreneurs	Correlations, Moderated regressions
<i>Reid, G.C. and Smith, J.A., 2000</i>	Strat. innovativeness/ new ideas a.o.	Employment growth/ productivity/ rate of return	Innovativeness/ new ideas -	150 young firms	Ordered logit model
<i>Hunsdiek, D., 1987</i>	Degree of innovativeness of product a.o.	Sales growth	Degree of innovativeness +	13 NTBFs	Correlations
<i>Brüderl, J., et al., 1992</i>	Innovative business a.o.	Months of survival	Innovative business +	1849 business founders	Logistic model
<i>Simon, M., et al., 2002</i>	Market pioneering a.o.	Sales of new product	Market pioneering n.s. Interaction of market pioneering and entrepreneurial confidence +	51 SME, high-technology	Hierarchical regression
<i>Thompson, J.E., et al., 1997</i>	70 competence domains	Importance for TMT	Technical innovation is third important competence area	30 SME, 6 different industries	Qualitative
<i>Heunks, F.J., 1998</i>	Process, product, R&D, marketing innovativeness	Growth, profitability, productivity	Process, R&D, marketing Innovativeness on growth + Innovativeness on profitability n.s. Process Innovativeness on Productivity+	200 SME	Correlations
<i>Picot, A., et al., 1989</i>	Degree of innovativeness with regards to customer demand	Performance (10 dimensions)	Degree of innovativeness with regards to customer demand +	52 NTBFS	Factor-analysis, Correlations

Tab. 7: Empirical studies relating to innovative competencies

4.1.3 Empirical studies relating to enforcement competencies

Different concepts related to enforcement competencies have been investigated in the entrepreneurial context. *Kakati, M., 2003* investigates the effects of an entrepreneur's abilities to sustain an intense effort on venture performance of VC-funded firms. The study reveals that the successful leaders of new ventures have significantly higher abilities to sustain an immense effort. However, the sample size of this research is small. The work of *Becherer, R.C. and Maurer, J.G., 1999* supports a positive relationship between a CEO's proactiveness and the overall entrepreneurial posture of a firm. Additionally, their study found that the CEO's proactiveness favors

the sales growth of a firm, while effects on profits are not significant. Yet, the sample of the study consists of SMEs and thus, has to be interpreted with caution for the entrepreneurial field.

Other related studies also are based in the SME setting. These investigate related concepts at the strategic firm level. Proactiveness is another dimension which is forming the entrepreneurial posture and the entrepreneurial orientation concepts. As highlighted earlier *Becherer, R.C. and Maurer, J.G., 1999* document a positive impact of the entrepreneurial posture on profits. *Covin, J.G. and Slevin, D.P., 1989* find that entrepreneurial posture is beneficially in hostile environments and has disadvantages in benign environments. Thus, there is some indication that proactiveness and similarly enforcement competencies are positive related, especially in dynamic and competitive markets.

Limited empirical evidence exists concerning the relationship of enforcement competence and venture success. The presented studies indicate a positive relationship. Yet the sample sizes of these studies are either very small or referring to SMEs. This implies that the encountered results might not be generalizable to the entrepreneurial domain.

Author/ Year	Input variable(s)	Output variable(s)	Results	Sample	Method
<i>Covin, J.G. and Slevin, D.P., 1989</i>	Entrepreneurial posture (innovativeness/ risk-taking/ proactiveness) a.o.	Subjective financial performance constructs	Entrepreneurial posture in hostile environments + Entrepreneurial posture in benign environments -	161 SME, 25 different industries	Moderated regression
<i>Chandler, G.N. and Jansen, E., 1992</i>	Drive a.o.	Profitability/ growth	Correlations: On profitability: n.s. On growth: +	134 small manufacturing and service firms	Correlations, Factor analysis, Canonical discriminant analysis
<i>Becherer, R.C. and Maurer, J.G., 1999</i>	CEO's proactiveness	Firm's Entrepreneurial Posture/ performance (sales/ profits)/ delegation of authority	CEO's proactiveness on entrepreneurial posture +, CEO's proactiveness on sales +, CEO's proactiveness on profits n.s., CEO's proactiveness on delegation n.s.	215 SMEs	Correlations, ANOVA
<i>Kakati, M., 2003</i>	Capability to sustain intense effort and 37 other independent variables	Subj. venture performance based on seven dimensions (sales, market share, marketing costs, production costs, general costs profit, rate of return)	capability to sustain intense effort +	27 venture capitalists rating their most/least successful venture	Mean comparison applying t-test

Tab. 8: Empirical studies relating to enforcement competencies

4.2 Empirical studies relating to social competencies

Two studies are found that use constructs which are of an overarching nature. The political competence conceived by *Chandler, G.N. and Jansen, E., 1992* combines social interaction of the founders with team members and network partners. The correlations of this concept of political competence with profitability and growth are significantly positive. It needs to be acknowledged, however, that the sample consists of SMEs and not new ventures. In another study, *Baron, R.A. and Markman, G.D., 2003* present additional empirical evidence about positive effects of social competence on venture success. The researchers find a significant impact of social competence on financial success of new ventures in the cosmetics and high-tech industry. In their study social competence is conceived to be an overarching construct which combines social perception, social adaptability, expressiveness, and impression management. Because these two studies measure social competence with respect to different interaction partners, they underline that in general social interaction competence is a valuable skill for business success.

Author/ Year	Input variable(s)	Output variable(s)	Results	Sample	Method
Chandler, G.N. and Jansen, E., 1992	Political competence (Involve people/ venture team complementarities/ gain Support of people)	Profitability/ growth	Correlations: On Profitability: political competence +. On growth: political competence + ³⁵¹	134 small manufacturing and service firms	Correlations, factor analysis, canonical discriminant analysis
Baron, R.A. and Markman, G.D., 2003	Social competence (social perception/ social adaptability/ expressiveness/ impression management)	Financial success	Social perception in cosmetics and high-tech + Social adaptability in cosmetics + Expressiveness in high-tech + rest n.s.	230 entrepreneurs in cosmetics and high-tech industry	Factor analysis, regression

Tab. 9: Additional empirical studies relating to social competencies

4.2.1 Empirical studies relating to teamwork competencies

The team aspect of entrepreneurship has been investigated intensely. Many studies have presented that team ventures are more successful than firms which are founded and lead by a single person.³⁵² While none of the studies specifically addresses the ability to work as a team, they focus on the self-reported characteristics regarding the attitudes and the interaction of the team members which can be closely linked to teamwork competence.

The positive effects of good team-work on business success are prevalent. *Watson, W.E., et al., 1995* illustrate that interpersonal team-process effectiveness and partner agreement favors venture growth and profitability. Similarly, *Dreier, C., 2001* finds that the interaction quality of the TMT in new ventures increases venture success. *Müller, T.A., 2003* illustrates that the teamwork quality of the TMT in new software firms positively impacts the customer's and competitive orientation of the new venture, which leads to technological, market, and financial success. In a study of high growth firms, *Ensley, M.D., et al., 2002* encounter significantly positive effects of team cohesion of the TMT on sales growth.

Other studies relating to teamwork in new firms concern the history and the composition of the TMT. The studies of *Roure, J.B. and Keeley, R.H., 1990* and *Roure, J.B. and Maidique, M.A., 1986* present that prior teamwork experience of the

³⁵¹ Level of significance .1.
³⁵² E.g. Kulicke, M. and al., e., 1993; Picot, A., et al., 1989; Tyebjee, T.T. and Bruno, A.V., 1982; Doutriaux, J. and Simyar, F., 1992; Roberts, E.B., 1991a; Doutriaux, J. and Simyar, F., 1992.

TMT and team completeness favors business success. With regards internationalization of SMEs, *Reuber, A.R. and Fischer, E.M., 2002* find that those firms whose TMT have a strong behavioral integration, which is measured by the intensity of interaction and joint decision making, are more likely to transfer the international sales growth dynamics into overall sales growth. *Chandler, G.N., et al., 2005* determine that the departure of members of the TMT in new ventures favors sales growth significantly, while the addition of members to the TMT hinders sales increases. While one might suspect that the departure of team members signals negative teamwork, the authors argue that the change in TMT are adaptive mechanisms where the team as a whole adapts to the exigencies of the environment.

Overall, empirical evidence indicates that the ability to work as a team increases success. While no researcher measured the teamwork competence directly, indicators of the ability to work as a team like prior teamwork experience or current teamwork quality are found to impact the success positively.

Author/ Year	Input variable(s)	Output variable(s)	Results	Sample	Method
<i>Roure, J.B. and Maidique, M.A., 1986</i>	Team-founding/ common teamwork experience/ team completeness a.o.	Survival/ sales/ profit	Team-founding +, common teamwork experience +, team completeness +	8 NTBFs	Qualitative
<i>Bruno, A.V., et al., 1987</i>	Ineffective team a.o.	Failure	Ineffective team identified as major/minor problem causing failure	10 NTBFs	Frequencies
<i>Roure, J.B. and Keeley, R.H., 1990</i>	Common teamwork experience/ team completeness a.o.	Rate of return (equity-owners)	Common teamwork experience +, team completeness +	36 NTBFs	Regression
<i>Watson, W.E., et al., 1995</i>	Interpersonal team process effectiveness (leadership/ interpersonal flexibility/ commitment/ helpfulness) and partner agreement of the quality of the team process	Perceived venture success (growth/ profitability)	Interpersonal team process effectiveness + Partner agreement +	171 dyadic small business teams	Factor-analysis, correlation, logistic regression
<i>Dreier, C., 2001</i>	Interaction quality	Subj. success measures	Interaction quality +	164 NTBFs, diverse industries	Factor-analysis, correlations
<i>Reuber, A.R. and Fischer, E.M., 2002</i>	Behavioral Integration of the TMT as moderator of impact of international sales growth on overall sales growth	Overall sales growth	Behavioral integration +	217 SMEs, Software and food processing industry	Regression
<i>Ensley, M.D., et al., 2002</i>	Team cohesion	Sales growth/ profitability	Team cohesion and sales growth + Team cohesion and profitability whole regression model n.s.	70 INC 500 firms	Hierarchical regression
<i>Müller, T.A., 2003</i>	Teamwork quality of TMT a.o.	Customer and competitor orientation which are relate to effect subj. success measures	Teamwork quality mediated effect on success +	101 NTBFs, software	Multi Traits Multi Method, Regressions
<i>Chandler, G.N., et al., 2005</i>	TMT departures TMT additions	Sales growth	TMT departures + TMT additions -	408 nascent entrepreneurs, service and trading businesses	Regression

Tab. 10: Empirical studies relating to teamwork competencies

4.2.2 Empirical studies relating to leadership competencies

The studies on leadership-related issues in NTBFs are limited. This might be due to the fact that some founders start without employees, thus limiting relevance and possibilities to investigate leadership issues.³⁵³ However, the studies show that leadership quality is improving venture performance. *Kakati, M., 2003* finds that more

³⁵³ *Doutriaux, J. and Simyar, F., 1992.* About one third of all investigated ventures consist just of members of the executive team without any additional employees at start-up. Refer to chapter 7.1.2.2.

successful venture-capital financed firms are headed by founders who have a significantly higher leadership quality; however, the sample size of the study is limited.

While the studies of *Gimeno, J., et al., 1997* and *Brüderl, J., et al., 1992* do not investigate current leadership skills, they document that prior experience of the founders in leadership positions fosters the economic performance of new ventures and increases the chances of survival. Thus, initial empirical support signals that leadership abilities support venture success.

Author/ Year	Input variable(s)	Output variable(s)	Results	Sample	Method
<i>Brüderl, J., et al., 1992</i>	Leadership experience a.o.	Month of survival	Leadership experience +	1849 business founders	Logistic model; mean comparisons
<i>Gimeno, J., et al., 1997</i>	General human capital (including supervisory experience)	Economic performance	General human capital (including supervisory experience) +	4814 Entrepreneurs	Censored and group data regression
<i>Kakati, M., 2003</i>	Leadership and 37 other independent variables	Subj. venture performance based on seven dimensions (sales, market share, marketing costs, production costs, general costs profit, rate of return)	Leadership quality +	27 venture capitalists rating their most/least successful venture	Mean comparison applying t-test

Tab. 11: Empirical studies relating to leadership competencies

4.2.3 Empirical studies relating to network competencies

Only one study could be identified which specifically addresses the competence to network in new firms. *Klocke, B., 2004* focuses on network competence and finds that it correlates with sales growth significantly. He also shows that the rate at which new ventures build external cooperation correlates highly with the development speed of the firms and the product development rate. Another finding is that the cooperation addition rate is closely linked to sales and employment growth. Additionally, that study illustrates how the network specification is changing along with the core tasks and the development of the firms.

Other empirical studies show that the social network of a venture benefits its development. *Davidsson, P. and Honig, B., 2003* depict that social networks favor the discovery of business opportunities and the pursuit of these opportunities. In a study of 275 high growth IPO firms, *Florin, J., et al., 2003* encounter that the social network of the TMT favors the acquisition of capital and return on sales. Yet, the effects on sales growth are not significant. Interpreting this non-significant relationship leaves room for speculation. From a measurement perspective it might indicate that the relationships between the proxies used to measure network capital might not be reliable or that the special pre-IPO-situation of the sampled firms implies a bias as sales growth might be manipulated to qualify for an IPO. From a theoretical perspective it could signal that networking carries a cost which might significantly reduce the benefit obtained through the network. Other disadvantages of networks might be strategic lock-in or lock-out effects. Lock-in and lock-out effects refer to disadvantages of being bound to strategic partners which might limit possibilities to access other strategic partnerships.

Another study, referring to primarily financially-based networks by *Chrisman, J.J. and McMullan, E., 2004* finds that the involvement in new venture assistance programs increases the chances of survival of a new venture. In a similar vein, *Yli-Renko, H., et al., 2001* present that social interaction and strong customer-network ties cause founders to acquire more knowledge which in turn favors product development, technological distinctiveness, and lowers sales cost. However, a surprising finding of their study is that the relationship quality has a negative effect on knowledge acquisition. The authors argue that over-embeddedness might explain this finding as very close relationships between the young firms hinder them from access to other sources of information. Another explanation offered is that a close relationship might lead to less monitoring and less intense processing of information.

Overall, literature indicates that network competence fosters growth. The few exceptions presented suggest that networking also requires resources and can create lock-in and lock-out effects that in total obstruct the positive effects of network competence.

Author/ Year	Input variable(s)	Output variable(s)	Results	Sample	Method
Yli- Renko, H., et al., 2001	Social Interaction/ relationship quality/ customer network ties	Direct: knowledge acquisition Indirect: new product development/ technological distinctiveness/ sales cost	Social interaction on knowledge acquisition +, relationship quality on knowledge acquisition -, customer network ties +, knowledge acquisition on new product development +, knowledge acquisition on tech. distinctiveness +, knowledge acquisition on sales cost -.	180 independent manufacturing NTBFS	Structural equation model
West, G.P.I. and Noel, T.W., 2002	Networking a.o.	Success	Network activity +	1. Study: 32 new ventures 2. Study: 83 new ventures from textile and tobacco industries	Moderate regression
Davidson, P. and Honig, B., 2003	Social Capital a.o.	Opportunity discovery/ exploitation of opportunity	Social capital on opportunity discovery +, social capital on exploitation of opportunities (moving founding process forward) +, social capital on exploitation of opportunities (first sales/ profitability) +/-	380 Founders	Logistic regression
Florin, J., et al., 2003	Social resources (business network/ personal network/ underwriters) a.o.	Financial capital/ sales growth/ return on sales	Social resources on financial capital +, social resources on sales growth n.s, social resources on return on sales +	275 IPO firms with high growth potential	Moderated hierarchical regression
Klocke, B., 2004	Cooperation creation rate/ cooperation addition rate/ network competence a.o.	Development speed/ product development rate/ sales-growth/ employment growth	Network competence on sales growth + ³⁵⁴ , cooperation creation rate on development speed +, cooperation creation rate on product development rate +, cooperation addition rate on sales growth +, cooperation addition rate on employment growth +	42 NTBFS, Nanotechnology field	Correlations
Chris- man, J.J. and McMul- lan, E., 2004	Assistance programs a.o.	Long term survival	Participation in assistance programs on chances for survival +	159 New Venture Founders	Logistic regression

Tab. 12: Empirical studies relating to network competencies

4.3 Empirical studies relating to functional competencies

Schefczyk, M. and Gerpott, T.J., 2000 document in a study involving 103 VC portfolio companies that the total functional experience as well as experience in each functional domain correlates positively with the ventures' rate of return. The correlation of functional experience with different rate of return measures is between .25 and .39. Out of different functional domains, marketing/sales, strategy/planning, and finance/controlling correlate stronger with the return measure (generally in the

³⁵⁴ Level of significance .1.

mid .2 to mid .3 range). Development and manufacturing/logistics show weaker correlations (around .2). Although the sample is limited to a very special form of venture financing, it signals that functional competencies relate positively to venture development. It also suggests that not all functional competencies have the same impact on venture success.

Author/ Year	Input variable(s)	Output variable(s)	Results	Sample	Method
Schefczyk, M. and Gerpott, T.J., 2000	Functional experience (R&D, manufacturing/logistics, marketing/sales, planning/strategy, finance/controllers) a.o.	VC investment performance (internal rate of return: absolute, relative to plan, relative to industry; full write-down)	Correlations with VC performance: R&D +, marketing/sales +, planning/strategy +, manufacturing/logistics +, financial controlling +, total functional experience +	103 portfolio companies of 10 VCs,	Correlations/ Regressions/LISREL

Tab. 13: A general study relating to functional competencies

4.3.1 Empirical studies relating to technology management competencies

In comparison with research regarding other functional areas like marketing or financing, the empirical research concerning technology management in NTBFs is less developed. Dominating the empirical literature are small-scale studies that investigate specific aspects of technology management or those that focus on technological abilities. Studies that specifically focus on a comprehensive technology management concept for new firms could not be identified.

Three studies which relate to abilities in the technology domain, document positive effects of technology-related abilities on business success. *Schuster, H. and Winkel, A., 1986* found that extensive know-how concerning the product technology increases the chances of survival. In the research by *Kakati, M., 2003*, the successful venture-financed firms are attributed significantly higher technological capabilities at the firm level than less successful firms. *Hunsdiek, D., 1987* shows that the use of legal technology protection and strength in the technology field favors sales growth. However, both of the last studies suffer from small sample sizes and rudimentary statistics.

Doutriaux, J., 1992 determines a negative impact of technology orientation on sales for smaller ventures. In larger new firms, sales are less when they possess higher

levels of R&D experience. *Stuart, R. and Abetti, P.A., 1987* find that limited R&D efforts positively impact different venture success dimensions; however caution is advised due to a small sample. Along this line, *Roure, J.B. and Keeley, R.H., 1990* determine that the optimal product development time in NTBFs is about one year.

The empirical findings appear to be conflicting as some authors find positive effects of technology management competence related issues, while others find negative effects. Neither area of findings is based on large sample sizes. The methods applied are often basic. Thus, the findings should be interpreted with caution. However, they could serve as a first empirical indication that an extensive technological orientation based on a profound technological background might detriment other important functional orientations like marketing or finance. The bias towards technology related issues and the subsequent bias in the activity level in these could harm business success.

Author/ Year	Input variable(s)	Output variable(s)	Results	Sample	Method
Schuster, H. and Winkel, A., 1986	Know-how concerning product technology a.o.	Survival	Know-how concerning product technology +	45 New ventures (13 failures)	Discriminant analysis
Huns- diek, D., 1987	Use of legal tech. protection/ technology strength a.o.	Sales-growth	Use of legal tech. protection +, technology strength +	13 NTBFs	Correlations
Stuart, R. and Abetti, P.A., 1987	Limited R&D efforts a.o.	Obj. and subj. success measures	Limited R&D efforts +	24 NTBFs	Correlations, Factor- analysis
Roure, J.B. and Keeley, R.H., 1990	Product development time a.o.	Return for VC/ Founders a.o.	Optimal product development time is one year.	36 NTBFs	Regression
Doutri- aux, J., 1992	Experience in F&E, F&E orientation in the beginning a.o.	Sales	F&E orientation in the beginning in small ventures - Experience in F&E on sales in large ventures -	73 NTBFs	Correlations, multivariate Analysis
Kakati, M., 2003	Technological capability and 37 other independent variables	Subj. venture performance based on seven dimensions (sales, market share, marketing costs, production costs, general costs profit, rate of return)	technological capability +	27 Venture capitalists rating their most/least successful venture	Mean comparison applying t- test

Tab. 14: Empirical studies relating to technology management competencies

4.3.2 Empirical studies relating to marketing management competencies

Different empirical studies investigate marketing-related issues of NTBFs.³⁵⁵ However, no study could be found that adopted a competence view in the entrepreneurial context.

Tzokas, N., et al., 2001 analyses diverse indicators of marketing competence and their correlations with a performance construct with small firms. A larger list of diverse marketing related items correlates significantly with firm's performance (achieving sales targets (.37),³⁵⁶ public relations (.37), and the development of a marketing program (.25) have the strongest correlations). However, the theory of the underlying marketing competence concept is weak, the methodology has shortcomings, and the

³⁵⁵ For a special publication which is devoted to this subject refer to Journal of Research in Marketing & Entrepreneurship.
³⁵⁶ These numbers indicate the correlations.

average small-firm age of 40 raises questions with regards to the generalizability of the findings in the entrepreneurial context.

Studies in the entrepreneurial field show that marketing experience at the executive level of new firms increases the chances of survival,³⁵⁷ increases sales,³⁵⁸ and fosters overall business success.³⁵⁹ Studies which investigate causes of failure of new ventures identify marketing-related problems as dominant failure reasons. In these studies, business failure arises primarily out of bad timing of market entry, distribution problems, lacking selling skills, the reliance on a small customer base, an underestimated duration to first sales, inadequate overall marketing/sales concept, insufficient or misjudged market demand, or corporate image problems.³⁶⁰ These failures might have been avoided if the entrepreneurs had possessed the respective marketing management skills.

Beyond the general indications that marketing-management foster new business development, some studies investigate more specifically which areas of the marketing domain have special relevance for new ventures. *Picot, A., et al., 1989* find that market analysis, product marketing and marketing cooperation favors venture performance. In *Meier, A., 1998*'s extensive study of marketing issues in NTBFs, the marketing organization and the innovation process were, however, not significantly more elaborate in successful ventures. Yet, he found support that in all other marketing areas the successful ventures had at least partially better marketing practices. According to *Meier, A., 1998*'s study, the five most important marketing aspects for NTBF success in the first two years of existence based on correlations are:³⁶¹

³⁵⁷ *Schuster, H. and Winkel, A., 1986; Pleschak, F., et al., 1994; Bruno, A.V., et al., 1987.* Yet, the study by *Bruno, A.V., et al., 1987* relies on a very small sample and descriptive methodology.

³⁵⁸ *Roberts, E.B., 1991a; Doutriaux, J. and Simyar, F., 1992.*

³⁵⁹ *Picot, A., et al., 1989; Kakati, M., 2003. Kakati, M., 2003* also uses a very small sample and limited statistics.

³⁶⁰ *Meier, A., 1998 194; Maisberger, P., 1998, 67; Pleschak, F. and Werner, H., 1998; 118, Pleschak, F., et al., 1994; Bruno, A.V., et al., 1987.*

³⁶¹ The results present the strongest correlations between almost 100 marketing issues and subj. business success. *Meier, A., 1998, 190-193.*

1. Experience in marketing and sales (.38³⁶²)
2. Target market analysis (.37)
3. Fast response to unfavorable developments in the marketing domain (.36)
4. Know-how in marketing and sales (.31)
5. Analysis of competition (.31)

The five most important marketing aspects in the two most recent years of existence of the NTBFs are:

1. Target market analysis (.39)
2. Professional corporate image (.35)
3. Analysis of cost-efficiency of marketing expenses (.31)
4. Resources of marketing/sales (.30)
5. Analysis of strengths and weaknesses (.30)

Because this study is one of the very few differentiating the impact of the activities at two points in time, it illustrates how the importance of specific tasks changes. This evolution reflects the development of the firm from a new entity that has to find its place in the market to a more established organization that needs to be more concerned about efficiency, professional appearance, and the leverage of its strengths/weaknesses-profile. It can be expected that a shift in the importance of the competence domains and its subdomains occurs.

Summarizing the research in this domain, no study is found which specifically addresses marketing-management competence in new firms. However, the literature illustrates that marketing-management aspects are important for business success in NTBFs.

³⁶² The numbers refer to correlations with a success construct. The sample size of the study is 111.

Author/ Year	Input variable(s)	Output variable(s)	Results	Sample	Method
Schuster, H. and Winkel, A., 1986	Market/ and marketing experience a.o.	Survival	Market / marketing experience +	45 New ventures (13 failures)	Discriminant analysis
Bruno, A.V., et al., 1987	Timing/ distribution/ selling/ reliance on single customer a.o.	Failure	All areas were identified as major reasons for failure	10 NTBFs	Frequencies
Dou- triaux, J. and Simyar, F., 1992	Marketing background	Sales	Marketing background +	73 NTBFs	Regression, variance- analysis
Picot, A., et al., 1989	Market analysis, product marketing experience, marketing cooperation a.o.	Performance (10 dimensions)	Market analysis +, product marketing experience +, marketing cooperation +	52 NTBFs	Factor- analysis, correlations
Roberts, E.B., 1991a	Existence of a marketing department, market analysis; market experience a.o.	Sales-growth	Marketing experience +, market-analysis +, existence of a marketing department +, customer integration in market research +	142 NTBFs	Correlations
Kulicke, M. and al., e., 1993	More than three products/ rapid market entrance/ foreign marketing efforts a.o.	Sales, employment and profit growth	> 3 products +, rapid market entrance +, foreign marketing efforts +	93 NTBFs	Correlations
Meier, A., 1998	Diverse marketing activities evaluated at start-up and at present	Subjective success measure (average of 12 dimensions)	Customer orientation +/-, integrated marketing organization n.s., marketing information +/-, strategic marketing +/-, marketing operations +/-, comprehensive innovation process n.s.	111 NTBFs	Factor- analysis, correlations, Mann- Whitney Test
Coviello, N.E., et al., 2000	Market planning Type of marketing practice Market performance measurement	Differentiated according to firm size	Smaller firms use less formal market planning, other difference are only partially valid	302 Production- based firms	Chi-squares, ANOVA, regression
Tzokas, N., et al., 2001	Marketing Competencies	Performance	Diverse marketing activities + Especially: public relationships, pricing methods, market image, effective advertising/promotion	246 Small manufacturing firms (<100 employees)	Correlations
Kakati, M., 2003	Marketing capability and 37 other independent variables	Subj. venture performance based on seven dimensions (sales, market share, marketing costs, production costs, general costs profit, rate of return)	Marketing capability +	27 Venture capitalists rating their most/least successful venture	Mean comparison applying t- test

Tab. 15: Empirical studies relating to marketing management competencies

4.3.3 Empirical studies relating to financial management competencies

The studies which investigate financial-management related issues in NTBFs dedicate themselves almost exclusively to the financing of new ventures; yet

financing is only a part of financial management. The other areas of financial management receive little attention. No study is found that specifically addresses the financial management competence of a TMT in the entrepreneurial context. Thus, again only adjacent studies can be presented to offer initial impact indications.

Different studies determine that the amount of start-up capital and the number of financiers increase the growth prospects of NTBFs.³⁶³ Other studies determine undercapitalization as a major cause of failure.³⁶⁴ This signals that competence to acquire external funding could increase success. A financing knowledge related item is used in the study by *Doutriaux, J. and Simyar, F., 1992*. The researchers find that experience in financing has a significant positive impact on sales. With regards to obtaining financing, the quality of the TMT has been identified as a major concern for financiers.³⁶⁵

Other areas of financial management might also impact success. *McMahon, R.G.P., 2001* states - referring to SMEs - that the state of financial reporting correlates positively with the performance of the firms.³⁶⁶ *Maisberger, P., 1998* find that the most frequent problem of founders in the financial domain is a delay of payments by their customers. This corresponds with the restricted capital and liquidity problems which follow as most cited problem areas by founders. Eleven percent of the respondents of the *Maisberger, P., 1998* study stated that the correct management of sales income, budgeting, and financial planning are major problem areas in the start-up process.³⁶⁷ The success relevance of these different activities in the financial field hints that competence as an antecedent to these activities fosters success.

Overall, the empirical base concerning financial practices of new business and more specifically focused on the financial management competence of entrepreneurs is too limited to make well founded conclusions. The initial research suggests, however, that a positive relationship can be expected.

³⁶³ Kulicke, M. and al., e., 1993; *Doutriaux, J. and Simyar, F., 1992*; *Tyebjee, T.T. and Bruno, A.V., 1982*.

³⁶⁴ *Bruno, A.V., et al., 1987*; *Maisberger, P., 1998*.

³⁶⁵ *Baum, J.A.C. and Silverman, B.S., 2004*; *Shane, S. and Cable, D., 2002*; *Cassar, G., 2004*.

³⁶⁶ *McMahon, R.G.P., 2001*.

³⁶⁷ *Maisberger, P., 1998, 72*.

Author/ Year	Input variable(s)	Output variable(s)	Results	Sample	Method
<i>Tyebjee, T.T. and Bruno, A.V., 1982</i>	Amount of start-up capital a.o.	Sales	Amount of start-up capital +	197 NTBFs	Frequencies, variance analysis
<i>Dou-triaux, J. and Simyar, F., 1992</i>	Financing experiences/ amount of start-up capital a.o.	Sales	Financing experiences +, amount of start-up capital +	73 NTBFs	Regression, variance-analysis
<i>Bruno, A.V., et al., 1987</i>	Initial undercapitalization/ assuming debt too early/ VC relationship a.o.	Failure	All areas were identified as major reasons for failure	10 NTBFs	Frequencies
<i>Kulicke, M. and al., e., 1993</i>	Large capital base/ number of financiers a.o.	Sales, employment and profit growth	Large capital base +, number of financiers +	93 NTBFs	Correlations
<i>Maisberger, P., 1998</i>	Diverse	Problems	Most frequent problems in the financial domain: Payment delays, restricted capital, liquidity problems.	547 Founder	Frequencies
<i>McMahon, R.G.P., 2001</i>	State of financial reporting	Performance	State of financial reporting +	1050 SMEs	Bivariate analysis

Tab. 16: Empirical studies relating to financial management competence

4.4 Empirical summary

The literature indicates that empirical research concerning competence of the TMT and the development of the NTBF is in an early stage. The limited quantitative base hinders meta-analysis. No specific quantitative competence research base was found, but a broader set of studies had to reviewed. Due to the early stage of investigation, empirical concepts about competence in general or in the specific domains are hardly standardized. Dependent success measures are diffuse, prohibiting direct comparison. Due to a lack of studies the entrepreneurial context had to be enlarged to include studies that investigate SMEs. In this respect questions arise to whether findings do apply to the entrepreneurial field as well. The empirical entrepreneurship field itself is dominated by small-scale studies and basic statistical analysis. In consequence, the empirical review is of an explorative nature; the proposed findings should be interpreted with caution.

Studies about founders' experience and background support the theories about a positive impact of competence on venture success. However, some studies also

indicate that specific advanced academic education has no impact on the founder's success.³⁶⁸ Some important forms of knowledge creation demand more than academic instruction.³⁶⁹ For this study it can serve as guide to include academic and practical experience in the assessment of competence.

The empirical findings which relate to conceptual competence are too limited to draw conclusions about its impact. The few studies signal a weak positive relationship. Yet, negative effects could arise from overstretched conceptual activity as a consequence of high conceptual competence.

Similarly, there is limited evidence that innovation competence directly impacts success positively. While some research finds a positive relationship of strategic innovation at the firm level, conflicting finding exists. Therefore, this study can contribute insights into innovation competence and its impact on venture development. Concerning enforcement competence related issues the empirical base too small to draw conclusions. This study intends to provide some initial evidence of its impacts.

With respect to the social competencies, the strongest empirical evidence exists for the teamwork dimension. Teamwork quality is generally found to benefit venture success. The other two dimensions of social competence – leadership and network competence – have not been investigated sufficiently to assess the impact on venture success. While some studies provide initial support, there is also evidence that network competence might have negative implications. This empirical finding can be explained by literature on network dynamics.³⁷⁰

Concerning the functional domains, the literature generally suggests positive effects on venture success. Especially the marketing and financial domains are found to have relevance for venture success. The effects of technology management are uncertain as some studies indicate negative effects of strong technological focus or technological skill. The findings are supported by literature on teams which argues

³⁶⁸ Schefczyk, M. and Gerpott, T.J., 2000.

³⁶⁹ Nonaka, I., 1994.

³⁷⁰ Klocke, B., 2004.

that a mix of competencies is more important than competence in one domain.³⁷¹ Since technology ventures are generally created by founders with a strong technology background, it might be more important to possess competence in the other areas. In order to investigate these effects this study specifically includes the different competence domains.

Overall, the effects relating to effects of TMT competencies on firm level success tend to be weaker. This could signal that diverse factors are important for a firm's development.³⁷² Empirical studies about which competencies foster venture success at what point in the firm's development are not found. Studies like *Kazanjian, R.K., 1988*, *Meier, A., 1998*, and *Klocke, B., 2004* indicate that there is change in tasks; yet little is investigated concerning how the competencies should evolve. Thus, the dynamic investigation of the competence effects remains another important topic for this research.

The measurements used in prior research indicate that self-assessment is a popular research tool. The limited sample sizes suggest that a multi-respondent design involving various founders while striving for a large firm sample might not be feasible. Instead, researchers report that when multi-respondent formats are used that the assessments of different respondents are similar.³⁷³ Background information of the team members can provide measures to additionally validate their self-assessments. For the design of competence measures, little support can be drawn from literature. There are no established and validated competence constructs for TMT in new firms. Yet, a measurement tool that can be closely adapted, is the well-established teamwork quality concept.³⁷⁴ Other measurement constructs need to be created drawing on various studies.

The statistical tests used in the entrepreneurship field are predominantly of basic nature (frequencies, correlations and regressions). In general reliability and validity is not assessed. This study contributes to research by illustrating the application of an advanced statistical method and by providing data on measurement characteristics.

³⁷¹ E.g. refer to *Lazear, E.P., 2002*; *Kilduff, M., et al., 2000*.

³⁷² *Terpstra, D.E. and Olson, P.D., 1993*; *Hisrich, R.D. and Peters, M.P., 2002*; *Timmons, J.A., 1999*.

³⁷³ *Chandler, G.N. and Jansen, E., 1992*; *Chandler, G.N. and Hanks, S.H., 1994*; *Müller, T.A., 2003*; *Baron, R.A. and Markman, G.D., 2003*; *Erpenbeck, J. and von Rosenstiel, L., 2003b*.

³⁷⁴ *Högl, M. and Gemünden, H.G., 2001*; *Müller, T.A., 2003*.

There are a few indications that context variables might influence the effects of competence-related characteristics on success.³⁷⁵ The literature oftentimes does not account for specific demands of the context, but uses convenience samples that include a wide variety of firms. In this research the sample is limited to firms from related technological areas. These firms have similar development paths as they all undertake own R&D, prototype development, production, and marketing. The conceptual framework of this research is presented next.

³⁷⁵ Baron, R.A. and Markman, G.D., 2003; Doutriaux, J., 1992; Covin, J.G. and Slevin, D.P., 1989; Coviello, N.E., et al., 2000.

5. Conceptual framework: Entrepreneurial-management-competence and its effects on task complexity and the success of new firms

The development of NTBFs is not a random phenomenon. The prior chapters delineated three major lines of reasoning about EMC's effects on the development and the success of new ventures: First, by definition the development of the EMC-concept assumes the relevance of the identified competencies for venture success. Second, the four presented management theories specifically capture development implications of competence. Third, empirical studies found effects of competence related concepts on the development of firms. Based on this theoretical and empirical foundation, in this chapter hypotheses are developed.

Fundamentally, the literature illustrates the close relationship between competence and activities. Competence enables activities which in consequence lead to success.³⁷⁶ At the same time, activities contribute to the development of competence. Thus, this comprehensive competence conception is expected to relate to venture success. How each competence domain affects the NTBF's development is hypothesized in this chapter. Three types of relations between competence and a NTBFs' development are put forward. First, direct effects of EMC on success dimensions will be proposed. Second, indirect effects will be proposed by introducing the concept of 'complexity of the first development task.' Third, the development of competence will be modeled by linking competence of the TMT to NTBFs activities.

In order to understand the effects of the TMT's competence on the development of the NTBF, a comparative static conceptual research design is applied, which is presented next.

³⁷⁶ Walter, A. and Gemünden, H.G., 2002; Walter, A., et al., 2003.

5.1 Design of the comparative static conceptual framework

According to the Klocke Model, activities can be divided between exploration and exploitation activities.³⁷⁷ Various companies might not perform exploration activities, because they already have a functioning production process or an established customer base at start-up. Because these companies undertake different tasks, an analysis needs to account for different contextual settings at start-up. In this study the focus is on determining the relevant competencies needed for explorative activities at start-up and how the competencies and their relevance changes as the ventures progress to exploitation activities. In order to get a precise understanding of the competencies needed to start a venture, only those firms are included in the analysis which undertake exploration activities in the technological and market domain at start-up. These are companies which do not have a production process established, but are focusing on R&D. These firms do not have an established customer base, but are establishing their customer base.

The framework of analysis at the exploration stage is depicted in figure 11. Three areas of analysis are presented: the initial entrepreneurial management competence concept, task complexity of the first development task, and success dimensions. The domains and subdomains of this concept were deducted earlier in this research. The initial entrepreneurial-management-competence refers to the very first moment when the team members got together ($t=0$).

³⁷⁷ Refer to chapter 3.2.3. Also refer to *March, J.G., 1991*.

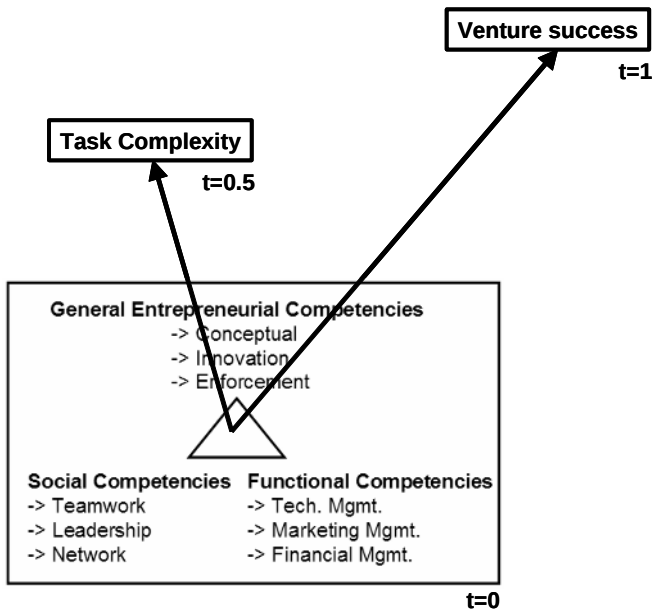


Fig. 11: EMC, task complexity and venture success at the exploration stage

The introduction of the complexity of the first development task results from theoretical and empirical findings. The literature illustrates that NTBFs face technological development activities which includes basic R&D, prototype development, production process establishment, the refinement of the production process, and the commencement of a new development cycle. In the marketing domain, the market needs to be explored, first customers need to be acquired, a customer base needs to be established, and the relationship to these customers needs to be deepened before proceeding to new markets. The theories linking competence and the development of the firm illustrate that competence leads to activities and impacts the tasks the organizations carry out. Empirical research signals that there is an intermediate dimension between competence and the success of the venture. Competence of the TMT impacts the tasks that are carried out at the firm level.³⁷⁸ This study accounts for this by introducing the complexity of the first development task. The complexity of the first development task refers to the intricacy of the first

³⁷⁸ E.g. Baron, R.A. and Markman, G.D., 2003; Cliff, J.E., et al., 2005 (forthcoming); Sandberg, J., 2000.

product development effort. A description of the concept and its sub-dimensions follows in chapter 5.2.2. Because the complexity of the first development task is determined after the initial competence reference point, but before success is determined, it is referred to as time point $t=0.5$. However, this does not imply that the time from $t=0$ to point $t=0.5$ and from $t=0.5$ to $t=1$ is equal, but that the specification of the first product development task takes place somewhere between $t=0$ and $t=1$.

The success-dimension reflects the dependent variables at the venture level. Four success dimensions reflect the complex phenomenon of venture development. Success is measured by technological, market, and financial success as well as growth of the venture up to the time when the study was undertaken.³⁷⁹ Because this reference point is the final point in time of this study and follows the specification of the complexity of the first development task, it is labeled $t=1$.

Figure 11 illustrates that the initial entrepreneurial-management competence is expected to impact the complexity of the first product development as indicated by the technology applied and the target market. Also the initial entrepreneurial-management competence of the TMT is expected to impact the success of the new venture.

In a separate analysis the current competence is assessed for those companies that are already established and which are involved in exploitation activities in the technological and market-oriented domain (see figure 12). The companies which are involved in exploitation activities have progressed from R&D to the production of goods in the technological field. In the marketing field, they have an established customer base. Again, as for new firms the effects of the different competence domains on success are evaluated. The analysis regarding established firms additionally includes the effects of the complexity of the first development task on success.

³⁷⁹ The specific success dimensions and their interdependence are described more in detail in chapter 5.2.

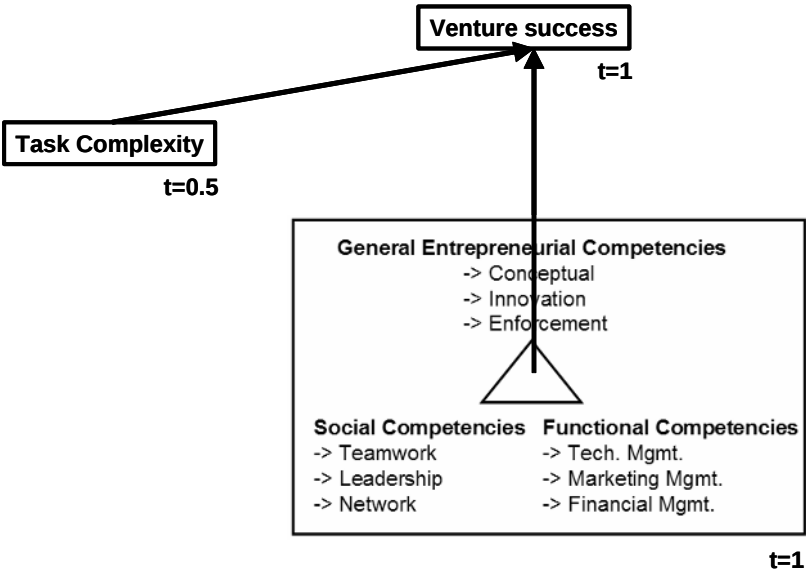


Fig. 12: EMC, task complexity and venture success at the exploitation stage

The comparative static framework allows investigating the hypothesized direct and indirect effects of competence on success. Concerning the direct effects, the impact of different competence domains on success can be tested at two development stages. With regards to indirect effects, this study analyzes how the initial competence impacts the complexity of the first development task and how in consequence the complexity of the first development tasks impacts success. Additionally, this framework allows an analysis how the competence of the TMT evolves as the NTBFs move from exploration to exploitation activities. The comprehensive conceptual framework is depicted in figure 13.

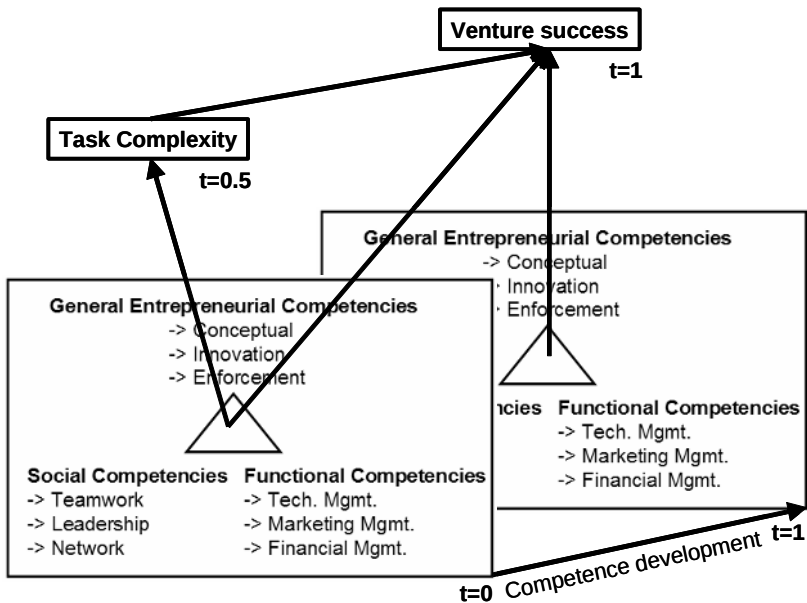


Fig. 13: EMC, task complexity and venture success at both stages

An important characteristic of causality is that the cause precedes the effect.³⁸⁰ This characteristic causes some concern in many empirical studies. The data is oftentimes obtained for one point in time and only assesses the variables for that particular point in time. In this study the same basic approach was used, because a longitudinal study was not feasible due to time constraints. In order to address the causality problem, respondents were asked to provide data referring to an earlier point in time (e.g. initial employment data, initial sales data, initial stages, and initial competencies). The accuracy of retrospective data which is documented continuously (e.g. sales and employment data) is expected to be high. Other data like the initial competence assessment might suffer from a recall bias. In order to assess the recall effect, other more objective data, like the background of the team members, and the nomological framework are used.

The current competencies (independent variables) and current success (dependent variables) are assessed at the same time. Growth, although determined at one point

³⁸⁰ Bortz, J., 1984.

in time, is a variable that relates to a time span. If the current competencies are anticipated to effect growth or certain current success dimensions are expected to impact the growth of the firm, the problems of time-reference and causality become apparent. To solve such problems, true longitudinal studies or objectively coded historical data referring to sequenced events are needed. This study did not have this type of data nor the time to generate it. Yet, the intention was to theoretically and empirically depict the complex effects of competence on firm development. When the effect of the current competence on the current success is assessed, the current competence has to be understood as an approximation of a competence level that preceded the success-determination in order to affect it. Competence is not expected to rise abruptly but to develop more continuous and path dependent.³⁸¹ The current competence level appears to be a somewhat adequate indicator of competence at an earlier point in time. When financial success (independent variable) is linked to growth (dependent variable) the empirical analysis should investigate an earlier financial success variable and a later stage growth variable. Yet, this data was not available. An approximation concept is assumed again. The growth slope determined by earlier data points is expected to apply also to later venture-growth, while the current financial success is assumed to be a reflection of earlier financial success.

Overall, this discussion shows the complex dynamic interactions between the different theoretical concepts in real world situations. An empirical model in social science always is a limited reflection of this complex reality. Rigorous research needs to raise awareness of its limitations, and findings have to be interpreted in light of these limitations. Still, this conceptual framework appears to be suitable to illuminate the causal relationships. This comparative-static analysis with an incorporation of a stage model has four major benefits:

First, the conceptual framework allows a dynamic assessment of the effects of competence on firm development. The literature review illustrated that the importance of the different competence domains changes with the development of the NTBFS. This conceptual framework provides insights into the competence needed at two stages of a firm's development.

³⁸¹ Refer to chapter 3.

Second, since two competence measurements are available - at an initial exploration stage and at an advanced exploitation stage - it can be analyzed how the competencies themselves evolve.

Third, the framework closely links the tasks that are carried out to the required competencies. The competencies needed to carry out exploration activities are analyzed, separately from those that are needed to carry out exploitation activities.

Fourth, the conceptual framework includes an investigation of the indirect effects of competence by introducing the complexity of the task and its subsequent effects on different success measures. The effects of the start-up competence on the technological and market complexity of the first development task are investigated in a first step. In a second step, it is analyzed how the first development task's technological and market complexity influence the technological and market success as well as growth.

Before describing the different expected direct and indirect relationships between competence and venture success in more detail, a clear understanding of venture success must be developed.

5.2 Venture success

A prime goal of management research is to find variables that explain the success of businesses.³⁸² The conceptualization and subsequent measurement of success of new ventures is an important, yet controversial and challenging task.³⁸³ Various dimensions of success and related research decisions are depicted in tab. 17.

³⁸² Underlying this orientation is the assumption that business success is not a random results, but result of a cause-and-effect relationship. Dietz, J.W., 1989, 277-278.

³⁸³ Murphy, G.B., et al., 1996. For a detailed discussion about success measures of innovation refer to Hauschildt, J., 1991.

Success dimension	Possible research orientations and decision options
Organizational orientation	Product-level? Product line-level? Functional area-level? Individual-level? Team-level? Company-level?
Stakeholder orientation	Depict the success perception from the founder's, owner's, manager's, employee's, investor's, or societal perspective?
Time orientation	Short vs. middle vs. long term? Static vs. dynamic perspective? Past vs. present vs. future orientation?
Success orientation	Survival vs. qualitative vs. quantitative development-measures?
Functional orientation	Financial, operational, technology, marketing goals?
Data source	Subjective data vs. objective data? Primary vs. secondary data?
Dimensionality	Uni vs. multidimensionality?

Tab. 17: Success dimensions and research orientations³⁸⁴

A first decision concerns the organizational level of aggregation the success refers to. In early stages of NTBF development, the organizational, divisional, and functional structures are not very differentiated. In general, the focus is on a single product or product family. Departments do not exist, but team-structures dominate the organization. The overall success of the venture is closely linked to the product success and the successful management of the teams.³⁸⁵ In this study competence is defined as the fit between the potential and the task. The task of the TMT is to successfully launch the venture. Thus, the organizational level selected in this study is the company as a whole.

Concerning the point of view of the success evaluation, different perspectives presented in Tab. 17 are joined in the TMT of NTBFs. Generally the TMT consists of founders, owners, and managers. Hence the success evaluation by the TMT is reflecting these different perspectives. It can be assumed that some success measures also reflect the interests of different stakeholders. For example venture growth benefits internal stakeholders like founders, owners, manager, employees and external stakeholders like investors and societal institutions. Because venture

³⁸⁴ Own conception based on Meier, A., 1998, 91, Murphy, G.B., et al., 1996; Rüggeberg, H., 1997.

³⁸⁵ Meier, A., 1998, 91.

growth reflects the interests of various stakeholders, growth is chosen as a prime success measure of this study.

The success of a venture can be assessed static (at a single point in time) or dynamic (covering a period of time). Since the development of a firm is a dynamic phenomenon, the perspective of the success dimension should be dynamic. The length of the time span can be short, middle, or long term. In order to depict the development of the NTBFs comprehensively, the longest possible time sequence appears to be most appropriate.

With regards to the definition of success, different orientations are present. Some researchers consider the pure survival of new ventures a success. This perspective can be explained by the high failure rates of new ventures. However, this perspective entails severe short-comings. If survival is the success measure, then it is mandatory to specifically include all non-surviving firms in the sample. Since this is an almost impossible task, the survival bias might have a severe distortion effect in these research settings. The success concept of survival is also questionable when considering the “living-dead” NTBFs.³⁸⁶ Additionally, survival is a very general measure that does not discriminate between developing, stagnant, or even shrinking ventures. Rather, it seems adequate to focus on development aspects as well. The development can be of qualitative and/or quantitative nature. A qualitative orientation would consider those ventures successful that improve the nature of procedures (e.g. engaging in more advanced tasks in venture development) or those ventures that progress concerning their structural setting (e.g. incorporating a functional firm structure). The quantitative orientation focuses on volume issues with regards to central success dimensions. Common quantitative development measures are sales, cash-flow, profit, or employee growth. Although, the qualitative and quantitative developments oftentimes are closely linked, the reflection of both orientations seems preferable for NTBF research in order to obtain a comprehensive assessment of the venture success.

³⁸⁶ E.g. in Germany it might be beneficial to continue a venture due to government support, fiscal, or derivative commercial reasons like shopping privileges. Refer to e.g. Brüderl, J., *et al.*, 1992.

With respect to the functional orientation of the success concept *Venkataraman, N. and Ramanujam, V., 1986* differentiate between financial and operational success which refers to all non-financial measures. Financial success is oftentimes selected as the key criterion. However, while it is a necessary condition for the existence of firms, different studies show that it is often not the primary goal of the founders.³⁸⁷ Financial success also entails problems especially when measured by profitability aspects. Profitability frequently needs years to materialize and is distorted due to fiscal, firm specific, or industry specific considerations. Hence, many researchers apply success concepts that reflect various functional dimensions.³⁸⁸ This study follows the multi-functional approach and specifically aims to identify relationships between the different success dimensions. For each functional competence domain, a specific functional success measure is used. This design allows additional nomological validation of these competence concepts. Additionally, venture-growth is used as a prime success measure. The relationships between the success-dimensions are also covered theoretically and empirically. A complex understanding of venture success can be obtained in contrast to studies that rely on isolated uni-functional measures.

With reference to the source of data, subjective and objective data are distinguished. Oftentimes objective data is considered more reliable, because it is quantitative data that is independent of personal perceptual biases (e.g. sales figures, employment figures, patents). Subjective data assesses success criteria that usually can not be obtained objectively (e.g. market or technological competitiveness). Subjective data often involves assessments of satisfaction levels; thus, it incorporates the expectation level of the assessor. Some researchers argue that subjective measures are more adequate, because the satisfaction level of the decision maker is of utmost importance and objective data of new ventures is hard to get.³⁸⁹ However, other researchers find high correlations between subjective and objective measures.³⁹⁰ In order to benefit from the advantages of both measures, and to gain a comprehensive picture of venture success, subjective and objective data sources are used in this study.

³⁸⁷ *Maisberger, P., 1998.*

³⁸⁸ *Müller, T.A., 2003; Murphy, G.B., et al., 1996; Klocke, B., 2004.*

³⁸⁹ *Meier, A., 1998, 129; Müller, T.A., 2003, 163-164; Luk, T.K., 1996.*

³⁹⁰ *Meier, A., 1998, 128-129; Dawes, J., 1999.*

Finally, success measures can be distinguished with regards to the number of dimensions. Prior arguments proposed the use of multi-dimensional measures in order to reflect the complex nature of venture development. This view is supported by various entrepreneurship researchers.³⁹¹ In this study, venture growth and functional success in the technological, market, and financial domain as well as relationships among these domains are investigated. This reflects earlier theoretical and empirical discussions that illustrated venture development as a multi-faceted phenomenon along different, interrelated dimensions.

5.3 Direct effects of EMC on venture success

The EMC construct aims to identify abilities which are closely related to the development of new ventures. Different success conceptions can be applied to evaluate the development of a new firm.³⁹² Since business growth is a major indicator of the NTBFs' development, all competencies are expected to be related to this dimension. Additionally, functional success dimensions are included to enrich the understanding of the effects which functional competencies have on their respective success dimensions and how these success dimensions impact growth.

5.3.1 Direct effects of general entrepreneurial competence on success

Conception, innovation, and proactiveness are reoccurring central concepts of entrepreneurial literature and viewed as core abilities of entrepreneurs. The following discussion resumes how ability in these domains may foster growth of the NTBFs.

5.3.1.1 Direct effects of conceptual competence on growth

Mental processes impact human actions.³⁹³ Planning enables to clarify the desired future.³⁹⁴ Subsequent actions are guided by plans to achieve goals. Especially in situations of high uncertainty, like the venture creation process, planning might be helpful.³⁹⁵ Business model development and business planning are standard activities of entrepreneurship.³⁹⁶ *Hisrich, R.D. and Peters, M.P., 2002*, 222 identify that a prime role of planning in entrepreneurship is "(...) to provide guidance and structure to management in a rapidly changing market environment." Conceptual

³⁹¹ Lumpkin, G.T. and Dess, G.G., 1996, 153-154; Müller, T.A., 2003.

³⁹² Refer to chapter 5.2.

³⁹³ Nuttin, J., 1984.

³⁹⁴ Bandura, A., 1986; Locke, E. and Latham, G., 1990.

³⁹⁵ Shane, S. and Delmar, F., 2004; Campbell, D., 1988.

³⁹⁶ Hisrich, R.D. and Peters, M.P., 2002.

skills of the TMT will aid venture growth in four ways. First, analytic strengths serve to identify the most promising business opportunities and fertile markets which allow disproportional sustainable growth. Second, more competence translates into an improved planning which might be a positive signal for important stake-holders like customers and financing partners. These stake-holders perceive the conceptual competence, e.g. in the form of documented results of planning activities like the business plan, or in direct interactions with the team members. Trust is enforced and critical resources needed for growth are provided. Third, conceptual competence will improve the quality of business models and the selection of adequate growth strategies. This ensures that resources which are at the disposition of the NTBF will be used effectively.³⁹⁷ Fourth, the implementation of the strategies in daily operations benefits from conceptual strength of the TMT. As problems arise, conceptual competence fosters ad-hoc decision making. Decisions will be based on more information and profound analysis. This is expected to improve the decision quality. Together these factors will increase growth of the NTBF.

H1: More conceptual competence is positively related to NTBF growth.

5.3.1.2 Direct effects of innovation competencies on growth

A large body of entrepreneurial business folklore and scientific publications stress the necessity of innovation in order to succeed.³⁹⁸ According to *Schumpeter, J., 1993* the ability to innovate is a central characteristic of the entrepreneur. The entrepreneur can create wealth by bringing innovations to the market and by causing creative destruction of economic systems.

Innovation competence of the TMT can lead to better business concepts as innovative teams have a more or better ideas and concepts to choose from.³⁹⁹ More innovative teams can not only generate more promising business ideas, but also broaden and enlarge them which will increase the quality of the business concepts. As the TMTs intend to realize their business concepts, challenges are likely to occur. Innovation strength can help to overcome the problems by finding new ways of

³⁹⁷ Man, T.W.Y., et al., 2002, 136.

³⁹⁸ Miller, W.L., 2001; Little, A.D., 1988; Comtesse, X., 1996; Camp, S.M., et al., 2001.

³⁹⁹ Mintzberg, H., 1989, 191; Bygrave, W.D., 1989, 10-11; Lettl, C. and Gemünden, H.G., 2005.

solving problems.⁴⁰⁰ Less innovative teams will have to rely on the pool of standard solutions or might not be able to solve a problem if it has not been solved elsewhere.

However, the presented empirical findings and theoretical literature on innovation also depict negative effects of an orientation towards innovation on business success.⁴⁰¹ Innovation abilities might lead to more difficult tasks which in consequence might decrease the likelihood of success.⁴⁰² Additionally, context factors are introduced to further understand the success effect of innovation.⁴⁰³ Dynamic environments may demand more innovation competence while less dynamic environments may require more conservative orientations and actuations.

This study follows the view of the entrepreneurial literature which assumes that innovation abilities are essential ingredients of entrepreneurship. Considering the dynamic environment the NTBFs operate in, entrepreneurial and more specifically innovation competencies are needed.⁴⁰⁴ The ability to innovate allows teams to try new ways which may result in increased effectiveness or efficiency of organizational routines and better offerings. Greater effectiveness and efficiency in the use of limited resources will translate into more growth. The new unique combination of means to achieve certain ends can also provide competitive advantages that less innovative teams will not be able to obtain. Thus, the following hypothesis is proposed:

H2: More innovation competence is positively related to NTBF growth.

5.3.1.3 Direct effects of enforcement competence on growth

As presented earlier, enforcement competence has two central dimensions which are directly related to growth. First, enforcement competence refers to taking the initiative. Second, it refers to tenacity, perseverance, and endurance.

Different teams might be able to identify business opportunities, develop innovative ideas, and create detailed plans to benefit from identified business opportunities. However, while contemplators might loose themselves in excessive planning, fear of

⁴⁰⁰ Lettl, C. and Gemünden, H.G., 2005.

⁴⁰¹ Hauschildt, J. and Salomo, S., 2005, 5-6; Also refer to chapter 4.1.2 and chapter 5.4.3.

⁴⁰² Hauschildt, J. and Salomo, S., 2005; Gilbert, J., 1996.

⁴⁰³ Hauschildt, J. and Salomo, S., 2005; Salomo, S., 2003; Covin, J.G. and Slevin, D.P., 1989.

⁴⁰⁴ Covin, J.G. and Slevin, D.P., 1989.

failure, or a quest for even better business opportunities, the entrepreneurial teams with high enforcement competence do not wait, but act to implement the plan. Literature researching entrepreneurial posture or entrepreneurial orientation concepts suggests that new ventures have to act proactively and to take the initiative in order to undo their competitors.⁴⁰⁵ Enforcement-oriented teams do not waste time, but understand the importance of speed. This can be important when there may be a limited 'window-of-opportunity'.⁴⁰⁶ Therefore, critical success factors like 'time-to-product' or 'time-to-market' are favored. This may lead to advantages in the marketing domain like branding power, skimming-pricing-premiums,⁴⁰⁷ or lower customer acquisition costs, while in the financial domain it could lead to less financing requirements, faster amortization, or higher returns on investment.⁴⁰⁸ These factors are important goals for NTBFs. Hence, new technology ventures can benefit from taking the initiative.⁴⁰⁹

It is widely reported that NTBFs face various obstacles and hindrances,⁴¹⁰ which may be overcome with tenacity and endurance. Several authors propose that entrepreneurs who possess strong commitment competencies will outgrow their peers.⁴¹¹ The implicit assumption appears to be that entrepreneurs with less commitment competencies are more likely to abandon their ventures prematurely or will hang on to their unsuccessful endeavors for too long. Overall, their activity level will be less than highly-committed and enduring entrepreneurs, leading to fewer advances according to the achievement of marker events, less productivity, and reduced growth. In accordance with these theoretical arguments the next hypothesis is proposed:

H3: More enforcement competence is positively related to NTBF growth.

⁴⁰⁵ Covin, J.G. and Slevin, D.P., 1989; Covin, J.G. and Covin, T.J., 1990; Wiklund, J., 1999.

⁴⁰⁶ Tyre, M.J. and Orlikowski, W.J., 1994.

⁴⁰⁷ Dean, J., 1969.

⁴⁰⁸ E.g. Kerin, R.A., et al., 1992.

⁴⁰⁹ VanderWerf, P.A. and J.F., M., 1997. For diverse literature proposing later mover advantages refer to VanderWerf, P.A. and J.F., M., 1997, 1510; Lieberman, M.B. and Montgomery, D.B., 1998.

⁴¹⁰ E.g. Greiner, L.E., 1972; Terpstra, D.E. and Olson, P.D., 1993; Szyperski, N. and Nathusius, K., 1977.

⁴¹¹ Man, T.W.Y., et al., 2002; Covin, J.G. and Slevin, D.P., 1989.

5.3.2 Direct effects of social competencies on growth

5.3.2.1 Teamwork-competence and growth

TMTs have an important impact on the development of firms by influencing such central aspects as strategy, product development, and eventually success.⁴¹² Teamwork competence expresses itself in high teamwork quality. *Högl, M. and Gemünden, H.G., 2001* illustrate the positive effects of good teamwork on the success of innovative projects which are assumed to have substantial similarities with the entrepreneurial task of founding a new venture. They identify six ways in which high teamwork quality can lead to success. Their arguments can be related to the competence concept as follows:

1. Communication

Teams that are competent in working together achieve a better flow of information within them. Consequently, the team members decide and act better.

2. Coordination

Teams can be viewed as mechanisms for integrating skills needed to perform a complex task. More competent teams will coordinate their joint efforts more effective and efficiently. Each member is enabled to leverage his/her respective skills better.

3. Balance of member contributions

More competent teams avoid having dominating team members, but allow all members to contribute their respective expertise, ideas, and views. In consequence, costly mistakes are avoided.

4. Mutual support

Teams that are able to work together well, do not compete amongst themselves but demonstrate constructive-cooperative behavior. This increases the quality and acceptance of their decisions.

⁴¹² Högl, M. and Gemünden, H.G., 2001; Hambrick, D.C., et al., 1996; Halebian, J. and Finkelstein, S., 1993; Kilduff, M., et al., 2000; Müller, T.A., 2003.

5. Effort

Beyond a contribution of their mutual skills, teams that are more competent in working together support their joint task with more effort. This higher level of efforts towards their team-goal facilitates goal-achievement.

6. Cohesion

The teams which are more competent in working together will stick together which can have positive effects as long as negative phenomena such as 'group-think' are avoided. Because the 'groupthink'-phenomenon is more likely to occur in long-standing teams, it may be less of a problem for the TMTs of new firms.

These six arguments delineate how competence of the team members improves overall task performance, leading to the following hypothesis:

H4: More teamwork competence is positively related to NTBF growth.

5.3.2.2 Leadership-competence and growth

General management theory attributes prime importance to the human factor to achieve competitiveness and business growth.⁴¹³ In NTBFs, human resources are assumed to be even more important due to the relative lack of other resources like production facilities, brands, intellectual property, or organizational routines. Hence, it is crucial that human resources of NTBFs are applied optimally to value creating activities. As presented in chapter 3.2.2.2, leadership competence is attributed to those TMTs that align the individual goals of the employees with the overall goals of the company. This alignment reflects the idea of optimizing the transfer of the human resource potential to actions which serve the intended company's goal. Suboptimal leadership leads to suboptimal use of human potential. An important example of suboptimal leadership in the entrepreneurial field is the excessive exercise of control and too-limited task delegation by entrepreneurs. Many entrepreneurs want to do as much as possible themselves and are reluctant to transfer responsibilities to

⁴¹³ Refer to chapter 3.3.

employees. As a result, the capacity of the TMT is restrained, economies of co-operation and specialization are not used, and growth is restricted.

Beyond using existing human resources, leadership encompasses the development of human potential through training. Various studies present evidence that human resource development programs can enhance the productivity of the individual,⁴¹⁴ leading to improved organizational performance.⁴¹⁵ In NTBFs, human resource development efforts are oftentimes informally organized and dependent on endorsement from the executive level.⁴¹⁶ Thus, leadership competence, as viewed in this study, ensures that human potential transfers into current value creation, but also focuses on expanding the future human potential. In a dynamic analysis, the two dimensions of current and future use of productive potential support the argument that leadership competence implies NTBF growth.

H5: More leadership competence is positively related to NTBF growth.

5.3.2.3 Network-competence and growth

Because the NTBF have limited resources, advantages can arise from the collaboration within value-creating networks.⁴¹⁷ *Klocke, B., 2004*, 44 identifies three major advantages of cooperation within NTBFs' business networks:

First, the NTBFs can use networking to achieve strategic goals. Examples are the reduction of risk associated with product developments, the establishment of industry standards, or reputation effects.

Second, networking can facilitate access to external resources the venture needs for its value-creation process and growth. In the technological domain, the NTBF can benefit from external research facilities or from outsourcing production capacity. In the marketing domain, NTBF can employ market research service providers or use sales-representatives. In the financial domain, external accountants are often found via entrepreneurial networking.

⁴¹⁴ Chandler, G.N., 2000a, 46; Barrett, A. and O'Connell, P.J., 2001.

⁴¹⁵ Chandler, G.N., 2000a, 46.

⁴¹⁶ Isusi, I. and Corral, A., No Year; Smith, A., et al., 1999.

⁴¹⁷ Klocke, B., 2004; Ritter, T., et al., 2002, 120.

Third, firms can leverage their own resource base. The NTBF can allow external partners to use its resources in their value-creation chain, e.g. by leasing of R&D facilities or production services to another firm. In the marketing field, the NTBF could use its customer base to market complementary products from other firms.

Thus, networking can create economies of scale and scope, generate learning-effects, and improve co-ordination.⁴¹⁸ Combining the three advantages, networking may fundamentally contribute to growth by expanding the resource base and assuring effective and efficient resource utilization.⁴¹⁹ At the same time, networking has inherent disadvantages:

First, strategic disadvantages can arise, such as strategic impediments are lock-out or lock-in effects. Lock-out effects occur when the activity within one network is an obstacle for the access to another network. Look-in effects exist when the venture is tied to a network that is strategically inconvenient.⁴²⁰

Second, potential competitors can obtain critical knowledge through networking, while the participating NTBF has little benefit.⁴²¹

Third, ineffective networking causes a waste of scarce managerial resources.

Thus, the quality of networking is of prime importance.⁴²² It can be expected that TMTs with competence in networking with external partners can reap benefits of networking, while less competent firms can not. Since competent networking benefits growth, it can be proposed:

H6: More network competence is positively related to NTBF growth.

⁴¹⁸ Larson, A., 1991.

⁴¹⁹ O'Donnell, A., et al., 2001, 749-752; Also refer to Klocke, B., et al., 2003.

⁴²⁰ Klocke, B., 2004, 44.

⁴²¹ Alvarez, S.A. and Barney, J.B., 2001.

⁴²² Alvarez, S.A. and Barney, J.B., 2001 present different alternatives to confront the inherent risks of networking.

5.3.3 Direct effects of functional management competence on functional success and growth

The EMC concept identified three central functional competencies which are considered important for NTBFs. These are the Technology Management Competence, Marketing Management Competence, and Financial Management Competence. Correspondingly, three dimensions of functional success were conceived which refer to technological, market, and financial success. Each functional competence is expected to influence its respective success dimension. At the same time, it is expected that functional competencies influence the growth of the NTBFs. The specific relationships are presented next.

5.3.3.1 Direct effects of technology management competence on technology success and growth

Technology management competence encompasses different subdomains like strategic technology management, technology analysis, or technology development. Each sub-dimension is expected to favor success.

NTBFs which prioritize technology development and define strategic goals devote more management attention and other resources to the technological domain. When goal-conflicts arise, a TMT with an elaborate technology orientation favors technology-related issues. Competence in strategic goal-setting assures a strategic approach to technology management, and specific planning on how best to achieve goals. Especially in highly turbulent environments, visions and the derived mission-statements can provide guidance for the NTBFs by serving as a north-star.⁴²³ According to *Luggen, M. and Savioz, P., 2003* technology strategies have two purposes: First, they help to decide which technology/technologies or strategic technology field(s) to pursue.⁴²⁴ Second, technology strategies can show ways to obtain technological capacity. At the implementation level, strategic goals provide an orientation. Additionally, strategic goals are mandatory for technology controlling.⁴²⁵

The analytic competence improves the relevance and the quality of the information obtained, which is the basis for technological strategy development and the

⁴²³ *Luggen, M. and Savioz, P., 2003, 5.*

⁴²⁴ Especially in larger firms this leads to a definition of a technology-portfolio.

⁴²⁵ *Luggen, M. and Tschirky, H., 2003.*

technology development process. Competence in the development of a technological potential leads to higher probabilities of achieving the technological goals, improved technological standards, faster development, and more efficient use of resources.

In general, technology strategies identify technological potentials which need to be established or secured. Due to continuous technological advance, even securing the present technological competitive position demands technological development. In general the development projects are of complex nature. The tasks are challenging and the outcome is uncertain. Additionally, time exerts a major pressure, since 'time-to-prototype', 'time-to-product', or 'time-to-market' are crucial in order to maintain technological leadership, to meet market demands, and to reduce development costs. Teams that are competent in developing a technology potential can advance faster according to the development models presented earlier, and increase the quality of their technological developments. This favors technological success and supports the growth of the organization as a whole.

Establishing a technological potential is not enough. It is also important that the technological potential is used effectively and efficiently. Effective utilization of the technological potential refers to the selection of those alternatives which offer the highest benefits. Efficient utilization implies that the process of converting the technological assets into economic value is yielding an optimum return. The technological controlling competence favors the implementation of the technological development plans.

In sum, these different technological competence domains lead to higher overall technological competitiveness. At the same time, venture growth is propelled:

- H7: More technology management competence is positively related to technology success.
- H8: More technology management competence is positively related to NTBF growth.

5.3.3.2 Direct effects of marketing management competence on market success and growth

The marketing competence comprises strategic marketing competence, analytic marketing competence, as well as transactional and relational marketing abilities.

Similar to the technological domain, a high normative attribution of importance to the marketing domain causes more management attention and resources to be devoted to this field, which fosters market-related goal achievement. Different researchers highlight the positive effects of market orientation - which has clear normative and strategic dimensions⁴²⁶ - on firm performance, especially market success and growth.⁴²⁷ Different authors stress that a strategic marketing approach (definition of target markets, positioning, and intended market share etc.) has positive effects on the market-related outcomes and growth especially in new ventures. A strategic marketing approach impacts competitive marketing factors, like the competitive environment in which the products are launched, the unique selling proposition, as well as marketing effectiveness and efficiency.⁴²⁸

Market-related information or market intelligence builds the basis for an effective market-approach.⁴²⁹ NTBFs which are more competent in gathering relevant information will make better decisions which lead to more effective and efficient marketing activities. Competence in transactional marketing favors sales directly. Thus, it impacts market share and improves the competitive market position and fosters growth.

The relationship-marketing competence has three important market-related dimensions: pre-sale, sale, and post-sale. Pre-sale relationship marketing can assist in shaping an attractive product offering. Especially in business-to-business markets relationships are an important facilitator of sales.⁴³⁰ With relationship marketing, the NTBF can establish trust as a business partner, achievement potential, professionalism, and vitality. Relational abilities can shorten the sales-cycle, and also impact the sale event, since the relationship component affects the perceived customer value.

⁴²⁶ Narver, J.C. and Slater, S.F., 1990.

⁴²⁷ Müller, T.A., 2003; Jaworski, B.J. and Kohli, A.K., 1993; Kohli, A.K. and Jaworski, B.J., 1990.

⁴²⁸ Lodish, L.M., et al., 2001; Meier, A., 1998.

⁴²⁹ Müller, T.A., 2003, 87-90; Jaworski, B.J. and Kohli, A.K., 1993.

⁴³⁰ Backhaus, K., 2003.

Different researchers underline that relationship building favors the transaction process and creates trust as well as customer loyalty, which in consequence have positive effects on customer equity and business success.⁴³¹ In the post-sale stage, relationship competence is mandatory to assure a high value-in-use of the products and customer loyalty.⁴³² Customer loyalty results in repeated sales and recommendations. After all, loyal customers mean higher customer equity.⁴³³ Accordingly, *Backhaus, K., 2003*, 710-787 highlights the importance for relationship marketing in business-to-business markets which are prime domains of new ventures.⁴³⁴

In sum, marketing-management competence impacts market success and business growth positively. This leads to the next hypotheses:

H9: More marketing management competence is positively related to market success.

H10: More marketing management competence is positively related to NTBF growth.

5.3.3.3 Direct effects of financial management competence on financial success

Financial management competence consists of the four domains strategic financial management, financing, liquidity management, and accounting.

A high awareness of the importance of finance ensures that more emphasis is placed on this area when goal conflicts arise. It is reported that there is a tendency by top teams in NTBFs due to their technological background to emphasize technology concerns on the expense of other functional areas.⁴³⁵ Hence, an increased normative awareness will attribute more management attention and resources to the financial aspects of the business which in consequence leads to better financial management.

Strategic financial goals are important to guide investment decisions. Financial planning is a central part of business planning. Treasurers attribute paramount

⁴³¹ Meffert, H., 2003; Morgan, R.M. and Hunt, S.D., 1994.

⁴³² Meffert, H., 2003.

⁴³³ Meffert, H., 2003.

⁴³⁴ Backhaus, K., 2003, 710-787.

⁴³⁵ Foo, M.D., et al., 2005; Hisrich, R.D., 1992; McMahon, R.G.P., 2001.

importance to clear financial objectives.⁴³⁶ Major benefits of financial planning arise from an identification of the most profitable business opportunities, a specification of the needed financial resources, a systematic evaluation of the assignment of scarce resources, the securing of sufficient and economical level of liquidity, and an establishment of a financial controlling system.⁴³⁷

A major task of NTBFs is financing. The TMT with higher management competence in financing can better determine their financial needs, know more about the sources of financing, and are able to obtain more financing. This has positive effects on liquidity and return on capital.⁴³⁸ In this regard, some entrepreneurship researchers understand the provision of capital as a selective system.⁴³⁹ The financial resources, which are essential for the development of NTBFs, are only provided to those businesses that meet the selection criteria of the financial intermediaries. Next to financial capital, the selected firms receive management expertise and additional resources from a support network. Since these financing institutions are received as informed agents, a selection of NTBFs by a renowned financial institution is a quality surrogate which assists the chosen firms when dealing with other stake holders.⁴⁴⁰ In the process these additional resources foster the development of the venture. Therefore, those teams that are able to obtain financing will prevail and grow faster than those with less financial resources. The firms with fewer abilities in acquiring capital need to make detouring projects in order to finance their intended projects or rely on bootstrap R&D.⁴⁴¹ Because these detouring activities are not preferred options, but started out of necessity, profits and returns will likely be less. Consequently, founders are less likely to achieve their goals concerning liquidity and profitability. Those founders that do not experience financial restrictions concerning their expansion plans can achieve higher growth rates.

Another major responsibility of executives in the financial field is liquidity management.⁴⁴² Beyond the initial acquisition of capital, the executive teams need to assure liquidity of the NTBFs since it is a necessary requirement for the operation and

⁴³⁶ Philips, A.L., 1997, 76.

⁴³⁷ Hauschildt, J., et al., 1981.

⁴³⁸ Hauschildt, J., et al., 1981.

⁴³⁹ Aldrich, H.E. and Martinez, M.A., 2001; Baum, J.A.C. and Silverman, B.S., 2004.

⁴⁴⁰ Baum, J.A.C. and Silverman, B.S., 2004.

⁴⁴¹ Winborg, J. and Landström, H., 2000; Davidson III, W.N. and Dutia, D., 1991.

⁴⁴² Philips, A.L., 1997.

existence of a firm. Ensuring a sufficient level of liquidity is mandatory to avoid insolvency and a necessary condition for profitability and growth.⁴⁴³ Those companies which are able to secure sufficient liquidity, considering negative scenarios and unexpected “kinks”, will outgrow less knowledgeable competitors.⁴⁴⁴ On the other extreme, excessive amounts of liquid assets imply an inefficient use of financial resources, since the capital could be invested elsewhere.⁴⁴⁵ TMTs that are competent in managing the NTBF's liquidity make more efficient use of capital. Growth can be propelled since capital is used efficiently and financially-caused setbacks are avoided. Thus, the ability to manage liquidity has direct implications for financial success as well as growth.⁴⁴⁶

In order to manage the efficient use of financial resources, it is indispensable to interpret financial measures.⁴⁴⁷ Top teams that are more experienced in interpreting and applying financial measures and who have at least a basic understanding of the tax system will understand the financial dynamics of a growing business and can adopt appropriate measures to ensure further growth and an adequate use of capital. This will result in an improved financial performance and faster growth. Hence, it is hypothesized that financial management ability favors the financial success and growth of new ventures.

H11: More financial management competence is positively related to NTBF financial success.

H12: More financial management competence is positively related to NTBF growth.

5.4 Indirect effects of competence on growth

So far all entrepreneurial-management-competence domains were hypothesized as being directly related to different venture success variables. As described in chapter 5.1, the effect of the different competence domains on the success dimensions can be illustrated at different points in the development of the ventures. At the same time, growth may be affected by task-dimensions and relationships among the different

⁴⁴³ Audretsch, D.B. and Elston, J.A., 2002.

⁴⁴⁴ Tushman, M.L. and Rosenkopf, L., 1992.

⁴⁴⁵ Stieff, J., 2005.

⁴⁴⁶ Hauschildt, J., et al., 1984; Wang, Y.J., 2002; Chittenden, F., et al., 1996; Jose, M.L., et al., 1996.

⁴⁴⁷ Hauschildt, J., et al., 1981; McMahon, R.G.P., 2001.

success-measures. This perspective allows assessing indirect effects of competence on the firm's growth.

5.4.1 Complexity of the first development task

NTBFs undertake a major development effort. Many researchers assume that this development effort centers on a principal development project.⁴⁴⁸ In order to differentiate between development projects, concepts like the degree of innovativeness and task complexity have been introduced.⁴⁴⁹

Task complexity can be defined by five characteristic attributes which are derived from general complexity theory.⁴⁵⁰ First, there are numerous actors involved in the task. Second, the actors have different characteristics. Third, numerous relationships exist between the different actors. Fourth, the relationships change with time. Fifth, the characteristics of the actors change over time. Additionally, *March, J. and Simon, H., 1958* identify three related characteristics of task complexity: First, the alternatives and/or consequences of actions are unknown or uncertain. Second, the tasks are characterized by inexact or unknown means-ends connections. Third, the complex tasks are composed of different subtasks which can not be separated easily into independent parts.⁴⁵¹

A high degree of innovation in general implies high-task complexity. New actors become relevant stake holders and existing partners might fulfill a new function. The existing knowledge base might have limited relevance for highly innovative tasks. The executive team is faced by unknown and uncertain alternatives as well as an increased level of different risks. Hence, more innovative tasks are likely to be perceived more complex.

Three forms of complexity can be distinguished: technological complexity, market complexity, and environmental complexity.⁴⁵² *Singh, K., 1997*, 340 defines a complex technology as "(...) an applied system whose components have multiple interactions

⁴⁴⁸ Klocke, B., 2004; Kazanjian, R.K. and Drazin, R., 1990; Galbraith, J., 1982.

⁴⁴⁹ Schlaak, T.M., 1999; Singh, K., 1997.

⁴⁵⁰ Suh, N.P., 2005.

⁴⁵¹ Campbell, D., 1988, 42.

⁴⁵² Refers to the macro-perspective of the degree of innovativeness. Salomo, S., 2003, 406-407.

and constitute a non-decomposable whole.”⁴⁵³ Technological complexity refers to the sophistication of the technology which is the basis for the products of the NTBF. Market complexity refers to the sophistication and demands of the target market. Environmental complexity is the sophistication of the surrounding of the NTBF and its customers. Characteristics of this surrounding are e.g. the infrastructure, the regulatory setting, or the influence of other stakeholders. Consistent with the functions represented in the entrepreneurial management construct, this research focuses on the technological and market-oriented dimensions of task complexity.

5.4.2 Functional competencies and task complexity

Stevenson, H.H. and Jarillo, J.C., 1990, 23 define that the entrepreneurial process is characterized by a pursuit of opportunities regardless of the resources which are currently controlled. A misleading interpretation is that the entrepreneurial event occurs arbitrarily or randomly; this would imply that characteristics of the founders do not influence the task.⁴⁵⁴ To the contrary, *Stevenson, H.H. and Jarillo, J.C., 1990*, 21 attribute prime importance to the founders' "(...) characteristics (personality, background, skills, etc.)".⁴⁵⁵ The traits-based, cognition-based, and competence-based approaches to entrepreneurial activity implicitly or explicitly reject that new ventures are path-independent.⁴⁵⁶ While a start-up firm does not have an original path, it is assumed that a path can be traced to their founders.⁴⁵⁷ The founders of a venture initially determine in which area, with which kind of offerings, based on what kind of internal arrangements, competitiveness can be established.⁴⁵⁸ Fundamental decisions regarding the entrepreneurial task for NTBFs concern the selection of the technology and the market for the first product. In order to classify technology and market-related tasks, technology and market complexity can be used.⁴⁵⁹

Cliff, J.E., et al., 2005 (forthcoming) depict that founders experiences and beliefs impact the innovativeness of the founding task. *Lefebvre, L.A., et al., 1997* show that

⁴⁵³ This definition encompasses the production process as well as the product itself. It is in contrast to the technical complexity conceived by *Woodward, J., 1965* who focuses on the production system.

⁴⁵⁴ *Stevenson, H.H. and Jarillo, J.C., 1990*, 21.

⁴⁵⁵ The phrase "(...) without the regard they currently control" in his definition stresses the acquisition and management of additional resources, beyond those that are currently dominated. It can be better understood in the context of corporate venturing when firms branch off into new activity fields.

⁴⁵⁶ For literature on path-dependency and dynamic capabilities please refer to chapter 3.4.3.

⁴⁵⁷ *Davidsson, P. and Honig, B., 2003; Kelly, L.M., et al., 2000.*

⁴⁵⁸ *Kirzner, I.M., 1997; Kirzner, I.M., 1997; Hisrich, R.D., 1992; Sapienza, H.J. and Grimm, C.M., 1997; Aldrich, H.E. and Wiedenmayer, G., 1993.*

⁴⁵⁹ Refer to chapter 5.4.1.

the personal background of SME personnel influences key activities of the ventures. The same study finds strong evidence for a relationship between characteristics like proactiveness and technology policy. *Shane, S., 2000* portrays how prior technological knowledge influences the discovery of business opportunities. Thus, first, only those entrepreneurs who possess an advanced technology understanding in a particular area are able to identify new opportunities in that area. Second, the entrepreneurs can decide if they pursue a technologically more demanding opportunity or choose a less complex technology to start with. However, since technology ventures have limited resources, it appears important that they leverage the resources they have. If a TMT has special competence in a technology field it can be expected that they will aim at more complex technologies in order to benefit from their perceived technological strength. Thus, the following hypothesis is proposed:

- H13: More initial technology management competence is positively related to technology complexity of the first product development.

Similarly, *Shane, S., 2000* illustrates how important prior market knowledge leads to the discovery of opportunities in specialized markets. Thus, parallel to the technology domain, it can be assumed that in a first step, TMTs which have more marketing abilities will identify opportunities with more demanding marketing efforts. In a second step, these teams may try to benefit from their relative marketing ability in order to gain a competitive advantage and choose more complex marketing environments. This leads to the next hypothesis:

- H14: More initial marketing management competence is positively related to market complexity of the first product development.

5.4.3 Task complexity and growth

The literature on innovativeness and the literature on effects of complexity generally highlight that with an increased degree of innovativeness/complexity the variability in outcomes increases.⁴⁶⁰ It has to be stressed that risk in this regard refers to both negative and positive outcomes.⁴⁶¹ If risk would only refer to the downside, it would be irrational for actors to take up any complex tasks. The relationship between task-

⁴⁶⁰ Hauschildt, J. and Salomo, S., 2005, 6-7. Miller, D. and Friesen, P.H., 1982.

⁴⁶¹ Sitkin, S.B. and Weingart, L.R., 1995. This is in analogy to basic concepts of financial management.

complexity and growth relates to the trade-off between risk and return known from finance. Venture teams select more complex (riskier) development tasks only if the expected return compensates for the higher risks. Thus, more complex tasks have to promise premium growth prospects.

However, the actual results of the more complex tasks might not match expectations. More complex tasks are more demanding. In highly complex development projects, more aspects need to be managed and uncertainty is greater. The TMTs might over estimate the positive effects of highly complex development tasks.⁴⁶² Some studies document the negative effects of high degrees of innovativeness and task-complexity on business performance.⁴⁶³

Other researchers propose that new firms are better suited for the challenging task of innovation.⁴⁶⁴ Thus, assuming higher risks through more complex development tasks might be beneficial for new firms. Similarly, various authors argue that the utilization of new, advanced technologies is essential for a company to create proprietary products and compete in fast growing and dynamic markets.⁴⁶⁵ The following hypotheses are proposed:⁴⁶⁶

- H15: More technological complexity is positively related to technology success.
- H16: More technological complexity is positively related to business NTBF growth.
- H17: More market complexity is positively related to market success.
- H18: More market complexity is positively related to NTBF growth.

Thus, the introduction of task complexity to the conceptual framework allows investigating if technology management competence and marketing competence have also indirect effects on business growth. Additionally, mediated effects of competence on growth can be assumed when taking into account that the different success dimensions are related.

⁴⁶² Cliff, J.E., et al., 2005 (forthcoming).

⁴⁶³ Singh, K., 1997; Meyer, M.H. and Roberts, E.B., 1986.

⁴⁶⁴ Christensen, C. and Bower, J., 1996; Hamilton, W. and Singh, H., 1992.

⁴⁶⁵ Siegel, R., et al., 1993; Roure, J.B. and Maidique, M.A., 1986; Harrison, E.L. and Taylor, B., 1997.

⁴⁶⁶ Due to the path modeling it is possible to evaluate both perspectives.

5.4.4 Functional success and growth

As described earlier, NTBFs carry out a sequence of tasks along different dimensions which are related. Significant growth, especially sales growth, occurs in later stages of development. First, technologies need to be developed and markets need to be explored and entered. It can be expected that there is a relationship between the different success dimensions. According to the development model presented in chapter 3.3.4, technological success is needed in order to achieve market success. Especially in high technology markets, technological competitiveness can be expected to favor market success since the technological dimension is an important competitive attribute.⁴⁶⁷ Thus, the following relationship is proposed:

H19: More technological success is positively related to market success.

Market success in turn can be expected to have financial implications. The PIMS-study has highlighted that a large market share favors business development, especially profitability.⁴⁶⁸ A large market share can lead to economies of scale and scope. Economies of scale and scope improve profitability and liquidity. A strong reputation and a large market share can create market dominance which further fosters sales and reduces customer acquisition costs leading to higher customer equity and financial success.⁴⁶⁹ Thus, market success is expected to favor financial success:

H20: More market success is positively related to financial success.

Additionally, financial success is expected to relate to business growth. Despite popular belief, different studies show that growth does not imply profitability.⁴⁷⁰ They could even be inversely related when strong “subsidized” growth is strategically chosen in order to capture a larger market share rapidly. Several NTBFs have followed this approach, presenting exorbitant sales growth, while incurring almost proportional losses.⁴⁷¹ The prominent use of the term “capital burn rate” illustrates

⁴⁶⁷ Park, J., 2005, 744; Oakey, R.P., 2003, 680.

⁴⁶⁸ Buzzel, R.D. and Gale, B.T., 1987.

⁴⁶⁹ Goldberg, A.I., et al., 2003; Buzzel, R.D., et al., 1975; Szymanski, D.M., et al., 1993. For detailed analysis of the relationship between market share and profitability refer to Schwalbach, J., 1991.

⁴⁷⁰ Markman, G.D. and Gartner, W.B., 2002; Chandler, G.N. and Jansen, E., 1992; Wiklund, J., et al., 2003.

⁴⁷¹ Demers, E. and Baruch, L., 2001; Wilson-Jeanselme, M. and Reynolds, J., 2005; Walters, D. and Halliday, M., 2004.

this approach.⁴⁷² The cause-effect relationship may be interpreted the other way around: financial success, as indicated by profitability and liquidity, fosters growth. If companies are able to achieve satisfactory levels of profitability and liquidity, they are able to receive more financial resources since the external capital providers can use assets or cash-flow as securities and more importantly trust a proven track record. The increased financial resources allow making more investments and therefore will facilitate growth. In order to test this view, the following hypothesis is proposed:

H21: More financial success is positively related to NTBF growth.

5.5 Venture development and the development of competencies

The preceding hypotheses presented assumptions about how competence affects different success-measures. With the development of the firm, the competencies of the TMT change. A fundamental change can be expected through the learning that takes place within the team as the venture grows. Various theoretical approaches illustrate the relationships between performing activities and competence development.

First, the development model of *Klocke, B., 2004* is based in learning theory. The basic argument of learning theory with regards to firm development is that when individuals enter new areas, they first undertake certain exploration activities to create a knowledge base in the respective area. Based on this knowledge base, the individuals exploit opportunities that exist in the respective area.⁴⁷³ Thus, along with the activities, the competence is increasing.

Second, the theory of the growth of the firm describes how managerial capacity increases as the executive team member gain experience in working together as an organized unit and deal with the challenges of managing growth. The increase in managerial capacity derives from the learning of the team as a unit.

⁴⁷² Mudambi, R. and Treichel, M., 2005; Wolff, M., 1998.

⁴⁷³ March, J.G., 1991; Yli-Renko, H., et al., 2001.

Third, according to the human capital theory, working experience increases human capital. This increase in human capital can be attributed to competence increase which occurred through business practice.

Overall, there is broad theoretical support that competence increases as the team members carry out diverse tasks. However, the change in competence over time might not be equal in all areas.

First, because the activities undertaken relate to competence development in the respective area, competence is likely to increase more in those areas which have a close relation to actual activities. In this regard the distinction between key competencies and functional competence gains importance. Functional competence was defined as competence relating to a certain functional area.⁴⁷⁴ As the function or task is carried out, a direct increase in competence can be expected. The general or key competencies, however, do not relate directly to a specific function. Thus, it can be assumed that their development does not occur directly as functional tasks are undertaken.

Second, there is evidence that some competencies may be relatively stable over time. Traits, which form part of the competence space, are rather stable over time. Key competencies can be assumed to be more stable since they are closely related to traits or the self-image of the different individuals or groups and have a longer history of development.⁴⁷⁵

Based on these considerations, this study proposes that all non-functional competencies are relatively stable over time and do not change significantly with the development of the firm.

⁴⁷⁴ Refer to chapter 3.1.2.

⁴⁷⁵ Erpenbeck, J. and von Rosenstiel, L., 2003b; Gerig, V., 1998.

- H22: When ventures pass from exploration to exploitation activities, general entrepreneurial competencies remain constant.
- H22.1: When ventures pass from exploration to exploitation activities, conceptual competence remains constant.
- H22.2: When ventures pass from exploration to exploitation activities, innovation competence remains constant.
- H22.3: When ventures pass from exploration to exploitation activities, enforcement competence remains constant.
- H23: When ventures pass from exploration to exploitation activities, social competencies remain constant.
- H23.1: When ventures pass from exploration to exploitation activities, teamwork competence remains constant.
- H23.2: When ventures pass from exploration to exploitation activities, leadership competence remains constant.
- H23.3: When ventures pass from exploration to exploitation activities, network competence remains constant.

In contrast, functional competencies are directly related to activities the team members undertake in the functional domains. As the team members undertake exploration and exploitation activities in technology, marketing, and finance, they are very likely to gain relevant competencies.

- | | |
|--------|---|
| H24: | When ventures pass from exploration to exploitation activities, functional competencies increase. |
| H24.1: | When ventures pass from exploration to exploitation activities, technology management competence increases. |
| H24.2: | When ventures pass from exploration to exploitation activities, marketing management competence increases. |
| H24.3: | When ventures pass from exploration to exploitation activities, financial management competence increases. |

5.6 Summary of hypotheses

In this chapter various hypotheses were proposed. Tab. 18 summarizes these hypotheses. In the next chapter, different methods to test these hypotheses are discussed. In chapter 7 the measurement of the constructs is presented, before these hypotheses are tested in chapter 8, based on data gathered for this quantitative study.

Research domain	Nr.	Hypothesis
Direct relationships between EMC and venture success	1	More conceptual competence is positively related to growth.
	2	More innovation competence is positively related to growth.
	3	More enforcement competence is positively related to growth.
	4	More teamwork competence is positively related to growth.
	5	More leadership competence is positively related to growth.
	6	More network competence is positively related to growth.
	7	More technology management competence is positively related to technology success.
	8	More technology management competence is positively related to growth.
	9	More marketing management competence is positively related to market success.
	10	More marketing management competence is positively related to growth.
	11	More financial management competence is positively related to financial success.
	12	More financial management competence is positively related to growth.
EMC and task-complexity	13	More initial technology management competence is positively related to technology-complexity of the first product development.
	14	More initial marketing management competence is positively related to market complexity of the first product development.
Task-complexity and venture success	15	More technological complexity is positively related to technology success.
	16	More technological complexity is positively related to business growth.
	17	More market complexity is positively related to market success.
	18	More market complexity is positively related to business growth.
Relationships between success dimensions	19	More technological success is positively related to market success.
	20	More market success is positively related to financial success.
	21	More financial success is positively related to the business growth.
Learning effects	22	When ventures pass from exploration to exploitation activities, general entrepreneurial competencies remain constant.
	22.1	When ventures pass from exploration to exploitation activities, conceptual competence remains constant.
	22.2	When ventures pass from exploration to exploitation activities, innovation competence remains constant.
	22.3	When ventures pass from exploration to exploitation activities, enforcement competence remains constant.
	23	When ventures pass from exploration to exploitation activities, social competencies remain constant.
	23.1	When ventures pass from exploration to exploitation activities, teamwork competence remains constant.
	23.2	When ventures pass from exploration to exploitation activities, leadership competence remains constant.
	23.3	When ventures pass from exploration to exploitation activities, network competence remains constant.
	24	When ventures pass from exploration to exploitation activities, functional competencies increase.
	24.1	When ventures pass from exploration to exploitation activities, technology management competence increases.
	24.2	When ventures pass from exploration to exploitation activities, marketing management competence increases.
	24.3	When ventures pass from exploration to exploitation activities, financial management competence increases.

Tab. 18: Summary of research hypotheses

6. Research process, sample and method

The preceding chapters identified relevant competencies which are expected to impact the development of new ventures. In order to get a more precise understanding of the development of NTBFs, to test the expected relationships, and to analyze the magnitude of the impact of different competencies on the different success measures in different stages of development, an empirical study was conducted. The research design of the study, the methodology, and the operationalization of the constructs are presented next.

6.1 Process of empirical research

In a first step of this empirical research, theoretical and empirical findings led to a fundamental understanding of important competencies and their effects on the development of NTBFs. The literature review yielded the comprehensive competence construct presented earlier. At the same time, the literature review was used to identify empirically validated constructs which could be applied to operationalize the constructs of the conceptual framework.⁴⁷⁶

In a second step, openly structured interviews were conducted with 27 top executives from new companies within the industries of interest to further enhance the understanding of the central competence issues and the relevance of the items constituting the constructs. In this step a private equity conference, a high-tech industrial fair and additional business contacts to NTBFs in Berlin were used to collect the information.⁴⁷⁷ In order to assure the adequacy of the development model, the findings by the Klocke study were carefully incorporated. These efforts led to a first version of a six-page standardized questionnaire.

In a third step, the first version of the questionnaire was pretested with executives of ten ventures. The pretest was used to improve the questionnaire with respect to clarity, relevance, and comprehensiveness of the issues under investigation. Special focus was given to the functional competencies and their subdomains. Additionally, the pretest was applied to assess the duration for completing the questionnaire, fatigue effects, and the layout. The pretest consisted of two parts. In a first part, the

⁴⁷⁶ Churchill, G.A.J., 1979.

⁴⁷⁷ The equity conference was biannual conference hosted by the Kreditanstalt für Wiederaufbau (KfW) and included a fair for equity seeking technological start-ups. The industry fair was the Laser- und Optikmesse Berlin (LOB).

participants were accompanied via telephone while completing the questionnaire. In a second part, semi-structured follow-up questions were presented in order to identify critical issues. The results of the pretests were drafted in protocols and led to a reconfiguration of the questionnaire. The resulting version was then used for subsequent pretests. The iterative process was finalized once further interviews yielded no improvements. The resulting final version of the questionnaire was then used for the quantitative investigation.⁴⁷⁸

The fifth step consisted of the quantitative field study. The goal was to obtain a large number of thoroughly completed questionnaires. This step presented special difficulties, because the executive teams of NTBFs are confronted with a large number of study requests.⁴⁷⁹ Starting in April 2004, members of the executive teams of young high-technology companies were contacted via visits of specialized industry fairs or by phone in order to motivate these companies to participate in the study. The contact information of firms which did not present themselves in commercial fairs was selected from registers of various technology-industry associations, by internet research, and referrals. Subsequently, the executive team members were introduced to the study. When the executives agreed to participate in the study, a questionnaire was presented. The questionnaire was offered in two formats. The candidates were asked if they would prefer a printed or an electronic version of the questionnaire.⁴⁸⁰ After the initial contact, several rounds of follow-up emails and telephone calls were launched if necessary.

The questionnaire was directed to one member of the executive team of the NTBFs following a key-informant research approach.⁴⁸¹ The introduction of the study and an initial question in the questionnaire were designed to ascertain that the respondent completing the questionnaire was part of the executive team and not an assistant. This is important since there is evidence that a member of the executive team is an adequate source of information on top team-characteristics.⁴⁸² It is desirable that different top-team members provide information to assure validity of the assess-

⁴⁷⁸ The questionnaire is attached in the appendix in the original German and a translated English version.

⁴⁷⁹ Several respondents explained that they receive an average of two questionnaires daily. Especially the biotechnology-based firms display a high degree of research saturation.

⁴⁸⁰ The electronic version of the questionnaire was produced using Microsoft Word Formula, which allowed the respondents to complete it by clicking themselves through a Word document. The electronic version was identical to the printed version.

⁴⁸¹ For a definition of the executive team please refer to chapter 2.5.

⁴⁸² Müller, T.A., 2003.

ments. However, several studies show that due to the small size of the executive team, their close interaction, and extensive involvement in the company's activities, one team member can offer reliable information.⁴⁸³ The adverse field conditions would have severely limited the sample size of two-paired questionnaires.

Despite adverse field circumstances, an impressive number of 212 NTBF completed the six-page questionnaire by the end of October 2004.⁴⁸⁴ This accomplishment can be attributed to the relevance of the questions of the study, the support of technology associations, and the efforts of the research team. Out of the 1100 contacted companies, about 600 met the participation requirements and qualified for the study. Thus, the resulting response rate of this study is about 35 percent.⁴⁸⁵ The electronic version of the questionnaire was the preferred medium. Around 80 percent returned the questionnaire electronically. In the evaluation process, the electronic version allowed an accurate transfer of the returned data into the applied statistical software packages. The importing of the data from the Word document could be achieved electronically avoiding human errors in the transformation process. Thus, this format yields high data quality.⁴⁸⁶ The parallel application of the printed version assured that the resulting sample was not biased towards computer affine respondents, which is likely to occur when exclusively relying on electronic formats.⁴⁸⁷

6.2 Sample description

Companies qualified to participate in the research when they met the following criteria: (1) they had to develop, produce, and market high-technology products (no trading businesses), (2) the age of the corporation had to be less than 15 years,⁴⁸⁸ and (3) the company had to be continuously lead by at least two persons.

The participating NTBFs are almost exclusively based in Germany. The five exceptions are founded in Austria, Switzerland, and the Netherlands and have a German-speaking member at the executive level. The technological background of the 212 NTBFs is displayed in figure 14. The various double classifications and comments by the participants illustrate close relations among these technology fields.

⁴⁸³ Chandler, G.N. and Jansen, E., 1992; Chandler, G.N. and Hanks, S.H., 1994; Erpenbeck, J. and von Rosenstiel, L., 2003b; Baron, R.A. and Markman, G.D., 2003.

⁴⁸⁴ The pretest of the questionnaire showed that about 40 minutes were needed to complete it.

⁴⁸⁵ For the qualification requirements refer to the next section.

⁴⁸⁶ Miller, T.W. and Dickson, P.R., 2001, 139.

⁴⁸⁷ Becker, J.U., 2004, 100-103.

⁴⁸⁸ For a discussion of the maximum age please refer to chapter 2.1.

Overall, it can be assumed that these companies reflect a central share of the high-technology landscape.

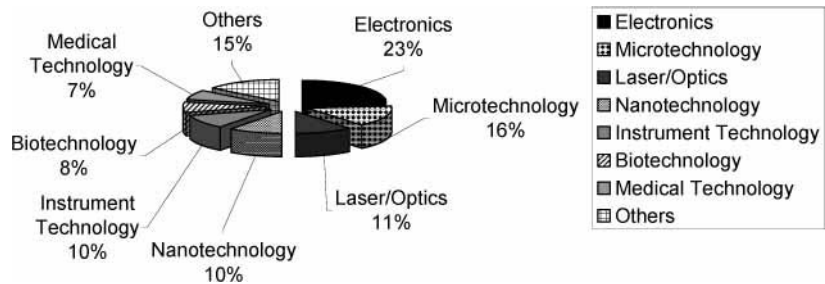


Fig. 14: Technology background of the NTBFs sample

Figure 15 presents the founding background of the participating companies. 60 percent were founded as independent ventures. Altogether 73 ventures are spin-offs representing 35 percent of all participants. Of those spin-offs, 65 percent have a research background, representing around 25 percent of all NTBFs. This share illustrates the importance of scientific research for the business landscape. Interestingly, joint-ventures play a minor part in the ventures surveyed.

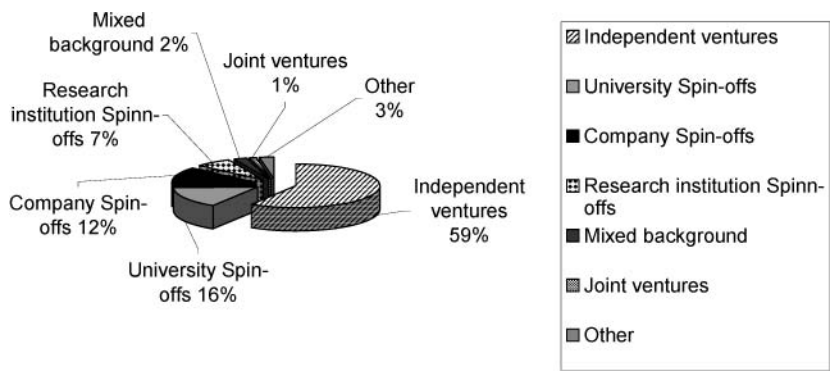


Fig. 15: Venture background of the NTBFs sample

Table 19 presents central characteristics concerning the sample of this study. The average team starts with 2.6 members and hardly adds members to their team with regards to the absolute numbers.⁴⁸⁹ After almost seven years, the executive team-size averages 2.9 members.

In contrast, the employee and sales growth illustrate a different dynamic. Within seven years, the average NTBF increases its staff from five employees to 20; adding two employees per year. The employment growth, which is exhibited by the sample, illustrates the growing challenge of managing the NTBF. Early on, leading and directing three employees appears to be manageable, by relying on immediate contact and informal exchange; especially when it is taken into account that between two and three executives head the firm. To lead a company with 20 employees is already a more challenging task. Because the average executive team consists of three persons, it still can be carried out in a direct matter. However, with further growth of the company, it appears obvious that management systems and a different leadership approach will be needed.

⁴⁸⁹ For a detailed analysis of the team member development please refer to chapter 8.1.3.

The sales growth reflects the dynamic development of the firms. On average, NTBFs grew their sales from 223,000 Euros to 1.6 million Euros. Combining the sales growth with the employment growth it can be assumed that most of the sampled companies grow profitably, since the average sale per employee is about 70,000 Euros. The average number of years to achieve a break-even supports this argument. The average company achieves its break-even in the fourth year of existence. These numbers manifest the importance of NTBFs for economic development. However, these numbers are not representative of all NTBFs, because firms which have ceased to exist are not included in this study.

Characteristic of Venture	Mean	Median	SD	Minimum	Maximum	N
Number of executive-team members (Start-up)	2.6	2.0	0.89	2.0	6.0	211
Number of executive-team members (Current)	2.9	2.0	1.38	2.0	9.0	211
Number of employees (Start-up)	5.3	3.0	9.82	1.0	100.0	211
Number of employees (Current)	19.9	9.0	32.84	2.0	324.0	209
Sales in thousands of Euro (Start-up)	222.5	50.0	674.68	0.0	6,297.0	194
Sales in thousands of Euro (Current)	1,594.7	600.0	3,013.14	0.0	3,3147.0	190
Number of product series (Start-up)	1.4	1.0	3.08	0.0	40.0	195
Number of product series (Current)	5.5	4.0	7.96	0.0	70.0	191
Sales growth per annum	177.1	71.5	329.1	-58.0	3,011.0	198
Employee growth per annum	2.0	1.1	2.85	-3.8	22.5	209
Number of years to Break-Even	3.7	3.0	2.77	0.0	13.0	164
Age	6.7	6.0	3.83	1	15.0	211

Tab. 19: Central characteristics of the NTBFs sample

6.3 Method of empirical study

6.3.1 Method selection for analysis of structural equation models

In order to analyze the expected relationships between the entrepreneurial-management-competence construct and the development of the NTBFs, it is important to choose an appropriate method and to apply the method in a correct manner. A review of prominent academic business publications reveals the rising importance of advanced statistical methods, especially structural equation models.⁴⁹⁰ Structural equation models allow to test if causal relationships exist between different latent constructs and to quantify the magnitude of their dependence.⁴⁹¹

In a structural equation model the relationship between the indicators and the latent constructs is being referred to as the measurement model, since it concerns the measurement of the latent variables.⁴⁹² Beyond this measurement concern the causal relationships between the variables under investigation (latent or directly observable) are labeled structural model. Thus, the structural model illustrates the dependencies of the different constructs, once they have been measured.

Latent constructs are used to measure variables which can not be observed immediately, e.g. like the competence of the executive team in an NTBF.⁴⁹³ In order to measure this latent characteristic empirically, indicators are used which are expected to have a direct relationship with the unobservable latent construct. There are two ways the relationship between the indicators and the latent construct can be characterized. Figure 16 presents these two possibilities. In a reflective relationship, the indicators are affected by the specification of the latent variable. A change in the latent variable causes the indicators to change. In a formative relationship, the cause-effect relationship is in the opposite direction. In a formative relationship a change of an indicator variable causes a change of the latent variable. In this respect, the latent variable can be understood as a theoretical construct which is defined by the researcher and by definition formed through a certain combination of measurable

⁴⁹⁰ Steenkamp, J.-B. and Baumgartner, H., 2000, 195-196; Bagozzi, R.P., 1994c; Baumgartner, H. and Homburg, C., 1996, 140-141.

⁴⁹¹ From a strict knowledge-theoretical perspective questions arise concerning the possibility to empirically prove hypotheses. Homburg, C. and Hildebrandt, L., 1998, 17; Popper, K.R., 2000; Popper, K.R., 2002.

⁴⁹² Another popular label applied to the measurement model is the term outer model, since it is referring to the indicator-latent variable relationship, which is generally presented in the outside.

⁴⁹³ Erpenbeck, J. and von Rosenstiel, L., 2003b.

indicators.⁴⁹⁴ In this light, indicators can be defined to be formative, if they entirely specify a construct by a linear combination.⁴⁹⁵

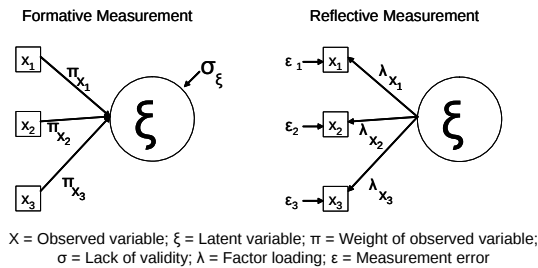


Fig. 16: Formative and reflective measurement models

A graphical example of a structural equation model is displayed in figure 17. This graphical model is termed path model. In path models the constructs are typically presented as circles while their indicators are visualized by boxes. The expected relationships are illustrated by arrows. A formative conceptualization is displayed by arrows pointing from the indicators to the respective construct while in a hypothesized reflective relationship the arrows point from the latent construct to the indicators. Since in a reflective model an alteration in of the latent construct causes the indicators to change, all indicators of the same construct should be highly correlated.⁴⁹⁶ Concerning formative models the opposite is the case. In this context it is not desired to have highly correlated indicators. Rather the intention is to apply a set of different indicators which grasp the different aspects of the latent construct. High correlations of formative indicators signal redundancy and result in misleading solutions. Thus, the avoidance of multi-collinearity between indicators is a major concern.

⁴⁹⁴ Diamantopoulos, A. and Winklhofer, H.M., 2001.

⁴⁹⁵ Chin, W.W., 1998a, 9; Bagozzi, R.P., 1994b, 333.

⁴⁹⁶ Bagozzi, R.P., 1994c, 331.

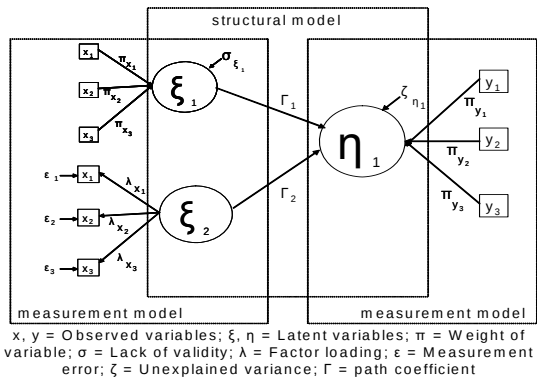


Fig. 17: Path model using formative and reflective constructs

After the specification of the structural equation model, the empirical testing of the hypotheses follows. In order to analyze the specified structural equation models, covariance-based methods like Linear Structural Relationships (LISREL) or AMOS, or variance-based methods like the Partial Least Squares (PLS) approach are prominently applied. Table 20 presents an overview of the LISREL and PLS methods.

Criteria	PLS	LISREL
Fundamental method	Variance-based	Covariance-based
Algorithm of estimation	Iterative 'least-squares' approximation	'Maximum likelihood' approximation
Distribution assumptions	Not necessary	Need to be known
Model evaluation	Heuristic method	Statistical 'fit' measures
Relationship between the indicators and the construct	Formative and reflective	Reflective
Interdependence between the constructs	Not possible in the basic model	Possible
Sample size	Small sizes are admissible	Depending on the complexity of the model, large sizes are mandatory
Application	Practice-oriented	Theory-oriented

Tab. 20: Comparison of the PLS and LISREL approach⁴⁹⁷

⁴⁹⁷ Translation from *Hahn, C.H., 2002, 107.*

Being full-information approaches, covariance-based methods like LISREL intend to reduplicate the entire covariance-matrix when estimating the model. Variance-based methods like PLS use the covariances blockwise. These methods use an iterative approach of multi-regressions to estimate the measurement model and the structural model. The covariance-based procedures lead to less-accurate approximations when comparing the variance of the residuals, while with regards to both the variance of the residuals and covariances, covariance-based methods yield more-accurate results.⁴⁹⁸ Variance-based models are less restrictive concerning certain data attributes. In order to assess the significance of the expected relationships, the data in covariance based procedure needs to have a normal distribution. This is not the case for variance-based models.⁴⁹⁹ Variance-based approaches do not demand a symmetrical distribution (homoscedasticity) of the residuals. Another major advantage of the variance-based procedures is the sample size. Especially complex conceptual frameworks require a large number of respondents in order to validate the proposed model. The variance-based models do not need a large sample size. Comparatively small samples can be used to obtain valid results.⁵⁰⁰ Thus, it can be argued that the application of variance-based methods like PLS is advantageous, especially to support complex conceptual frameworks.⁵⁰¹ For the selection of the appropriate method of analysis, construct specifications are also important. Variance-based models can assess formative and reflective specified constructs; covariance-based methods are primarily designed for reflective constructs.⁵⁰²

Various arguments support the selection of the PLS approach for this study. First, while the sample size of 212 participating ventures can be considered large enough to apply methods like LISREL or AMOS, it still seems more adequate to employ PLS, since part of the calculations involve significantly less cases. Second, it is unlikely that the variables under investigation will follow a normal distribution. Rather, in other studies as well as this one the self-reported data tends to be slightly skewed to the left. Fourth, the conceptual framework represents a comprehensive and complex design. This level of comprehensiveness would severely limit the possibilities of interpreting the model estimations. The fifth argument concerns the construct

⁴⁹⁸ Herrmann, A., et al., 2004, 6.

⁴⁹⁹ Fornell, C. and Cha, J., 1994, 2; Fornell, C. and F.L., B., 1982; Herrmann, A., et al., 2004, 6.

⁵⁰⁰ Hahn, C.H., 2002, 107; Chin, W.W., 1998b; Herrmann, A., et al., 2004, 8-9.

⁵⁰¹ Fornell, C. and F.L., B., 1982.

⁵⁰² The superficial observation of this fundamental difference led to problematic construct specifications and the erroneous application of statistical methods. Eggert, A. and Fassott, G., 2003.

specifications. As will be illustrated in chapter 7, central competencies as well as the success dimensions are of a formative nature. The formative specification favors the utilization of variance-based models. Thus, due to the estimation quality, sample size, distribution assumptions, framework adequacy and construct specifications, the PLS approach is the prime statistical method applied in this research.⁵⁰³ Other statistical methods are used additionally to enhance the interpretation of the data and for controlling purposes. These methods include exploratory factor analysis, confirmatory factor analysis, correlation and variance analysis, multiple regressions, and t-tests.⁵⁰⁴

6.3.2 Description of the partial least square approach

Wold developed the PLS-method to evaluate the compatibility of hypothesized relationships between different constructs which can be measured directly or indirectly with empirical data.⁵⁰⁵ In the process, multiple regressions and principal component analysis are applied. Overall, the PLS approach uses an iterative approximation method to determine the latent constructs and the path model. Figure 18 presents the basic functioning of the calculation procedure.

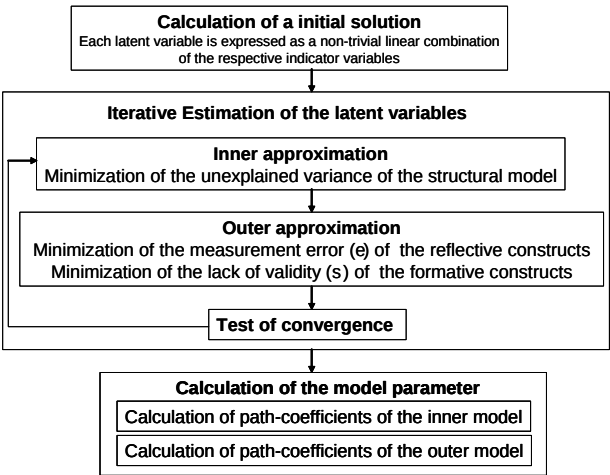


Fig. 18: Estimation process of the PLS-algorithm⁵⁰⁶

⁵⁰³ Herrmann, A., et al., 2004; Fornell, C. and F.L., B., 1982; Chin, W.W., 1998a; Bagozzi, R.P., et al., 1991; Bookstein, F.L., 1980.
⁵⁰⁴ For the calculations the software packages PLS Graph 3.0, LISREL 8.51 and SPSS 12.0 were used.
⁵⁰⁵ Wold, H., 1982, 25.
⁵⁰⁶ Kern, E., 1990, 87.

In a first step, all latent variables are estimated using regression models, assuming in each case, that the neighboring latent variables are known. The starting values in this operation are arbitrarily set. Since the regression is aimed at minimizing the unexplained variance, the regression approach reflects statistically the partly least square method.⁵⁰⁷ In a second step, the preliminary results for the latent variables are used to obtain an approximation of the relationships between the constructs minimizing again the unexplained variance while temporarily assuming that the rest of the model is determined. The determination of the estimates can be achieved by three possible weighting schemes. These are the path weighting scheme, the centroid weighting scheme, and the factor weighting scheme. Though there is a conceptual difference between these weighting schemes; the difference in the results is generally marginal.⁵⁰⁸ In a third step, the latent variables or measurement models are recalculated using the structural model results of the second step. Following this step a test of convergence is undertaken. If the results of the last approximation exceed the values of the previous approximation, another iteration cycle is started until the improvement is smaller than a predefined value. Though each calculation step is only searching for a partial optimal solution, the iteration process assures an optimum solution for the entire model. Thus, this approach is iteratively minimizing the unexplained variance of the inner model, the unexplained variance of the outer formative models, and the residual variances of the outer reflectively specified constructs.⁵⁰⁹

6.3.3 Evaluation of measurement and structural models

The evaluation of a structural equation model has two fundamental assessment tasks. On one hand the measurement model needs to be tested. On the other hand the structural model needs to be evaluated. Accordingly, different authors propose a two step process:⁵¹⁰ In a first step the measurement model is assessed. Once it is assured that the measurement of the constructs is adequate, in a second step the structural relationship between the constructs and the quality of the overall model are evaluated.

⁵⁰⁷ Hahn, C.H., 2002, 103.

⁵⁰⁸ Lohmüller, J.B., 1989, 42.

⁵⁰⁹ For a extensive description of the PLS approach refer to Fornell, C. and Cha, J., 1994.

⁵¹⁰ Anderson, J.C. and Gerbing, D.W., 1982, 453.; Fornell, C. and Larcker, D., 1981, 45; Hulland, J., 1999, 20.

6.3.3.1 Evaluation of the measurement model

A questionnaire format was used to obtain the information to assess a variety of parameters which are supposed to measure the level of different latent constructs. Due to this procedure, systematic and stochastic measurement errors must be expected.⁵¹¹ In order to assess the quality of this measurement and the errors involved, an analysis of the measurement model is indispensable. Two forms of construct conception were presented earlier. These are the formative and the reflective approach. The evaluation of the measurement model differs according to the conceptual setting.

6.3.3.1.1 Evaluation-criteria for reflective constructs

Due to the extensive use of reflective constructs, various studies delineate evaluation criteria of reflective constructs.⁵¹² In this regard reliability and validity of the measurement model are principal evaluation criteria.⁵¹³

Reliability concerns the credibility of the measurement model. On one hand, the reliability of each indicator can be assessed. On the other hand, the reliability of the construct can be evaluated.

The *indicator reliability* can be assessed by the indicator loadings (λ) and the *t*-values of the loadings. The indicator loadings are correlations of the indicators with their respective construct.⁵¹⁴ Indicator loadings beyond .7 are desired, which imply that there is more shared variance between an indicator and its construct than error variance. In practice, however, the threshold is generally considerably lower at .5 or .4 when items are expected to reflect important dimensions of the construct and scale development is in early stages.⁵¹⁵

The loadings of the indicators should be significant.⁵¹⁶ A *t*-test can be employed which evaluates whether the factor loadings differ significantly from 0.⁵¹⁷ The *t*-value is the quotient of the factor loading and the standard error (SE) of the estimation:

⁵¹¹ Bagozzi, R.P., 1994a.

⁵¹² E.g. Hulland, J., 1999; Fornell, C. and Larcker, D., 1981; Edwards, J.R. and Bagozzi, R.P., 2000; Bagozzi, R.P., et al., 1991.

⁵¹³ Churchill, G.A.J., 1979, 65.

⁵¹⁴ Hulland, J., 1999, 198.

⁵¹⁵ Hulland, J., 1999, 198.

⁵¹⁶ Hair, J.F., et al., 1998, 111.

⁵¹⁷ Jöreskog, K.G. and Sörbom, D.S., 1989, 41.

$$t(x_i) = \frac{\lambda_{x_i}}{SE_{x_i}}$$

T-values should exceed 1.97 which implies a 5% level of significance for a two-tailed distribution test.⁵¹⁸

In order to evaluate the *reliability of a latent construct*, the concurrence of different indicators reflecting the latent variable is calculated which is labeled internal consistency of the construct.⁵¹⁹ Measurement criteria used to assess the internal consistency of a construct are Cronbach's-alpha, composite reliability, and the average variance extracted.

The Cronbach's-alpha coefficient⁵²⁰ is the average correlation-coefficient of all possible combinations of half-scales of a construct.⁵²¹ It can assume values between 0 and 1. High correlations among the indicators cause high Cronbach's-alpha values while values close to zero signal that the different indicators are uncorrelated. Generally it is proposed that the Cronbach's-alpha should exceed .7 in order to call a measurement reliable.⁵²² However, the Cronbach's alpha coefficient depends on the number of indicators which reflect the construct.⁵²³ A meta-analysis of *Peterson, R.A., 1994* depicts that for scales of two or three items lower Cronbach's alpha coefficients can be expected.⁵²⁴ Thus, different authors propose to adjust the threshold criteria for scales with few indicators to .5.⁵²⁵ If the Cronbach's alpha does not meet the threshold requirement, the item-to-total correlations are considered. The item-to-total correlations specify the correlation of a measurement item with the sum of all items pertaining to a construct.⁵²⁶ If Cronbach's-alpha is below the critical value, those items are eliminated which display the weakest item-to-total correlation.⁵²⁷

⁵¹⁸ Bagozzi, R.P. and Baumgartner, H., 1994, 404.

⁵¹⁹ Churchill, G.A.J., 1979, 68.

⁵²⁰ Cronbach, L.J., 1951.

⁵²¹ Homburg, C. and Giering, A., 1996, 8.

⁵²² Backhaus, K., et al., 2000; Nunnally, J.C., 1978, 245.

⁵²³ Homburg, C. and Giering, A., 1996, 8, Cronbach, L.J., 1951.

⁵²⁴ Peterson, R.A., 1994, 389.

⁵²⁵ Schlaak, T.M., 1999, 153; Peterson, R.A., 1994, Peter, S.I., 1997, 180 sets the minimum requirement to .4.

⁵²⁶ Nunnally, J.C., 1978, 279.

⁵²⁷ Churchill, G.A.J., 1979, 68.

The composite reliability is defined as follows:⁵²⁸

$$\rho_n = \frac{(\sum_i \lambda_{y_i})^2}{(\sum_i \lambda_{y_i})^2 + \sum_i \text{var}(\varepsilon_{y_i})}$$

Thus, it is a measure which relates factor-loadings and measurement error (ε_{y_i}). The composite reliability should exceed .7. *Fornell, C. and Larcker, D., 1981* argue that the composite reliability measure is superior to Cronbach's alpha, because it uses the item loadings obtained in the nomological network.

A third measure to evaluate internal consistency is the Average Variance Extracted (AVE). The AVE is calculated as follows:⁵²⁹

$$AVE = \frac{\sum_i \lambda_{y_i}^2}{\sum_i \lambda_{y_i}^2 + \sum_i \text{var}(\varepsilon_{y_i})}$$

Again this measure relates indicator loadings and measurement error. It captures the average variance of a construct which is explained by its indicators. Values beyond .5 signal that the variance captured by the construct is larger than the measurement error; hence a threshold requirement is proposed.⁵³⁰

The concept of *validity* reflects if a measurement concept corresponds to the concept which is intended to be measured.⁵³¹ In order to assess the validity of a measurement concept, four specific types of validity assessments exist.⁵³² While the first two focus on inner-construct characteristics, the third and fourth concepts propose an analysis of the relationship of the construct under investigation with other constructs.

First, a content validity evaluation explicitly addresses the question whether the intended content of the measured construct corresponds to the content which was

⁵²⁸ *Fornell, C. and Larcker, D., 1981, 45.*

⁵²⁹ *Fornell, C. and Cha, J., 1994, 69.*

⁵³⁰ *Fornell, C. and Larcker, D., 1981, 45-46.*

⁵³¹ *Bortz, J., 1984, 138.*

⁵³² *Homburg, C. and Giering, A., 1996.*

intended to be measured. This includes an analysis if all relevant aspects of the construct are reflected by the measures. Several authors underline the importance of a thorough development of the measurements to assure validity of the construct.⁵³³ Additionally, exploratory factor analysis can be an appropriate method to evaluate indicators with regards to the underlying concepts. Exploratory factor analysis explores the structure of data in order to identify indicators which pertain to common factors, and to condense the number of indicators to few factors.⁵³⁴ The indicator loadings of an explorative factor analysis⁵³⁵ should exceed .5, while the loadings on other factors should be considerably smaller. The cumulated explained variance of a factor should surpass .5.⁵³⁶

Second, convergence validity assesses whether different attempts to measure the same construct yield corresponding results.⁵³⁷ A common criterion for the evaluation of convergence validity is the correlation among the different indicators, because strong correlations signal a high degree of conformity of the different measures and a close fit to the overall construct.⁵³⁸ Internal consistency measures can be applied to evaluate convergent validity.⁵³⁹

Third, discriminant validity captures whether different measures reflect different concepts.⁵⁴⁰ Discriminant validity focuses on correlations between different constructs. Independent constructs should display low levels of correlations.⁵⁴¹ The Fornell/Larcker-criteria is a discriminant validity test.⁵⁴² It relates the average variance explained (AVE) to the correlations among the latent constructs (R). A latent construct's average variance which is explained by its indicators should exceed the construct variances which are explained by other latent constructs ($AVE > R^2$).⁵⁴³ The number and strength of cross-loadings derived from exploratory factor analysis gives further indications about the uni-dimensionality of the hypothesized constructs.

⁵³³ Homburg, C. and Giering, A., 1996, 11-12; Homburg, C. and Baumgartner, H., 1995.

⁵³⁴ For a detailed description of explorative factor analysis refer to Backhaus, K., et al., 2000.

⁵³⁵ In this work principal component analysis is applied for factor extraction in order to achieve a comprehensive reflection of the original data. Backhaus, K., et al., 2000, 285. The varimax rotation procedure was used to facilitate the interpretability of the factor matrix.

⁵³⁶ Homburg, C., 2000.

⁵³⁷ Peter, J.P., 1981, 136; Bagozzi, R.P., 1980, 129; Bagozzi, R.P. and Phillips, L.W., 1982, 468.

⁵³⁸ Schnell, R., et al., 1999, 153-155; Peter, J.P., 1981, 136.

⁵³⁹ Hulland, J., 1999, 199.

⁵⁴⁰ Homburg, C. and Giering, A., 1996, 7; Hulland, J., 1999, 199.

⁵⁴¹ Bagozzi, R.P. and Phillips, L.W., 1982, 469.

⁵⁴² Hulland, J., 1999, 199-200.

⁵⁴³ Fornell, C. and Larcker, D., 1981.

Fourth, nomological validity aims to evaluate if the relationships of the construct within the overall framework support the assumption that the content captured by the measurement corresponds to the content which was intended to be captured.⁵⁴⁴ In order to analyze nomological validity, the strength and significance of relationships with theoretically related concepts can be evaluated.

Additionally, the measurement characteristics of reflective constructs can be evaluated by second-generation global fit measures like χ^2/df , RMSEA, GFI, and AGFI which are provided by covariance-based methods as part of confirmative factor analysis.⁵⁴⁵

χ^2 evaluates the null-hypothesis that the model is specified correctly. It assesses how well the estimated covariance matrix ($\hat{\Sigma}$) fits the covariance matrix of the sample (Σ) in relation to the sample size (n):⁵⁴⁶

$$\chi^2 = (n-1) * F(\Sigma, \hat{\Sigma})$$

If χ^2 is divided by the degrees of freedom (df) it can serve as an indicator for the appropriateness of the model.⁵⁴⁷ With good model fit, this quotient should fall below the threshold value of 2.5.⁵⁴⁸ The degrees of freedom of the model are calculated according to the following formula, where q is the number of observed variables and r is the number of estimated parameters of the model:

$$df = \frac{1}{2} * q * (q+1) - r$$

The Root Mean Square Error of Approximation (RMSEA) is another criterion assessing the fit between the modeled and the sample covariance matrixes.⁵⁴⁹ It is defined as:

⁵⁴⁴ Bagozzi, R.P., 1994a, 25.

⁵⁴⁵ Backhaus, K., et al., 2000, Homburg, C. and Baumgartner, H., 1995; Marsh, H.W., et al., 1988.

⁵⁴⁶ Marsh, H.W., et al., 1988, 392.

⁵⁴⁷ Homburg, C. and Giering, A., 1996.

⁵⁴⁸ Homburg, C. and Baumgartner, H., 1995.

⁵⁴⁹ Steiger, J., 1990, 175.

$$RMSEA = \left[\frac{\chi^2 - df}{df(n-1)} \right]^{1/2}$$

Values of .05 or below signal a good model fit. If the RMSEA exceeds .08 the estimated model should be rejected.⁵⁵⁰

The Goodness-of-Fit (GFI) and Adjusted-Goodness-of-Fit (AGFI) are measuring which part of the variance and covariance of the empirical covariance matrix can be explained by the measurement model. While the GFI does not consider the degrees of freedom of a model, the AGFI adjusts for those differences:

$$GFI = 1 - \frac{sp \left[(\hat{\Sigma}^{-1} * \Sigma - I)^2 \right]}{sp \left[(\hat{\Sigma}^{-1} * \Sigma)^2 \right]}$$

In this formula sp is the sum of the elements of the diagonal of a matrix and I is the identity matrix.

$$AGFI = 1 - \frac{q * (q+1)}{2 * df} * (1 - GFI)$$

The GFI and AGFI both range between 0 and 1. In general, models have adequate model fit if the GFI exceeds .9.⁵⁵¹ Some authors demand the same threshold value for the AGFI,⁵⁵² while others propose that models with an AGFI equal or greater than .08 are acceptable due to a downward bias of the AGFI.⁵⁵³

In sum, several measures have been developed to statistically analyze the validity and reliability of reflective constructs. Tab. 21 presents an overview of such measures and threshold values. SPSS, LISREL, and PLS Graph algorithms are used to determine the respective measures. *Herrmann, A., et al., 2004*, 16-17 attest that covariance-based analysis of the measurement model assesses the whole model

⁵⁵⁰ Hair, J.F., et al., 1998, 656.

⁵⁵¹ Homburg, C. and Baumgartner, H., 1995.

⁵⁵² Homburg, C. and Baumgartner, H., 1995; Müller, T.A., 2003.

⁵⁵³ The downward bias refers to a deterioration of the AGFI when sample size is small in relation to the degree of freedom of the model. Talke, K., 2005, 184. Sharma, S., 1996, 159; Morgan, R.M. and Hunt, S.D., 1994, 30.

and obtains more consistent estimations for the factor loadings than PLS derived figures. Thus, this study relies on factor loadings of the covariance-based approach of LISREL.

Criteria	Threshold values
Cronbach's alpha	More than three items-scales: $\geq .7$ Three or less items: $\geq .5$
Item-to-Total correlation	Elimination of the item with the smallest value if Cronbach's-alpha is below minimum requirement.
χ^2/df	≤ 2.5
RMSEA (Root Mean Squared Error of Approximation)	$\leq .08$
GFI (Goodness of Fit Index)	$\geq .8$
AGFI (Adjusted Goodness of Fit)	$\geq .8$
Indicator reliability	$\geq .4$
t-value of factor loadings (5% level)	≥ 1.98
Composite reliability	$\geq .7$
AVE (Average variance extracted)	$\geq .5$
Fornell/Larcker-criteria	$AEV > R^2$
t-value of structural model (5% level)	≥ 1.98

Tab. 21: Evaluation criteria for reflective constructs⁵⁵⁴

These threshold values represent commonly accepted values. However, the values offer no definite conclusion, since the critical values should be altered depending on e.g. samples size, model complexity, or history of the construct development.⁵⁵⁵ Still, the displayed values serve as a general guideline to evaluate the measurement quality.⁵⁵⁶

⁵⁵⁴ Adoption from Homburg, C. and Baumgartner, H., 1995; Herrmann, A., et al., 2004; Hulland, J., 1999.

⁵⁵⁵ Homburg, C. and Baumgartner, H., 1995, 153; Nunnally, J.C., 1978; Hulland, J., 1999.

⁵⁵⁶ With respect to the actual application of PLS many researchers use only a selective set of criteria to evaluate their reflective measurement model. Herrmann, A., et al., 2004, Ringle, C.M., 2004, Becker, J.U., 2004, 1. This research intends to comply with all the presented criteria.

6.3.3.1.2 Evaluation-criteria for formative constructs

Many of the criteria to test for reliability and validity in reflective contexts do not apply to formative settings.⁵⁵⁷ Due to the inverse cause-effect relationship of formative constructs in comparison to reflective constructs, internal consistency and indicator reliability measures are not useful.⁵⁵⁸

The nature of the formative constructs demands special caution developing the constructs and its indicators.⁵⁵⁹ Accordingly, the four step approach of formative construct development proposed by *Diamantopoulos, A. and Winkelhofer, H.M., 2001* is followed in this study. As presented in figure 19, the first step consists in a specific definition of the construct and a detailed description of its relevant contents. In a second step, several indicators have to be applied to cover the multiple-facets of the construct. In a third step, items which cause high multi-collinearity have to be eliminated. In a fourth step, the external validity needs to be evaluated by the nomological network the construct is placed in.

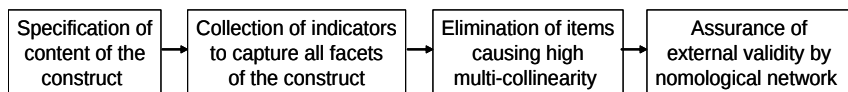


Fig. 19: Operationalization process of formative constructs⁵⁶⁰

The multi-collinearity analysis of step three refers to the analysis of linear interdependence of the indicators. Since multi-collinearity of the indicators is a severe problem in the application of formative constructs,⁵⁶¹ it is important to evaluate the multi-collinearity and reduce it if needed. Multi-collinearity analysis can be analyzed via correlation matrixes, by calculating the Variance Inflation Factor (VIF), and by assessing the Condition Index (CI) of *Belsley, D.A., et al., 1980*.

The correlation analysis investigates if two items of the same formative constructs are highly correlated. If there is a strong correlation (above .7), one of the items

⁵⁵⁷ *Diamantopoulos, A., 1999, 453-454.*

⁵⁵⁸ *Chin, W.W., 1998b, 306.*

⁵⁵⁹ *Götz, O. and Liehr-Gobbers, K., 2004, 17.*

⁵⁶⁰ *Diamantopoulos, A. and Winkelhofer, H.M., 2001.*

⁵⁶¹ In case of high multi-collinearity the influence of an indicator can not be evaluated and can lead to distorted parameters. *Diamantopoulos, A. and Winkelhofer, H.M., 2001, 272.*

should be excluded since it causes multi-collinearity.⁵⁶² In order to determine which item should be substituted, the focus of the decision should reflect the content specification of the overall construct.

The VIF, another indicator of multi-collinearity, reflects the part of the variance which can be explained by the other indicators of the construct. If the VIF is exceeding 10 it indicates high multi-collinearity.⁵⁶³

A third measure for multi-collinearity is Belsley's et al.'s CI. It is defined as:⁵⁶⁴

$$CI = \sqrt{\frac{Eigenvalue_{max}}{Eigenvalue_i}}$$

In this formula $Eigenvalue_{max}$ is the maximum Eigenvalue of the estimation. $Eigenvalue_i$ designates the Eigenvalue of the variance-covariance matrix of the non-standardized regression coefficients between the indicators and the latent variable. Values of the Belsley et al.'s CI which exceed 30 manifest significant multi-collinearity.⁵⁶⁵

Additionally, bootstrap and jack-knife procedures can be applied to evaluate the robustness of the model results. Since the PLS method does not rely on distribution assumptions, these two methods allow to calculate levels of significance for the path coefficients as well as the indicator weights and loadings.⁵⁶⁶ The weights of a formative construct represent the beta coefficients which are determined by multiple-regression. Thus, in order to interpret the results, another important criterion is the analysis of the indicator weights in formative constructs. If significant mixed-sign weights arise within a construct when the signs should be the same the resulting validity of the measurement may be questionable. Tab. 22 summarizes measures

⁵⁶² Götz, O. and Liehr-Gobbers, K., 2004, 19. In this research the correlation of formative constructs does not exceed .4. Only the correlation between the two success measures is in the .6 range.

⁵⁶³ Gujaratti, D.N., 2003, 362; Götz, O. and Liehr-Gobbers, K., 2004, 20.

⁵⁶⁴ Belsley, D.A., et al., 1980, 117-118.

⁵⁶⁵ Götz, O. and Liehr-Gobbers, K., 2004, 21. For a discussion of the condition index please refer to Hair, J.F., et al., 1998, 220-221.

⁵⁶⁶ For a presentation on the bootstrap-method refer to Efron, B. and Gong, G., 1983.

and threshold values used to evaluate formative measurement models in this study.⁵⁶⁷

Criteria	Critical value
Correlation between indicators	< .7
Variance Inflation Factor (VIF)	< 10
Belsley at al.'s Condition Index (CI)	< 30
Inter-construct correlation	< .9
t-value of indicator weights (exclusion of significant non-interpretable variables)	> 1.98
t-value of relationships with respective constructs (nomological validation)	> 1.98

Tab. 22: Evaluation criteria for formative constructs

After an accurate measurement of the concepts has been assured, the structural relationships can be interpreted.

6.3.3.2 Evaluation of the structural model

A central concept for determining the quality of the overall model is the nomological validity. As specified above, nomological validity refers to a content analysis of the established relationships between the constructs. The strength of the structural parameters indicates the causal relations among the theoretical concepts. To calculate the significance of those parameters, bootstrap procedures can be applied.

Because the PLS-approach uses multiple-regression to calculate the structural model, the explained variances of the dependent variables serve as another indicator of the quality of the established relationships and the model fit. In analogy to regressions, the explained variance (R^2) reflects the part of variance which is captured by the independent variables of the model. It is not appropriate to determine a threshold R^2 level, because it is primarily dependent on the conceptual framework

⁵⁶⁷ Anderson/Gerbing present two additional measures to evaluate content validity of indicators used in formative constructs in pre-tests environments. To calculate the two indicators experts or members of the pre-test sample are requested to classify arbitrarily presented indicators to the pre-defined constructs. Two indices are calculated based on the accuracy of this classification. *Anderson, J.C. and Gerbing, D.W., 1982, 734.* In this research the recurrence on used scales, the participation of different research experts in the respective fields and the described pre-test were intended to serve the same purpose.

and how the different constructs are operationalized and measured. Thus, factors like the source of data for dependent and independent variables, the theoretical relatedness of the constructs, or sample size can have significant effects on the explained variance level.

If the dependent variable of the model is a reflective construct, an evaluation of the Stone-Geisser-criteria can be applied as an indicator of the forecast validity of the combined structural and measurement model.⁵⁶⁸

⁵⁶⁸ Fornell, C. and Cha, J., 1994, 72; Fornell, C. and F.L., B., 1982, 450; Herrmann, A., et al., 2004, 26.

7. Presentation of the measurement model

In prior chapters different constructs were outlined and put into an overall framework. Next, the constructs need to be operationalized. This chapter is devoted to this task. First, the general operationalization of the different constructs is discussed. Second, the specific measurement-models are presented.

Constructs can be formative or reflective. The decision about the construct specification should be made carefully, since misspecifications lead to erroneous results.⁵⁶⁹ A fundamental distinction between these two construct types concerns the causality between the construct and the indicator. According to *Herrmann, A., et al., 2004*, 13-15 the question of causality between the construct and its indicators is of utmost importance when a decision between formative and reflective construct specification is made.⁵⁷⁰ After considering the theoretical characteristics of the constructs, as well as the expected and the empirically-assessed causal relationships between the constructs and its indicators, the constructs were operationalized as either formative or reflective. Of the nine subconstructs which capture the entrepreneurial-management-competence, the functional and network management competencies were formative constructs, while the remaining constructs were reflective constructs.

The theoretical deduction illustrated that functional competencies are theoretical concepts which have various interpretations and specifications. Clearly, it could not be expected that a team with, e.g., a high degree of marketing competence would be equally knowledgeable in all marketing areas at the same time. Rather the proficiency in different - maybe unrelated - marketing areas would signal overall marketing management competence. This assumption was underpinned by the empirical data indicating, e.g. low item-correlations. Though the network competence is in general operationalized in a reflective way, in this study it was operationalized in a formative way, since the network competence was measured in the three functional areas. This conception made it possible to illustrate in which functional areas the executive teams undertook network activities. In order to obtain an indicator representing the overall network competence, the three functional network abilities

⁵⁶⁹ Homburg, C. and Giering, A., 1996; Edwards, J.R. and Bagozzi, R.P., 2000, Bollen, K.A. and Lennox, R., 1991.

⁵⁷⁰ For other decision criteria refer to Jarvis, C.B., et al., 2003.

were combined in one formative construct. It was not expected that the separate functional network competencies would be highly correlated. For example, it is plausible that teams have strong abilities collaborating with external technological partners, while lacking skills in the collaboration with external marketing experts.

The five remaining entrepreneurial and social competencies were operationalized in a reflective way following literature on the respective constructs. When considering the two remaining social abilities, it was expected that executive teams possess skills in teamwork and leadership that characterize the team. This general characteristic in turn reflects itself in different activities simultaneously. The extensive studies on team-work quality and the data of this study support this assumption.⁵⁷¹ The general entrepreneurial competencies were defined as conceptual, innovation, and enforcement competencies. The theoretical characteristics of these domains also let to conclude that the top teams have respective latent attributes which express themselves in the measurement indicators. Again the obtained data supported this assumption.

All success dimensions are specified as formative constructs. The causality assumption underlying this judgment is that growth is a theoretical conception that is defined to occur when certain measures increase. Increases in different measures can be independent of each other. Thus, the growth indicators are specified similar to the growth indices commonly used in economical analysis like the gross domestic product or the human development index. The complexity of the first development task is measured by one overall item; thus a specification discussion does not apply.

7.1 Entrepreneurial-management-competence

Measuring competence is a challenging task. To grasp the various elements, special caution is demanded. In order to ensure adequate measurements, various steps were taken. First, a comprehensive theoretical foundation was built. Second, where possible, previously-validated scales or parts of scales were used. Third, reliability and validity were thoroughly tested according to the procedures and measures presented in earlier chapters. Fourth, background data about the teams was gathered to validate their self-assessments. Fifth, the conceptual framework was

⁵⁷¹ Högl, M. and Gemünden, H.G., 2001; Thompson, J.E., et al., 1997; Dreier, C., 2001; Ensley, M.D., et al., 2002.

conceived to facilitate nomological validity testing. The results of these steps are presented in this chapter. The nomological validity test will be illustrated when presenting the results of the structural models in chapter 8.2.

Each of the following subsections involves two parts. First, the conception of the items is explained and reference is made to corresponding previous studies when possible. Second, statistical measurement results are presented and interpreted.

7.1.1 General entrepreneurial competencies

7.1.1.1 Conceptual competence

The conceptual competence reflects decision-making abilities characterized by a formal, systematic, and very structured approach. Systematic decision-making involves an extensive search for information. *Miller, D., 1987* presents a formal planning style concept for the context of small and medium sized companies is presented by. *Auer, M., 2000* investigates the planning in the entrepreneurial context. Some of the items of these works were extracted or adapted to form this new concept. Tab. 23 presents the items and the respective dimensions.⁵⁷²

⁵⁷² Because this investigation uses a German questionnaire, translations are presented.

Dimension	Item
Extensive information gathering	The executive team gathers extensive information to base its decisions on.
Develop solutions analytically and structured	The executive team creates solutions analytically and in a structured manner.
Detail of considerations and analysis	Extensive considerations and analysis characterize central decisions.
Decisions based on several alternatives	When decisions are made the executive team always considers different alternatives.
Importance of systematic approach vs. intuition	When making its decision the executive team favors a systematic approach to one driven by intuition.

Tab. 23: Measurement indicators of conceptual competence

Tab. 24 highlights the measurement characteristics of this construct. The 'detail of considerations' and 'decisions based on several alternatives'-items had limited overall construct fit. The resulting construct has good measurement characteristics regarding the construct and indicator reliability as indicated by the composite reliability, average variance extracted, and indicator loadings. The goodness of fit values indicate a perfect fit which is due to the saturation of the model in LISREL. Cronbach's alpha falls slightly below the threshold value in the second measurement instant, while it is above the threshold requirement of .7 in the first measurement instant. Thus, some concern is raised regarding the construct consistency. However, since the composite reliability measure signals a reliable measurement and all other statistical requirements are met at both measurement instances, the measurement was judged to be suitable to evaluate the conceptual competence of the executive team. Still, a conservative interpretation suggests that the estimated relationships between the construct and others need to be interpreted with caution. For future research an enlargement and refining of the measurement scale is suggested.

Constructs and items	t=0		t=1		Previous research
	Loading	t-value	Loading	t-value	
Extensive information gathering	.81	10.86	.76	6.59	<i>Miller, D., 1987</i>
Develop solutions analytically and structured	.81	10.85	.80	6.79	<i>Miller, D., 1987</i>
Importance of systematic approach vs. intuition	.62	8.39	.41	4.23	<i>Auer, M., 2000</i>
t=0			t=1		
Chi-Square:	-	CA: .79	Chi-Square:	-	CA: .66
df:	-	AVE: .58	df:	-	AVE: .61
RMSEA:	-	CR: .80	RMSEA:	-	CR: .82
GFI:	-	EV: 70.11%	GFI:	-	EV: 61.30%
AGFI:	-	N: 182	AGFI:	-	N: 133

Tab. 24: Measurement characteristics of conceptual competence

7.1.1.2 Innovation competence

Innovation competence reflects abilities to conceive and to pursue new ways. This includes the departure from well-established paths, the questioning of conventions and norms, and abilities in sustained risk-taking. Some items of this construct measured the innovation orientation of the entrepreneurial orientation construct. Other items were derived from *Auer, M., 2000* reflecting innovation abilities of entrepreneurial managers. Additionally, empirically focused literature on innovative behavior e.g. *Covin, J.G., et al., 1999* and *Chandler, G.N., 2000b* provided guidelines for the conception of the innovation competence construct.

Dimension	Item
Find innovative solutions for existing problems	The executive team can easily find new (innovative) solutions for problems.
Development strength of new products and procedures	The executive team has strength in development of new products and procedures.
Importance to go its own way	The executive team attributes special importance to pursuing its own way.
Ability to develop unconventional solutions	The executive team is characterized by the ability to develop unconventional solutions further.
Risk taking	The executive team has an ability to pursue calculated risks.

Tab. 25: Measurement indicators of innovation competence

The items 'development strength' and 'risk-taking' could not be included due to limited construct fit. For the remaining items statistical measures which assess reliability and validity of the construct provide support for the adequacy of the proposed scale. Composite reliability, AVE, and factor loadings all meet the outlined requirements at both instances. The goodness of fit measures signal perfect fit. The Cronbach's alpha value is below the minimum requirement at one instant. However, again the construct can be considered reliable due to the composite reliability values. However, the relationships involving innovation competence should be judged cautiously.

Constructs and items	t=0		t=1		Previous research
	Loading	t-value	Loading	t-value	
Find innovative solutions for existing problems	.61	7.27	.63	6.33	<i>Auer, M., 2000</i>
Importance to go its own way	.60	7.21	.56	5.71	<i>Miller, D., 1987</i>
Ability to develop unconventional solutions	.81	9.02	.82	7.58	<i>Lumpkin, G.T. and Dess, G.G., 1996</i>
t=0		t=1			
Chi-Square:	-	CA: .70	Chi-Square:	-	CA: .67
df:	-	AVE: .59	df:	-	AVE: .58
RMSEA:	-	CR: .81	RMSEA:	-	CR: .80
GFI:	-	EV: 63.21%	GFI:	-	EV: 62.98%
AGFI:	-	N: 182	AGFI:	-	N: 133

Tab. 26: Measurement characteristics of innovation competence

7.1.1.3 Enforcement competence

The enforcement competence is mainly characterized by efforts to push the venture ahead, to be persistent, and to be enduring. The intention is to capture attitudes, behaviors, and abilities that reflect that “extra” effort. The entrepreneurial orientation construct included a dimension which reflected proactiveness. Again items of *Auer, M., 2000* were used who investigated the drive for performance of technology-transfer managers. Additionally, *Chandler, G.N. and Hanks, S.H., 1994* presented the quickness of response as a related item. The autonomy dimension of the entrepreneurial orientation constructs includes an item which relates to the quick responsiveness and non-hesitant nature of entrepreneurial teams.

Dimension	Item
Take initiative	The executive team prefers taking the initiative instead of waiting for things to happen.
Make big personal sacrifices	The executive team is willing to make big personal sacrifices to achieve the company's goals.
Strive for goals in spite of set backs	The executive team is pushing hard towards its goals in spite of severe set-backs and obstructions.
Try anything to be successful	The executive team is trying extremely hard to make the venture successful.
Quick decisions	Important decisions are never postponed.

Tab. 27: Measurement indicators of enforcement competence

The 'initiative' item is excluded due to poor concept fit. The statistical measures for the resulting construct are very encouraging. All of the various reliability and validity requirements of the construct are satisfied. The items have strong correlations with the overall construct. Thus, the resulting construct yields an adequate measurement of enforcement competence.

Constructs and items	t=0		t=1		Previous research																																				
	Loading	t-value	Loading	t-value																																					
Make big personal sacrifices	.72	10.48	.73	8.34	<i>Covin, J.G. and Slevin, D.P., 1989</i>																																				
Strive for goals in spite of set backs	.84	12.75	.66	7.48	<i>Auer, M., 2000</i>																																				
Try anything to be successful	.83	12.56	.73	8.33	<i>Gerig, V., 1998; Auer, M., 2000</i>																																				
Quick decisions	.58	7.90	.51	5.49	<i>Covin, J.G. and Covin, T.J., 1990</i>																																				
<table> <tr> <td colspan="3">t=0</td><td colspan="3">t=1</td></tr> <tr> <td>Chi-Square:</td><td>3.48</td><td>CA: .82</td><td>Chi-Square:</td><td>0.07</td><td>CA: .74</td></tr> <tr> <td>df:</td><td>2</td><td>AVE: .64</td><td>df:</td><td>2</td><td>AVE: .55</td></tr> <tr> <td>RMSEA:</td><td>.000</td><td>CR: .87</td><td>RMSEA:</td><td>.000</td><td>CR: .83</td></tr> <tr> <td>GFI:</td><td>1.00</td><td>EV: 66.74%</td><td>GFI:</td><td>1.00</td><td>EV: 57.91%</td></tr> <tr> <td>AGFI:</td><td>1.00</td><td>N: 182</td><td>AGFI:</td><td>1.00</td><td>N: 133</td></tr> </table>						t=0			t=1			Chi-Square:	3.48	CA: .82	Chi-Square:	0.07	CA: .74	df:	2	AVE: .64	df:	2	AVE: .55	RMSEA:	.000	CR: .87	RMSEA:	.000	CR: .83	GFI:	1.00	EV: 66.74%	GFI:	1.00	EV: 57.91%	AGFI:	1.00	N: 182	AGFI:	1.00	N: 133
t=0			t=1																																						
Chi-Square:	3.48	CA: .82	Chi-Square:	0.07	CA: .74																																				
df:	2	AVE: .64	df:	2	AVE: .55																																				
RMSEA:	.000	CR: .87	RMSEA:	.000	CR: .83																																				
GFI:	1.00	EV: 66.74%	GFI:	1.00	EV: 57.91%																																				
AGFI:	1.00	N: 182	AGFI:	1.00	N: 133																																				

Tab. 28: Measurement characteristics of enforcement competence

The review of the three concepts of general entrepreneurial competencies reveals that all measurement-concepts generally comply with the statistical requirements. Suggestions are given to enlarge the conceptual and innovation competence scale in future studies. All three competence measurements are considered reliable and valid. They can be used for further analysis.

7.1.2 Social competencies

7.1.2.1 Teamwork competence

The construct to measure teamwork-competence is an extract of the teamwork-quality-construct initially developed by Högl, M., 1998. In the process several studies applied a condensed construct and illustrated its accurate measurement characteristics.⁵⁷³ Müller, T.A., 2003 and Dreier, C., 2001 analyzed measurement characteristics and relevance of this concept in the entrepreneurial context. The thorough test of the scale provided an indication that the measurement quality would be high. Theoretically a high teamwork quality is a reflection of high competence of the team-members to work as a team. Thus, the earlier measurement model used in the entrepreneurial context is closely adopted. The following figure presents the construct as applied in this study.

Dimension	Item
Intensity of communication	The members of the executive team communicate intensively.
Openness of communication	Important ideas and information are communicated openly within the team.
Exactness of information	I am satisfied with the exactness of the information.
Coordination of tasks	The execution of the tasks is coordinated well among the executive team-members.
Mutual support	The members of the executive team support each other the best they can.
Atmosphere of cooperation	Within the executive team there is a cooperative working atmosphere.

Tab. 29: Measurement indicators of teamwork competence

⁵⁷³ Helfert, G., 1998; Lechler, T. and Gemünden, H.G., 2002.

In this study the communication items do not correspond well with the rest of the construct and were excluded. For the remaining items high indicator loadings, a high composite reliability, AVE, and Cronbach's alphas at both measurement instances indicate measurement validity and reliability. Thus, the scale provides an adequate measurement. However, in future studies it appears helpful to use the other dimensions of the Högl, M. and Gemünden, H.G., 2001 concept which reflect the effort and cohesion within the team.

Constructs and items	t=0		t=1		Previous research
	Loading	t-value	Loading	t-value	
Coordination of tasks	.73	10.96	.72	9.04	<i>Auer, M., 2000</i>
Mutual support	.92	14.86	.89	11.63	<i>Gerig, V., 1998; Auer, M., 2000</i>
Atmosphere of cooperation	.86	13.67	.82	10.44	<i>Chandler, G.N. and Hanks, S.H., 1994</i>
t=0			t=1		
Chi-Square:	-	CA: .87	Chi-Square:	-	CA: .85
df:	-	AVE: .77	df:	-	AVE: .64
RMSEA:	-	CR: .91	RMSEA:	-	CR: .84
GFI:	-	EV: 79.97%	GFI:	-	EV: 77.08%
AGFI:	-	N: 182	AGFI:	-	N: 133

Tab. 30: Measurement characteristics of teamwork competence

7.1.2.2 Leadership competence

The measurement of leadership competence proposes difficulties. A prominent discussion concerns the adequate leadership style. To avoid a normative proposition, this leadership concept intends to grasp a more fundamental idea of leadership. This refers to the ability to align employees' goals with the goals of the company.⁵⁷⁴ The motivation to work hard and the effort for constant improvement reflect this leadership ability. Delegation of responsibilities and providing freedom for employees to carry out their task independently are additional aspects of competent leadership. Fostering the development of employees is another important leadership task in order to assure long-term success.⁵⁷⁵ Since a variety of new ventures commence

⁵⁷⁴ Refer also to chapter 5.2.1.1.5.

⁵⁷⁵ Gupta, V., et al., 2004, 246-248 propose that entrepreneurial leadership consists of scenario enactment and cast enactment. Both aspects are covered by this construct.

their activities without any employees, only those respondents were asked to assess their leadership skills whose teams had to fulfill leadership responsibilities. 71 of the 112 team stated that they had no leadership responsibilities.

Dimension	Item
Offer incentives	The executive team offers its employees performance incentives.
Motivate employees to work hard	The executive team can motivate the employees to work hard.
Initiate improvement of work of employees	The executive team aims to achieve a constant improvement of the performance of its employees.
Support personal development of employees	The executive team facilitates the development of its employees.
Delegation	The executive team delegates and offers freedom to carry out the tasks.

Tab. 31: Measurement indicators of leadership competence

The ‘incentive’ and ‘delegation’ items are excluded based on poor construct fit. The validity and reliability-analysis of the resulting construct provides support for its adequacy. All of the criteria concerning reliability and validity are fulfilled at both measurement instances. Hence, this reflective construct provides an adequate measurement of leadership competence of the TMT.

Constructs and items	t=0		t=1		Previous research
	Loading	t-value	Loading	t-value	
Motivate employees to work hard.	.67	7.71	.57	6.14	Walter, A., et al., 2003
Initiate improvement of work of employees.	.84	10.06	.90	9.04	Chandler, G.N. and Jansen, E., 1992
Support personal development of employees.	.87	10.46	.67	7.07	Walter, A., et al., 2003
t=0		t=1			
Chi-Square:	-	CA: .84	Chi-Square:	-	CA: .75
df:	-	AVE: .66	df:	-	AVE: .51
RMSEA:	-	CR: .87	RMSEA:	-	CR: .71
GFI:	-	EV: 75.29%	GFI:	-	EV: 67.35%
AGFI:	-	N: 182	AGFI:	-	N: 133

Tab. 32: Measurement characteristics of leadership competence

In order to assure discriminant validity of all reflective constructs presented above, the Fornell/Larcker criteria are tested for both measurements. Tab. 33 and tab. 34 show the results of these tests. The inter-construct correlations are limited. At start-up, the highest correlation found is .5 between the leadership and the enforcement domain. The AVE of the enforcement and leadership construct is .64 and .73. This data signals discriminant validity. This finding is supported by the exploratory factor analysis. The exploratory factor analysis detects just one minor cross-loading of .45 between the enforcement competence item 'quick decisions' and the conceptual competence factor. The rest of the extracted factors reflect the constructs presented earlier with no strong cross-loadings between them.

		Conceptual	Innovation	Enforcement	Teamwork	Leadership
Competence Domain	AVE	Squared Factor Correlations				
Conceptual	.58	1				
Innovation	.59	.11	1			
Enforcement	.64	.11	.16	1		
Teamwork	.77	.12	.24	.22	1	
Leadership	.73	.10	.14	.25	.12	1

Tab. 33: Test of discriminant validity at the exploration stage⁵⁷⁶

At the exploration stage, the measurement data shows the highest inter-construct correlation between innovation and teamwork. However, the correlation is limited at .39 and the Fornell/Larcker criterion is fulfilled. The exploratory factor analysis supports the constructs presented above. There are no cross-loadings between the construct that surpass the .3-level. Clearly, the specified dimensions are independent. Thus, discriminant validity is proven for both measurements. Additionally, a confirmatory factor analysis is calculated for both stages containing all reflective constructs.⁵⁷⁷ All fit measures are adequate and meet the requirements outlined earlier.

		Conceptual	Innovation	Enforcement	Teamwork	Leadership
Competence Domain	AVE	Squared Factor Correlations				
Conceptual	.61	1				
Innovation	.58	.04	1			
Enforcement	.55	.16	.07	1		
Teamwork	.64	.08	.15	.12	1	
Leadership	.51	.07	.04	.08	.03	1

Tab. 34: Test of discriminant validity at the exploitation stage⁵⁷⁸

The preceding results show that the measurement of all reflective constructs is reliable and valid. Up to this point, all constructs were reflective. In contrast, the following constructs are formative.

⁵⁷⁶ Fornell, C. and Larcker, D., 1981.

⁵⁷⁷ Refer to appendix.

⁵⁷⁸ Fornell, C. and Larcker, D., 1981.

7.1.2.3 Network competence

Network competence is a formative construct. The central item referring to ‘constructive cooperation with others’ was adapted from the network competence construct of *Ritter, T., et al., 2002*. Ritter started with an extensive list of items and narrowed it down to a limited number of items with accurate measurement characteristics. The resulting network competence construct has been validated in the German cultural context. It was adopted and validated as an English-scale in different cultural contexts. Due to the validation history, the construct could be assumed to be adequate in the present study as well. However, in this study the intention is to evaluate networking activities in the different functional domains. One item was formed which is expected to reflect a central component of the network competence scale. This item was then used to evaluate the quality of cooperation with outside partners in different functional domains. The functional domains are the three functional competence domains which are evaluated in the competence construct. Thus, the network competence construct results from combining the abilities to constructively cooperate with technology, marketing, and financial partners. In contrast to earlier reflective conceptions, this networking construct is a formative construct consisting of three separate dimensions (tab. 35)

Dimension	Item
Constructive cooperation with technology partners.	The executive team has the ability to work co-operationally with external technology partners.
Constructive cooperation with marketing partners.	The executive team has the ability to work co-operationally with external marketing partners.
Constructive cooperation with financial partners.	The executive team has the ability to work co-operationally with external financial partners.

Tab. 35: Measurement indicators of network competence

The resulting formative construct fulfills the requirements outlined in chapter 6.3.3.1.2. All items have a considerable impact on the resulting scale. At start-up the assessment of the marketing dimension has a stronger effect on the overall scale (see tab. 36). Multi-collinearity is limited. The highest correlation between items is .37.

Constructs and items	t=0		t=1		Previous research
	Weight	VIF	Weight	VIF	
Constructive cooperation with technology partners.	.20	1.20	.41	1.07	<i>Ritter, T., et al., 2002</i>
Constructive cooperation with marketing partners.	.84	1.21	.50	1.08	<i>Ritter, T., et al., 2002</i>
Constructive cooperation with financial partners.	.21	1.13	.58	1.03	<i>Ritter, T., et al., 2002</i>
t=0 Condition-Index: 8.9		t=1 Condition-Index: 19.1			

Tab. 36: Measurement characteristics of network competence

All of the presented constructs referring to social competencies are adequate measurement models of the respective constructs at both time-references.

7.1.3 Functional competencies

The functional competencies are operationalized by second-order constructs. Each functional competence is formed of several latent sub-constructs. The second-order constructs as well as their sub-dimensions are formative constructs. By using second order-constructs it is possible to rely on a broad empirical foundation of diverse indicators. Many different facets of the construct can be captured. The resulting overarching construct condenses the effect of the separate sub-domains; thus it represents an overall assessment.

7.1.3.1 Technology management competencies

The technology management competence comprises seven subdomains containing 22 items. The relevant areas which were presented in chapter 3.2.3.1 are strategic technology management, technology analysis, internal technology development, external technology acquisition, technology protection, use of technology, and technology controlling. The scale development in all of these technology management areas is at an early stage. While technology competence is a popular field of empirical investigation, concepts measuring the management of those technologies are scarce. Most of the following measures had to be conceived, drawing on general theoretical works.

7.1.3.1.1 Strategic technology management

Four dimensions constitute the strategic technology-management displayed in tab. 37. In order to have a strategic approach, first the importance of the relevant area needs to be acknowledged. In every functional area this normative understanding was covered by one item. The term “prime importance” was applied to elicit evaluations by the respondents, because it was assumed that all respondents would attribute some importance to the respective field. In order to shape viable strategies a thorough understanding of the technology field appears mandatory. This is captured by the second item. Another item measures if the team acts in accordance to a defined strategy. This illustrates that the team possesses skills in developing a technology strategy. The last item refers to the strategic orientation in action. To select a customer order that allows technological advancement reflects a strategic long-term orientation in the technology field.

Dimension	Item
Importance of technology Management.	The executive team attributes prime importance to technology management.
Technological back-ground.	The executive team has a profound technological understanding.
Technological strategy focus.	The executive team is following a clear technology strategy.
Technological develop-ment.	The executive team primarily selects customer orders that imply a technological advancement.

Tab. 37: Measurement indicators of strategic technology management competence

The inter-item correlations of this construct are slightly increased, but meet the requirements. The highest inter-item correlation is .43. All items significantly influence the resulting construct at least at one time-reference. The technological background barely influences the first model, while the technological development has little impact in the second model.

Constructs and items	t=0		t=1		Previous research
	Weight	VIF	Weight	VIF	
Importance of technology Management.	.16	1.30	.39	1.36	<i>Gemünden, H.G. and Heydebreck, P., 1995;</i>
Technological background.	.05	1.32	.49	1.09	<i>Kenneth, I.R., et al., 1999</i>
Technological strategy focus.	.82	1.46	.49	1.31	<i>Gemünden, H.G. and Heydebreck, P., 1995;</i>
Technological development.	.20	1.11	.01	1.21	<i>Kenneth, I.R., et al., 1999</i>
t=0 Condition-Index: 20.4		t=1 Condition-Index: 24.0			

Tab. 38: Measurement characteristics of strategic technology management competence

7.1.3.1.2 Technology analysis

The technology analysis consists of three dimensions. The first two dimensions refer to objects that are investigated through technology research: competition and customers' future needs. Third, the competitive standing is evaluated by identifying strengths and weaknesses in the technology domain. An evaluation of strengths and weaknesses together with an identification of future opportunities and threats forms the popular SWOT-analysis. The SWOT analysis is a basic tool that can be used in the technology field. The item structure captures these important fields of analytic consideration.

Dimension	Item
Analysis of technology competition.	The executive team analyzes the firm's competitive standing with regards to technology.
Analysis of technology needs.	The executive team analyzes the future technological requirements of its customers.
Technology opportunity and threat identification.	The executive team has the ability to identify opportunities and threats in the technological field.

Tab. 39: Measurement indicators of technological analysis competence

The items used in the construct show some correlation. As expected, an analysis of technology competitive standing correlates with identification of opportunities and threats at .55. Still, these correlations meet the requirements concerning multi-collinearity. Theoretically and empirically, they capture different dimensions. All items impact the resulting construct at both time references.

Constructs and items	t=0		t=1		Previous research
	Weight	VIF	Weight	VIF	
Analysis of tech. competition.	.15	2.15	.38	1.61	
Analysis of tech. needs.	.50	2.19	.27	1.38	
Tech. opportunity and threat identification.	.48	1.85	.56	1.52	
t=0 Condition-Index: 13.0		t=1 Condition-Index: 22.2			

Tab. 40: Measurement characteristics of technological analysis competence

7.1.3.1.3 Internal technology development

At the heart of technology management is the development of technologies. The production-based ventures included in this study all undertake technology development, which is depicted by the development model.⁵⁷⁹ Oftentimes internal technology development is their core competence. The literature and the explorative interviews conducted for this study emphasized the importance of a well-defined development

⁵⁷⁹ Refer to chapter 3.4.5.

process which includes three fundamental elements: product-related specifications, a timeline and milestones, and a specific budget. Because time, e.g. ‘time-to-production’ or ‘time-to-market’, is a critical competitive measure, the parallel development of product and production is an indicator concerning the quality of the technology management process. Next to the linear analysis of the development process from a chronological perspective, another item was created to capture the breadth of the technological development: The ability to handle complex development projects.

Dimension	Item
Precise definition of product characteristics, time and budget definition.	The characteristics of the products, which are developed, the time-table and the budgets are precisely defined.
Synchronization of product and production development.	The executive team has experience in synchronizing product and production development.
Knowledge about management of complex projects.	The executive team has knowledge about managing complex projects.

Tab. 41: Measurement indicators of internal technological development competence

The resulting construct has good formative measurement characteristics. All items have low inter-item correlations (< .35). Other multi-collinearity measures signal little effects. All items have some influence on the constructs at both time-references.

Constructs and items	t=0		t=1		Previous research
	Weight	VIF	Weight	VIF	
Precise definition of product characteristics, time and budget definition.	.57	1.23	.54	1.17	
Synchronization of product and production development.	.39	1.43	.44	1.17	<i>Cooper, R.G., et al., 2002</i>
Knowledge about management of complex projects.	.31	1.38	.37	1.22	<i>Cooper, R.G., et al., 2002</i>
t=0 Condition-Index: 8.8		t=1 Condition-Index: 15.8			

Tab. 42: Measurement characteristics of internal technological development competence

7.1.3.1.4 External technology acquisition

External technology acquisition is the complementary aspect to internal technology development. The salient role of customer integration in technology development has been documented in numerous studies.⁵⁸⁰ Other major drivers for technology advancement are scientific institutions. Studies concerning technology clusters and development networks provide evidence that these institutions supply cutting-edge technology knowledge, research resources, and a support network.⁵⁸¹ The aim of the collaboration and integration efforts is to increase a NTBF's knowledge base. The knowledge resides primarily in a company's workforce. Thus, the facilitation of technology education supports the knowledge-flow into the organization. An additional item is included to capture technology transfer elements that are overarching and not included in the previous items. Technology transfer can have other sources of knowledge than institutional collaboration. Yet, institutional collaboration is of special importance. Thus, it appears advantageous to include two separate items.

⁵⁸⁰ E.g. Salomo, S., et al., 2003; Cooper, R.G., et al., 2002; Kohli, A.K. and Jaworski, B.J., 1990; Wagner, E.R. and Hansen, E.N., 2003.

⁵⁸¹ E.g. Baum, J.A.C. and Silverman, B.S., 2004; Pennings, J.M. and F., H., 1992; Roberts, E.B., 1991a.

Dimension	Item
Knowledge of customer integration.	The executive team is able to involve the customer closely in the development efforts.
Workforce education.	The executive team is facilitating technology education of its employees.
Collaboration with institutions.	The executive team pursues collaborates with scientific institutions in order to obtain technology know-how.
Knowledge transfer.	The executive team enables technology transfer.

Tab. 43: Measurement indicators of external technology acquisition competence

Inter-item-correlations are moderate. The highest correlation is found between the overall knowledge transfer and the cooperation with institutions. The correlation is .45. The resulting construct attributes hardly any importance to the item which relates to the cooperation with institutions. In the first time reference, a slight negative, albeit not significant, influence is found. This could be caused by an over-assessment of other correlated items.

Constructs and items	t=0		t=1		Previous research
	Weight	VIF	Weight	VIF	
Knowledge of customer integration.	.32	1.13	.34	1.07	
Workforce education.	.55	1.23	.42	1.17	<i>Kenneth, I.R., et al., 1999</i>
Collaboration with institutions.	-.11	1.46	.05	1.28	<i>Gemünden, H.G., et al., 1996</i>
Knowledge transfer.	.62	1.43	.63	1.40	<i>Gemünden, H.G., et al., 1996</i>
t=0 Condition-Index: 13.7		t=1 Condition-Index: 19.5			

Tab. 44: Measurement characteristics of external technological acquisition competence

7.1.3.1.5 Technology protection

In general, the NTBFs act in very competitive environments. Their technological know-how is an essential asset. Technology management must not only assure knowledge-creation, but also the protection of their technology know-how. The first item refers to the protection effort which could e.g. be patent protection or internal protection policies. The interviews displayed that oftentimes the executives are not aware of the crucial role certain employees have. In many NTBFs, a few employees or even a single key employee possess the crucial technological understanding that the company relies on. If this key employee leaves the venture, major technological know-how is lost and the survival of the firm may be at stake. This latent danger is oftentimes not acknowledged by the NTBFs, although the turbulent environment conveys an inherent chance of loosing key employees. Two items address this issue. First, the application of instruments to tie key employees to the firm is measured. This indicates an awareness of the importance of key employees for the technology-competitiveness. It also measures if there is knowledge concerning measures to tackle the latent problem of loosing key employees. The second item measures an alternative protective measure. This relates to protecting technological knowledge assets by spreading the technology knowledge within the company. The intention of this approach is that the loss of technological staff does not endanger the technological competitiveness.

Dimension	Item
Competitive protection.	The executive team is able to protect the technology know-how against competition.
Tech. employee tying.	The executive team applies measures, to tie employees with special technology acumen to the company.
Employee knowledge-sharing.	The executive team knows instruments to facilitate technology knowledge sharing of its employees.

Tab. 45: Measurement indicators of technological protection competence

There is no indication of multi-collinearity. The variance inflation factors, condition indices, and correlations are low. The highest inter-item correlation is .34. All items have a significant contribution to the resulting construct at both measurement instances.

Constructs and items	t=0		t=1		Previous research
	Weight	VIF	Weight	VIF	
Competitive protection.	.44	1.22	.56	1.21	
Tech. employee binding.	.23	1.60	.16	1.18	
Employee knowledge sharing.	.62	1.51	.58	1.18	<i>Kenneth, I.R., et al., 1999</i>
t=0 Condition-Index: 9.47		t=1 Condition-Index: 13.30			

Tab. 46: Measurement characteristics of technology protection competence

7.1.3.1.6 Utilization of technology

Development of technology is not an end in itself. Technologies must be utilized to achieve economic goals. There are several ways to turn the technological know-how into commercial success. The constructs embraces two fundamental dimensions. The first dimension concerns an externally-oriented perspective in which the firm intends to benefit from its own technology by commercializing it to external market participants. This can either be in the form of a joint use of technology or in the form of selling technological assets to others. The second dimension represents an internally oriented perspective. The aim of this approach is to benefit from the technological know-how by using it effective and efficiently for own R&D, production process, and product development efforts.

Dimension	Item
Joint use.	The executive team has experience in the joint use of technologies (e.g. Joint- Ventures, alliances).
External use.	The executive team has experience with commercializing its technological know-how (e.g. licensing, sale of technologies, sale of R&D capacity).
Own production.	The executive team is able to optimally apply its technological Know-how with regards to the development of own offerings.

Tab. 47: Measurement indicators of utilization of technology competence

Interdependence of the items is limited. The multi-collinearity requirements are fulfilled. All items affect the construct, although the external use has a relatively limited effect.

Constructs and items	t=0		t=1		Previous research
	Weight	VIF	Weight	VIF	
Joint use.	.28	1.73	.30	1.22	
External use.	.12	1.83	.10	1.34	<i>Huang, X., et al., 2002; Badawy, M.K., 1998</i>
Own production.	.82	1.17	.86	1.13	<i>Badawy, M.K., 1998</i>
t=0 Condition-Index: 9.90		t=1 Condition-Index: 15.0			

Tab. 48: Measurement characteristics of utilization of technology competence

7.1.3.1.7 Technology controlling

The final element of the technology management domain is controlling of the technology development process. Controlling is used to assure that the technological goals are achieved. If problems arise that prevent the realization of the plan, controlling should detect them instantly and facilitate the solving of the problem. The three basic dimensions of project management are used to specify relevant controlling areas. Controlling comprises two functions. First, safeguards that the technological goals are fulfilled. Second, technological controlling aims at a constant improvement of the process of technological development. These two functions are represented by two unique items.

Dimension	Item
Evaluation of tech. dev. process.	The executive team is regularly monitoring the technological development process with regard to performance, budget, and schedule.
Continuous improvement.	The executive team aims to improve the technological development process continuously.

Tab. 49: Measurement indicators of technological controlling competence

At start-up the correlation of these two items is .51. At the advanced stage the correlation is .40. This indicates that these items represent two separate dimensions. The problem of multi-collinearity is not indicated. Both items have a substantial effect on the formative constructs.

Constructs and items	t=0		t=1		Previous research
	Weight	VIF	Weight	VIF	
Evaluation of tech. dev. process.	.77	1.55	.71	1.18	<i>Kenneth, I.R., et al., 1999; Miller, D., 1987</i>
Continuous improvement.	.34	1.55	.48	1.18	<i>Kenneth, I.R., et al., 1999</i>
t=0 Condition-Index: 10.8		t=1 Condition-Index: 19.5			

Tab. 50: Measurement characteristics of technological controlling competence

The review of the data indicates that the separate formative constructs of technological management competence meet the demanded requirements. Next, the strengths of the impact of the subdimensions on the overall formative construct are presented.

7.1.3.1.8 Composition of the technological management construct

The seven competence subconstructs of the technology management domain form a second order construct, which is used in the structural equation model. The impact of each subdomain on the resulting overall construct is presented in tab. 51 for the two

models. The different subdomains impact the second order construct almost equally at both time instances.

	Technology Management Competence (Second Order)	
First order domain	Exploration Model (t=0)	Exploitation Model (t=1)
Strategic Technology Management Competence	.18	.17
Technology Analysis Competence	.18	.20
Internal Technological Development Competence	.18	.19
External technological acquisition Competence	.22	.20
Technological Protection Competence	.19	.18
Use of Technology Competence	.18	.20
Technological Controlling Competence	.17	.19

Tab. 51: Composition of the technology management competence construct

In order to additionally validate the competence measurement in the functional domains, objective data concerning the background of the TMT members can be used. The self-assessed competence should correlate positively with the number of team members with special expertise due to prior functional experience. Tab. 52 presents the relationships based on an analysis of Spearman correlations.

		Overall number of team members with technology management background Mean: 1.85 SD: .90 Min: 0 Max: 5	Number of team members with practical technology management background Mean: 1.43 SD: .94 Min: 0 Max: 4	Number of team members with academic technology management background Mean: 1.28 SD: .95 Min: 0 Max: 4
Average Self-assessed Technology Management Competence Mean: 3.46 SD: .66 Min: 1 Max: 4.7	Corr. Coe. (Spearman)	.16	.21	.11
	Sig.	.03	.00	.12
	N	204	204	204

Tab. 52: Validation of the technology management competence assessment at the exploration stage (t=0)

The number of founders with a technology management background and their technological management competence correlates significantly at .16 at start-up. The correlation between self-assessed competence and practical background experience is significant at .21. The correlation with academic technology background is weaker at .11 and not significant. The results appear plausible, because practical experience generally appears to be more relevant for the work-related competence than academic training. Because the average number of team members is low, an additional analysis of variance (ANOVA) was performed to ascertain the findings. The ANOVA signaled a significant relationship at the .03-level between the number of team members with a practical technology management background and the self-assessed technology management competence. However, the other two relationships in the ANOVA were not significant. There is specific evidence that the technology competence measurement is valid and that a relationship exists between practical experience and competence. While there is also some indication of a positive relationship between academic technology management formation and the respective competence, this relationship appears to be significantly weaker.

Unfortunately, the functional background of the TMT members at present ($t=1$) can only be estimated roughly.⁵⁸² Based on these estimations, correlations with the self-assessed competence can determine validity (tab. 53).

		Overall number of team member with technology management background
		Mean: 2.10 SD: 1.13 Min: 0 Max: 5
Average Self-assessed Technology Management Competence Mean: 4.02 SD: .45 Min: 2.89 Max: 5	Correlation coefficient (Spearman)	.19
	Sig.	.05
	N	111

Tab. 53: Validation of the technology management competence assessment at the exploitation stage ($t=1$)

At the exploitation stage ($t=1$), the correlation between the self-assessed technology management competence and the estimated functional background of the team members is .19 and at the brink of the .05-significance-level. The ANOVA is not significant. The low level of significance can be due to the rough measurement (estimate of the number of team members) or signal that the link between the competence and previous background expertise is weaker. From a theoretical point of view the weaker relationship between the previous background experience and current competence seems reasonable, because more time has passed. Also, the weaker relationship between academic formation and job competence might interfere. From a measurement perspective it is encouraging, that there is some validation with more objective indicators.

7.1.3.2 Marketing management competencies

The marketing management competence is formed by four domains.⁵⁸³ These are the strategic marketing competence, market analysis competence, transactional

⁵⁸² The formula to calculate the present number of members with the respective background is to add the initial number of team members to the number of additions of team members with the respective functional background. Departures from the team were not classified with regards to their functional background; thus could not be included in the analysis. For further insight please also refer to the questionnaire in the appendix.

⁵⁸³ Refer to chapter 3.2.3.2.

marketing competence, and relational marketing competence. Their measurement models are portrayed next.

7.1.3.2.1 Strategic marketing competence

Prominent authors of marketing management argue that an understanding of the importance of the marketing domain is necessary in order to develop a strategic approach to marketing.⁵⁸⁴ Like in all functional strategy domains of this work, an item represents this normative disposition. Key elements of strategic marketing concern the target market and a strategic positioning of the firm's offerings. Overcoming market entrance barriers is crucial for the success of a new venture and can be planned at the strategic level. Another frequent problem of new ventures concerns the integration of different marketing measures into one comprehensive marketing plan. Oftentimes singular or ad-hoc marketing activities are carried out without an overall strategic orientation.

Dimension	Item
Importance of marketing	The executive team attributes the highest priority to marketing management.
Positioning	The executive team has the ability to clearly position its offering in the market.
Strategy to overcome entry barriers	The executive team knows how to overcome market entrance barriers.
Precise target market	The executive team is able to precisely define the target market.
Holistic marketing approach	The executive team has the ability to develop a comprehensive marketing concept.

Tab. 54: Measurement indicators of strategic marketing competence

The different items have increased correlations. The highest correlation is .65 between “entry barriers” and “holistic approach”.⁵⁸⁵ Several other correlations are in the .5 range. Yet, the condition index of the construct is below the limit of 30. Thus, multi-collinearity is not problematic. From a content-oriented perspective, the correlations signal that the different strategic dimensions of marketing are correlated

⁵⁸⁴ Kotler, P. and Keller, K.L., 2006; Meffert, H., 2000.

⁵⁸⁵ Both refer to the start of the venture.

to some extent. All items have an impact on the overall strategic marketing competence.

Constructs and items	t=0		t=1		Previous research
	Weight	VIF	Weight	VIF	
Importance of marketing	.14	1.542	.21	1.11	<i>Meier, A., 1998</i>
Positioning	.17	1.96	.31	1.30	<i>Woodside, A.G., et al., 1999 ; Conant, J.S., et al., 1993</i>
Strategy to overcome entry barriers	.34	2.10	.36	1.64	<i>Rüggeberg, H., 1997</i>
Precise target market	.19	2.17	.21	1.29	<i>Meier, A., 1998</i>
Holistic marketing approach	.38	1.96	.37	1.52	<i>Woodside, A.G., et al., 1999; Meier, A., 1998</i>
t=0		t=1			
Condition-Index: 11.7		Condition-Index: 27.4			

Tab. 55: Measurement characteristics of strategic marketing competence

7.1.3.2.2 Market analysis competence

Three items are used to assess the market analysis competence. Parallel to the technological analysis domain, two items refer to central market participants. The first item assesses the ability to evaluate the customer needs. The second item refers to the knowledge about the competition. A third item is used to test if the team knows how to determine the market and sales potential of their offerings. This item specifically differentiates between market and sales potential of the target market to determine whether the teams are familiar with those marketing concepts.

Dimension	Item
Customer need analysis	The executive team is able to evaluate the requirements and wishes of the customers.
Analysis of market potential.	The executive team has the ability to assess the market and sales-potential of the markets accurately.
Analysis of competitor's strength/weakness.	The executive team knows the strengths and weaknesses of the competition in great detail.

Tab. 56: Measurement indicators of market analysis competence

The measurement characteristics of the constructs are good. Limited correlations are found between the items ($< .5$). Multi-collinearity measures are adequate. All items have a considerable impact in the construct specification.

Constructs and items	t=0		t=1		Previous research
	Weight	VIF	Weight	VIF	
Customer need analysis	.51	1.586	.55	1.40	<i>Meier, A., 1998</i>
Analysis of market potential.	.46	1.782	.47	1.47	<i>Gemünden, H.G. and Melheritz, M., 1998</i>
Customer need analysis	.51	1.586	.55	1.40	<i>Meier, A., 1998</i>
t=0 Condition-Index: 10.4		t=1 Condition-Index: 17.2			

Tab. 57: Measurement characteristics of market analysis competence

7.1.3.2.3 Transactional marketing competence

In transactional marketing, the product, price, promotion, and place are central instruments to close the sale. The ability to employ these instruments is measured by the first item. Another important element concerning sales is the ability to present a unique selling proposition to the customer.⁵⁸⁶ Because customers can have different characteristics and demands, it is necessary that the sales force has the ability to adapt and present its offerings accordingly. Enhancing the direct sales channel, the NTBFs can apply sales intermediaries e.g. agents, representatives, or distribution

⁵⁸⁶ Kotler, P., 1964.

firms. The experience in working with different sales channels to facilitate transactions is captured by the fourth item.

Dimension	Item
Create attractive offerings for the customer (4Ps).	The executive team is experienced in creating an attractive offering for the customer by drawing on product, price, etc.
Communication of value proposition.	The executive team is able to present the differentiation of the offerings with regards to the competitive landscape.
Flexibility to respond to customer wants.	The executive team can adapt well to the specific customer requirements.
Knowledge of sales channels.	The executive team is experienced in working with direct and indirect sales channels.

Tab. 58: Measurement indicators of transactional marketing competence

The measurement of these transaction related dimensions indicates low correlations (<.5) which result in modest values of multi-collinearity. Especially at t=0 flexibility to respond to the customer has a limited impact on the transaction marketing construct.

Constructs and items	t=0		t=1		Previous research
	Weight	VIF	Weight	VIF	
Create attractive offerings for the customer (4Ps).	.41	2.14	.48	1.39	Woodside, A.G., et al., 1999; Meier, A., 1998
Knowledge of sales channels.	.41	1.87	.39	1.17	Meier, A., 1998
Flexibility to respond to customer wants.	.09	1.62	.17	1.21	Homburg, C., 2000
Communication of value proposition.	.30	1.73	.49	1.47	Meier, A., 1998
t=0		t=1			
Condition-Index: 11.2		Condition-Index: 23.1			

Tab. 59: Measurement characteristics of transactional marketing competence

7.1.3.2.4 Relational marketing competence

The vast majority of the NTBFs have commercial customers.⁵⁸⁷ A prime factor for the successful sale is the relationship which exists between the firm and its prospective customers. The management of a corporate identity is a central element in this relationship-building. Especially since the NTBFs suffer from a liability of newness, it is imperative to use a professional market approach to gain market attention and to signal trustworthiness; thus, the item referring to the ability to present a professional image to the public. Market entrants oftentimes underestimate the time it takes to form a relationship. Knowledge about the importance of early customer contact indicates that the team has experiences in dealing with professional customers and the demands of customer relationship management. The second part of the scale refers to the diversity of customers and the implications for relationship building. In a first step, the NTBFs need to evaluate who their valuable customers are. In a second step, they need to relate to these customers in an adapted manner.

Dimension	Item
Presentation of a professional corporate image.	The executive team is able to present a professional corporate identity of the company.
Early customer contact.	The executive team knows about the importance of early customer contacts.
Judgment of customer typology.	The executive team has experience to determine which customers are valuable for the company.
Adoption to different customer-types.	The executive team has a special ability to adapt to different types of customers.

Tab. 60: Measurement indicators of relational marketing competence

The measurement of the relationship related construct meets the outlined requirements. Inter-item-correlations are below .5. The multi-collinearity figures are not problematic. All items impact the scale notably.

⁵⁸⁷ Refer to chapter 2.1.

Constructs and items	t=0		t=1		Previous research
	Weight	VIF	Weight	VIF	
Presentation of a professional corporate image.	.09	1.86	.47	1.47	<i>Droge, C., et al., 1994</i>
Early customer contact.	.32	1.97	.29	1.30	<i>Hartmann, E., et al., 2004</i>
Judgment of customer typology.	.34	1.90	.34	1.49	<i>Hartmann, E., et al., 2004</i>
Adoption to different customer-types.	.42	2.34	.42	1.51	<i>Homburg, C., 2000</i>
t=0 Condition-Index: 11.8		t=1 Condition-Index: 21.1			

Tab. 61: Measurement characteristics of relational marketing competence

The results of the measurements of marketing-related competence construct are encouraging. All formative constructs meet the outlaid requirements.

7.1.3.2.5 Composition of the marketing management construct

The formative composition of the second order construct with regards to its sub-domains is presented in tab. 62. It is important to note that the impact of the transactional marketing sub-domain is very limited relative to the other subdomains at the exploitation stage. This means that this sub-domain has only limited relevance for the results regarding marketing management competence at the exploitation stage. Beyond this limitation, the weights show a fairly even distribution, which signals that each sub-domain impacts the overall marketing management construct with similar strength.

	Marketing Management Competence (Second Order)	
First order domain	Exploration Model (t=0)	Exploitation Model (t=1)
Strategic Marketing Management Competence	.29	.44
Market Analysis Competence	.26	.41
Transactional Marketing Competence	.30	.03
Relational Marketing Competence	.28	.32

Tab. 62: Composition of the Marketing Management Construct

In order to validate the competence assessment with the functional background data in analogy to chapter 7.1.3.1.8, correlations are calculated (tab. 63).

		Overall number of team members with marketing management background Mean: .77 SD: .78 Min: 0 Max: 3	Number of team members with practical marketing management background Mean: .67 SD: .75 Min: 0 Max: 3	Number of team members with academic marketing management background Mean: .33 SD: .61 Min: 0 Max: 3
Average Self- assessed Marketing Management Competence Mean: 3.09 SD: .83 Min: 1 Max: 5	Corr. Coe. (Spearman)	.34	.36	.17
	Sig. (2-sided)	.00	.00	.01
	N	204	204	204

Tab. 63: Validation of the marketing management competence assessment at the exploration stage

The Spearman correlation between the number of team members with a marketing background at start-up and the self-assessed competence is .34. The correlation with the practical and academic marketing background and the self-assessed marketing competence is .36 and .17 respectively. Again it can be observed that the practical background has the closest relation to the competence level. This seems reasonable and provides support for the self-assessment of the marketing management competence. The ANOVA also supports the relationship between the self-

assessment and the objective team member data. All three relationships are significant at the .05-level. Once more the academic background relationship is slightly less significant at the .05-level compared to the other two relationships (overall marketing background and practical marketing background relating to self-assessed marketing competence) which are significant at the .00-level.⁵⁸⁸ Concerning the second competence assessment at the exploitation stage, the correlation is significant (tab. 64).

		Overall number of team member with marketing management background
		Mean: 1.06 SD: .93 Min: 0 Max: 4
Average Self-assessed Marketing Management Competence Mean: 4.01 SD: .48 Min: 2.50 Max: 5	Correlation coefficient (Spearman)	.19
	Sig. (2-sided)	.05
	N	111

Tab. 64: Validation of the marketing management competence assessment at the exploitation stage

In analogy to the technology management domain, the ANOVA concerning the relationship between the roughly-estimated current number of team members with a previous marketing background and the self-assessed marketing competencies is not significant. The interpretation of this observation is similar to the one expressed earlier: The rough estimate seems to be combined with a weak link between the number of team members who had experience (in academia or practice) in the marketing domain before founding and the current self-assessed competence level of the whole team.⁵⁸⁹

7.1.3.3 Financial management competence

In order for a new venture to operate it needs to acquire resources and utilize these resources effectively and efficiently. In this study the ability to manage the acquisition of financial resources and assuring their economic use is defined as financial management competence. The financial competence is formed by a bundle of related

⁵⁸⁸ N=204.

⁵⁸⁹ Refer to chapter 7.1.3.2.5. Again it needs to be advised that per average 6-7 years have passed between the founding time and the current situation.

skill areas: strategic financial management competence, competence in financing the venture, skills concerning the management of liquidity, and financial accounting skills.

7.1.3.3.1 Strategic financial competence

Literature on management suggests that, in order to act successfully, executives need to have an understanding of the importance of the relevant domain and clearly specified goals.⁵⁹⁰ Accordingly, it is expected that those executive teams who attribute special importance to financial management are more likely to achieve financial success. There is a tendency of top teams in NTBFs to emphasize technology concerns at the expense of other functional areas due to their technological background.⁵⁹¹ Teams who incorporate and communicate the normative imperative of financial management will devote more attention, efforts, and resources to this domain. The second item of the strategic financial management competence refers to the definition of strategic goals. Strategic financial goals of NTBFs could relate to major financial measures like sales, cost, cash-flow, profit, or liquidity objectives.

Dimension	Item
Importance of financials.	The executive team attributes the highest priority to financial management.
Strategic financial goals.	The executive team has defined its financial goals clearly.

Tab. 65: Measurement indicators of strategic financial competence

Because this construct is measured by two items the overall multi-collinearity measures are low. The correlations between the two items are .58 at the start-up stage and .51 at the exploitation stage. This indicates some relatedness, but the measurement still complies with the requirements. From a theoretical perspective, the normative and the strategic domain are assessed. Though somewhat dependent, these two items measure two aspects of competence in two different areas. From a statistical point of view, the measurement concept is valid. Both items have similar impacts on the formation of the constructs.

⁵⁹⁰ Bleicher, K., 1994; Hinterhuber, H.H. and Krauthammer, E., 2005.
⁵⁹¹ Foo, M.D., et al., 2005; Hisrich, R.D., 1992; McMahon, R.G.P., 2001.

Constructs and items	t=0		t=1		Previous research
	Weight	VIF	Weight	VIF	
Importance of financials.	.53	1.48	.64	1.35	
Strategic financial goals.	.60	1.48	.55	1.35	
t=0 Condition-Index: 7.2		t=1 Condition-Index: 11.1			

Tab. 66: Measurement characteristics of strategic financial competence

7.1.3.3.2 Financing competence

Technology based start-ups often demand high investments to finance their intensive technological efforts. Main cost drivers of the NTBFs are generally salaries and associated costs of highly-skilled staff, technical equipment needed for R&D as well as for production, rent of laboratory and office space, patent protection or approval process fees, and marketing expenses. These expenses precede first sales oftentimes by several years.⁵⁹² The required capital generally can not be provided by the founder's personal savings.⁵⁹³ Thus, NTBFs depend on substantial outside financing. In a first step, founders need to assess the amount of capital needed. A thorough analysis will facilitate the acquisition of capital and assures that the capital is used effectively and efficiently. The second step concerns the actual acquisition of the capital. To obtain outside financing is a challenging task. Founders have no assets to secure bank loans. Expected cashflows are uncertain. Good knowledge about sources and conditions of external funding is essential. In the German-speaking venture environment, governmental support programs and banking finance are important sources of external finance. Venture capital has a minor role. Thus, the items specifically capture the knowledge of the TMT concerning these common ways of funding in Germany.⁵⁹⁴

⁵⁹² Klocke, B., 2004.

⁵⁹³ Ravasi, D. and Turati, C., 2005, 138; Wupperfeld, U., 1993, 9.

⁵⁹⁴ Maisberger, P., 1998.

Dimension	Item
Know-how of bank funding.	The executive team has knowledge about public venture funding (institutions, amounts, conditions, deadlines, etc.).
Assessment of financial needs.	The executive team has knowledge about conditions and requirements of bank financing.
Know-how of public funding.	The executive team is evaluating how much capital is needed.

Tab. 67: Measurement indicators of financing competence

The correlations among the items are increased, but meet the correlation requirements. The highest correlation is .61. The multi-collinearity measures are low. The impact of the items on the scale varies. Knowledge of public funding has a slight negative impact on the resulting construct. The slight negative effect can be due to correlations with the other items. However, at the exploitation stage the impact is positive as expected. Due to the minor impact the item is used in both instances. This assures comparability of the measurement model.

Constructs and items	t=0		t=1		Previous research
	Weight	VIF	Weight	VIF	
Know-how of bank funding.	.51	1.91	.10	1.16	<i>Maisberger, P., 1998</i>
Assessment of financial needs.	.73	1.71	.28	1.41	<i>Winborg, J. and Landström, H., 2000</i>
Know-how of public funding.	-.19	1.84	.81	1.38	<i>Maisberger, P., 1998</i>
t=0		t=1			
Condition-Index: 8.8		Condition-Index: 13.3			

Tab. 68: Measurement indicators of financing competence

7.1.3.3.3 Liquidity management competence

Beyond the initial acquisition of capital, the executive teams need to assure liquidity of the NTBFS. A thorough management of liquidity involves activities like the evaluation of the financial records of customers, knowledge about the payment

standards of the respective industry, and efficient invoicing procedures.⁵⁹⁵ Negative scenarios should be considered in the liquidity analysis.⁵⁹⁶ In case of unexpected liquidity problems, the executive teams should have knowledge concerning instruments which assure short-term liquidity.⁵⁹⁷

Dimension	Item
Liquidity incorporates negative scenarios.	Negative scenarios have been considered in liquidity planning.
Procedures for short-term liquidity assurance.	The executive team knows measures to confront liquidity constraints in the short term.
Liquidity evaluation of customers.	The executive team is evaluating the credit history when selecting customers.
Know-how of payment morals of industry.	The executive team is familiar with the payment customs of the industry.
Know-how of invoicing procedures.	The executive team is skilled in invoicing and payment procedures.

Tab. 69: Measurement indicators of liquidity management competence

Though this construct consists of five indicators, the condition index is modest. Correlations of the items are at or below .5s. There is no indication that multi-collinearity is a problem. The item concerning the knowledge about payment morals has very limited influence on the resulting scale, while the rest of the items have a considerable impact on the scale.

⁵⁹⁵ Gallinger, G.W. and Healey, P.B., 1991.
⁵⁹⁶ Hauschildt, J., et al., 1981; Hauschildt, J., et al., 1984.
⁵⁹⁷ Hauschildt, J., et al., 1981.

Constructs and items	t=0		t=1		Previous research
	Weight	VIF	Weight	VIF	
Liquidity incorporates negative scenarios.	.42	1.65	.48	1.50	<i>Davidson III, W.N. and Dutia, D., 1991</i>
Procedures for short-term liquidity assurance.	.12	1.90	.18	1.66	<i>Hauschildt, J., et al., 1984; Davidson III, W.N. and Dutia, D., 1991</i>
Liq. evaluation of customers.	.17	1.67	.28	1.34	<i>Winborg, J. and Landström, H., 2000</i>
Know-how of payment morals of industry.	-.02	1.77	.03	1.52	<i>Winborg, J. and Landström, H., 2000</i>
Know-how of invoicing procedures.	.58	1.59	.42	1.52	<i>Winborg, J. and Landström, H., 2000</i>
t=0 Condition-Index: 11.23		t=1 Condition-Index: 21.07			

Tab. 70: Measurement characteristics of liquidity management competence

7.1.3.3.4 Accounting competence

Accounting competence is measured in three broad dimensions. First, it is indispensable to interpret financial measures, in order to determine and steer the efficient use of financial resources.⁵⁹⁸ Two indicators refer to economic measures concerning the profitability of specific investments and of the business as a whole. The second dimension concerns financial controlling aspects.⁵⁹⁹ The third dimension investigates the acumen regarding tax related issues.

⁵⁹⁸ McMahon, R.G.P., 2001.

⁵⁹⁹ Davidson III, W.N. and Dutia, D., 1991; Hauschildt, J., et al., 1981.

Dimension	Item
Evaluation of profitability.	The executive team is evaluating economic measures of investments systematically (e.g. amortization, net present value, internal rate of return, return on investment).
Know-how of financial indicators.	The executive team has abilities to interpret profitability measures (EBITDA, Net profit, return on sales, return on capital, etc.).
Business success controlling.	The executive team is controlling the financial success of the venture regularly.
Know-how in taxation issues.	The executive team has a fundamental understanding of the tax system.

Tab. 71: Measurement indicators of accounting competence

The measurement characteristics of this construct are good. Multi-collinearity is not a problem. The strongest correlation exists between the knowledge of financial indicators and the controlling of business success (.56). The rest of the correlations are below .5. All items have a considerable influence on the overall construct.

Constructs and items	t=0		t=1		Previous research
	Weight	VIF	Weight	VIF	
Evaluation of profitability.	.28	1.77	.18	1.39	Davidson III, W.N. and Dutia, D., 1991
Know-how of financial indicators.	.34	2.28	.27	1.81	Davidson III, W.N. and Dutia, D., 1991
Business success controlling.	.41	1.66	.49	1.51	Davidson III, W.N. and Dutia, D., 1991
Know-how in taxation issues.	.20	1.72	.35	1.41	
t=0		t=1			
Condition-Index: 9.86		Condition-Index: 22.07			

Tab. 72: Measurement characteristics of accounting competence

7.1.3.3.5 Composition of the financial management construct

The composition of the second-order financial management construct based on the subdomains presented above is depicted in tab. 73. The weights of the subdomains are at similar levels at both time instances. The different subdomains have a fairly equal impact on the second order construct.

First order domain	Financial Management Competence (Second Order)	
	Exploration Model (t=0)	Exploitation Model (t=1)
Strategic Financial Management Competence	.27	.24
Financing Competence	.28	.32
Liquidity Management Competence	.33	.36
Accounting Competence	.29	.29

Tab. 73: Composition of the Financial Management Construct

The correlations of the financial management background data and the financial management competence assessment provide additional support for the validity of the measurement (tab. 74).

		Overall number of team members with financial management background Mean: .79 SD: .75 Min: 0 Max: 3	Number of team members with practical financial management background Mean: .66 SD: .73 Min: 0 Max: 3	Number of team members with academic financial management background Mean: .39 SD: .60 Min: 0 Max: 3
Average Self-assessed Financial Management Competence Mean: 3.10 SD: .84 Min: 1 Max: 4.92	Rang Corr. Coe.	.31	.35	.15
	Sig. (2-sided)	.00	.00	.04
	N	204	204	204

Tab. 74: Validation of the financial management competence assessment at the exploration stage

The correlation between the number of team members with a finance background and the financial management competence is .31. The number of members with prior practical and academic experiences at start-up correlates significantly with the financial management competence at .35 and .15 at both measurements. Again, a pattern can be observed that the strongest connection exists between practical experience and self-assessed competence. The three respective tests based on ANOVA are also all significant at the .05-level and reflect the same pattern.⁶⁰⁰ This provides support for the measurement of competence and suggests that previous practical experience is a salient antecedent of competence for the TMT.

At the exploitation stage, the correlation between the number of team members with a finance background and the present level of finance management competence correlates also significantly at .19 (tab. 75).

		Overall number of team members with financial management background
		Mean: 1.07 SD: .83 Min: 0 Max: 5
Average Self-assessed Financial Management Competence Mean: 4.11 SD: .55 Min: 2.13 Max: 5	Correlation coefficient (Spearman)	.19
	Sig. (2-sided)	.05
	N	111

Tab. 75: Validation of the financial management competence assessment at the exploitation stage

The additional ANOVA indicates a significant relationship between the roughly estimated number of current team members with a financial management background and the self-evaluated financial management competence at the exploitation stage. This provides additional support for the subjective self-assessment of competence. Furthermore, it signals that previous experience matters for competence formation.⁶⁰¹

⁶⁰⁰ N=204,
⁶⁰¹ N=204.

7.2 Complexity of the first development task

In order to measure the complexity of the first product development, single items are used. These are designed to capture the overall complexity with regards to the technological development and the market. The phrasing of the items is presented in tab. 76.

Dimension	Item
Technological complexity	The technological development of the first product is (was) extremely complex.
Market complexity	The market for our first product is (was) extremely complex.

Tab. 76: Measurement indicators of the complexity of the first product development

Due to the single-item-measurement a measurement evaluation of the constructs does not apply.

7.3 Success-measures

7.3.1 Technology success

The subjective success in the technological domain is evaluated using three dimensions. First, goal achievement concerning the quality of the technology is assessed. Second, technological strength in relation to competitors is evaluated.⁶⁰² These two dimensions concern the technological process and the output of the R&D project as well as the technological capability which was developed. Additionally it is important that those technological outcomes are achieved in an efficient and planned manner with adequate R&D expenses. Thus, a third dimension refers to the cost side of the technological development project.

⁶⁰² Müller, T.A., 2003, 169.

Dimension	Item
Quality of technology.	Goal achievement concerning the quality of the technology/the product.
Technological competitiveness.	Goal achievement concerning technological competitiveness of the firm.
Compliance with cost targets.	Goal achievement concerning compliance with the R&D budget targets.

Tab. 77: Measurement indicators of technology success

The multicollinearity measures of these constructs meet the outlined requirements. The weights of the indicators signal an influence of all items. However, at the exploitation stage, the cost compliance item has a slight, non-significant negative weight. The correlations between the items in both instances are moderately positive. The correlation between the quality of technology item and the cost item at the exploitation stage is .41. Thus, this relationship can explain the slight negative weight. However, at the exploration stage, the impact is as expected. Still, the item is used in both instances to assure comparability of the measurement model.

Constructs and items	t=0		t=1		Previous research
	Weight	VIF	Weight	VIF	
Quality of technology.	.19	1.23	.71	1.51	
Technological competitiveness.	.66	1.43	.71	1.50	
Compliance with cost targets.	.55	1.38	-.11	1.01	<i>Salomo, S., et al., 2003</i>
t=0		t=1			
Condition-Index: 18.1		Condition-Index: 18.0			

Tab. 78: Measurement characteristics of technology success

7.3.2 Market success

The market success measurement has two dimensions: market share of the firm and name recognition of the firm. Market share related indicators are popular measures to determine the market success of new ventures.⁶⁰³ They signal competitiveness in the market and are independent of overall market growth conditions which might impact

⁶⁰³ Williams, M.L., et al., 1991, 321.

other measures. Due to their relative nature they have industry-specific benchmark character. The measure is defined with regard to individual goals.⁶⁰⁴ Brand recognition of the firm indicates effectiveness of marketing efforts and signals reputation building. The creation of a professional corporate image is an important task for new ventures. Because name recognition facilitates market transactions, this measure identifies those ventures that are likely to have successful exchanges with market partners like customers and suppliers.

Dimension	Item
Market share.	Goal achievement concerning the market share of the firm.
Reputation.	Goal achievement concerning the degree of familiarity of the firm at the market.

Tab. 79: Measurement indicators of market success

The correlation between the two items is .5. The measures of multi-collinearity are low and meet requirements. The weights of the items signal that both indicators influence the resulting construct substantially.

Constructs and items	t=0		t=1		Previous research
	Weight	VIF	Weight	VIF	
Market share.	.27	1.45	.80	1.35	<i>Lumpkin, G.T. and Dess, G.G., 1996</i>
Reputation.	.82	1.45	.32	1.35	<i>Lumpkin, G.T. and Dess, G.G., 1996</i>
t=0 Condition-Index: 9.9		t=1 Condition-Index: 11.1			

Tab. 80: Measurement characteristics of market success

⁶⁰⁴ Müller, T.A., 2003, 167.

7.3.3 Financial success

The financial success has two financial dimensions. These are liquidity and profitability. These two dimensions are the most popular measures for financial success in entrepreneurship research.⁶⁰⁵ Some authors use sales growth as another measure for financial performance. However, in this study this measure is included in the growth assessment.⁶⁰⁶

Dimension	Item
Liquidity.	Goal achievement concerning the liquidity of the firm.
Profitability.	Goal achievement concerning the profitability of the firm at the market.

Tab. 81: Measurement indicators of financial success

The correlation between both items is .6. Still no multi-collinearity can be observed. At both stages, both dimensions have a significant impact on financial success.

Constructs and items	t=0		t=1		Previous research
	Weight	VIF	Weight	VIF	
Liquidity.	.71	1.59	.57	1.60	<i>Driessen, M.R. and Zwart, P.S., 1999</i>
Profitability.	.40	1.59	.54	1.60	<i>Lumpkin, G.T. and Dess, G.G., 1996, Narver, J.C. and Slater, S.F., 1990</i>
t=0		t=1			
Condition-Index: 9.2		Condition-Index: 9.1			

Tab. 82: Measurement characteristics of financial success

⁶⁰⁵ Murphy, G.B., et al., 1996, 17.

⁶⁰⁶ Brinckmann, J., et al., 2005; Murphy, G.B., et al., 1996, 17.

7.3.4 Growth

The last measurement construct assesses growth of the new venture. Growth is measured by annual sales growth and employment growth of the venture.⁶⁰⁷ These two dimensions are the most frequently used measures for growth of new ventures.⁶⁰⁸ They can be assessed by objective data.

Dimension	Source
Annual sales growth.	Calculation of annual sales growth.
Annual employment growth.	Calculation of annual employment growth.

Tab. 83: Measurement indicators of growth

The correlation between sales growth and employment growth is .5. Again multicollinearity indicators meet the requirements. In the first calculation the weight of the sales growth item is relatively small in comparison to the employment growth item which limits the impact of this measure on the resulting construct value. In the second model, both values have a strong impact on the formative construct.

Constructs and items	t=0		t=1		Previous research
	Weight	VIF	Weight	VIF	
Annual sales growth.	.07	1.32	.55	1.31	<i>Baum, J.A.C. and Silverman, B.S., 2004, Klocke, B., 2004</i>
Annual employment growth.	.97	1.32	.62	1.31	<i>Wiklund, J., 1999</i>
t=0 Condition-Index: 2.62		t=1 Condition-Index: 2.5			

Tab. 84: Measurement characteristics of growth

⁶⁰⁷ The annual sales growth is calculated by subtracting the initial sales from the current sales. A division of the current sales by the initial sales was not feasible since various firms had no or minor initial sales. In order to determine the annual sales growth rate this figure was divided by the age of the firm. The average employment growth rate is the relation between current employees to initial employees divided by the age of the venture.

⁶⁰⁸ *Murphy, G.B., et al., 1996, 17.*

8. Empirical findings

After describing the measurement model, this chapter aims to analyze the relationships between entrepreneurial-management competence and development of the NTBFs.

8.1 Descriptive analysis of the competencies and firm development

8.1.2 Development of new technology-based firms

The participants of the study were asked to specify the type of activity in the earliest days of existence of their ventures (exploration stage, $t=0$) and their present activities (exploitation stage, $t=1$). Based on this data it is possible to illustrate development patterns of NTBFs.

8.1.2.1 Activities at start-up

Tab. 85 presents the focal activities at the start of the ventures. It is based on the extended model of high-technology venture development which was presented in chapter 3.3.4.⁶⁰⁹ In order to depict the development in the technological domain more precisely, the activities of Klocke's first stage were further differentiated into a stage 0 and a stage 1. In stage 0 the ventures exclusively undertook fundamental scientific research to generate a marketable product idea. In stage 1 the firms were involved in product-oriented research and tried to establish a first prototype.⁶¹⁰

⁶⁰⁹ The following presentations might appear to present longitudinal data which is not the case. The subsequent illustrations document the diversity of activities of the sampled firms at start-up and when they responded to the questionnaire. The variance in the sampled firms is used to depict development patterns. Please also refer to the design of the questionnaire in the appendix.

⁶¹⁰ For a description of the Klocke model refer to chapter 3.3.3.

		Technological-Stage										Total
		0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	
Marketing-Stage	1.0	19	13	18	4	1	0	0	0	1	1	57
	1.5	8	7	18	3	3	3	0	0	0	0	42
	2.0	8	4	33	8	9	2	4	1	0	0	69
	2.5	0	2	4	2	3	1	1	0	0	0	13
	3.0	2	1	3	1	3	0	4	0	2	0	16
	3.5	0	0	0	1	1	1	1	0	0	0	4
	4.0	0	0	0	0	1	1	3	0	0	0	5
	4.5	0	0	0	0	0	0	0	1	0	0	1
Total		37	27	76	19	21	8	13	2	3	1	207
		1. Stage	2. Stage	3. Stage	4. Stage	5. Stage						
Tech. activities		Basic & Concept related R&D	Improvement of prototype & production setup	Production process running & minor improvements	Improvement of Technology & Maybe new product lines	Focus on fundamental new technologies						
Market activities		Almost none	Getting to know first customers & minor sales	Focus on sales Establishment of customer base	Satisfying customers Reputation & Brand building	Focus on fundamental new markets						

Tab. 85: Activities in the technology and market domain at start-up

With regards to technological activities, 77% of the ventures start with actions which encompass basic technological research activities (technology stage 0 through 1.5). About 40% of these firms commence with fundamental technological research without a precise product concept (stage 0 and 0.5). Less than nine percent are involved in technological activities which would be considered exploitation activities. These numbers document the research-dependability of NTBFs and their limited marketable technology at start-up. They also indicate a high dependence on outside financing due to extensive R&D stages. When the market-related activities are considered, this pattern is similar. At business start-up, only 13% of the participants have a functioning production process, which is the marker event for changing from exploration to exploitation market activities (stage 3). Around 28% of the venture teams undertook no market-related activities at all when they commenced their businesses (stage 1).

186 firms (90%) commence with exploration activities in the technology and market domain.⁶¹¹ This illustrates the fact that almost all NTBFs have to learn and establish a technological as well as market-related resource base in the beginning. Only a limited number of firms had already a working production process and/or an established customer base at the beginning.

A close connection between the technological and market-based activities can be identified. Spearman's correlation co-efficient concerning the Klocke stages in the technological and marketing domain is .47.⁶¹²

The highlighted numbers in tab. 85 refer to ventures which fit the Klocke model.⁶¹³ 122 of the 207 firms (59%) correspond to combinations of activities suggested by the Klocke model. Six percent initiate with a focus which could be labeled a technological head-start. The remaining 72 (35%) companies begin with a market head-start relative to the Klocke model.⁶¹⁴ This finding enriches the understanding of the Klocke model. Especially the combination of product-oriented R&D with a first contact and initial sales to customers is the most represented starting-point. However, this combination is not covered by the Klocke model.

Fig. 20 provides a graphical illustration of the technology and market-related activities. A vast majority of the NTBFs are in early stages of marketing and technological activities. The double peak indicates two prominent start-up scenarios. The left peak represents the combination suggested by Klocke. These NTBFs start with R&D and have no market-related activities. The right peak, however, represents another prominent scenario, which refers to ventures that already contact first customers and generate initial sales while still in the process of R&D.

⁶¹¹ The 186 companies, which are involved in exploration technology and market activities at start-up are the ones used to evaluate the impact of the entrepreneurial-management-competence on growth by the comprehensive PLS-model.

⁶¹² Significance level = .001; N = 207. All correlations in this chapter are based on Spearman.

⁶¹³ Included are as well those cases where ventures specified that they were in-between two stages.

⁶¹⁴ Interestingly, these figures do not change when considering only the independently founded firms. Of the 123 independently founded ventures 58% follow the Klocke model while 3% commence with a technological headstart – leaving 39% which are market head-starters. Spin-off firms are not more likely to starting with a technology or market head-start than their independent peers.

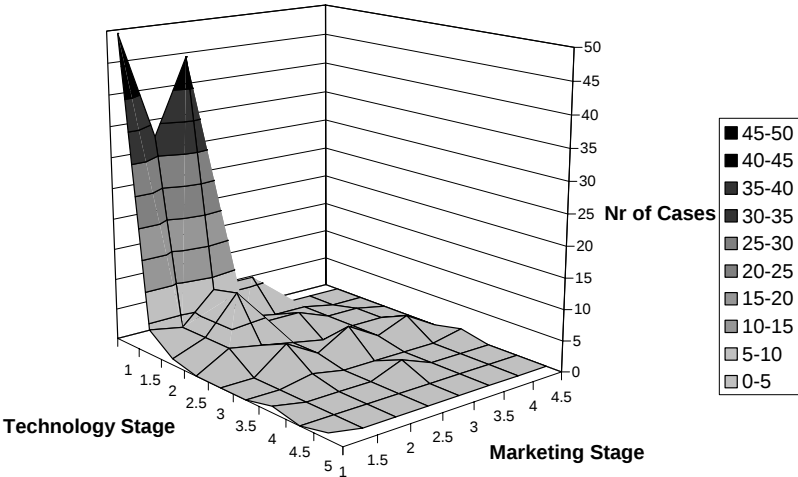


Fig. 20: Start-up activities in the technology and marketing domain

The financing-related activities were introduced to broaden the Klocke model. Tab. 86 presents the distribution of financing activities at start-up. 61 ventures are not included in this analysis, because they did not depend on external financing, but were able to finance their development from cash-flow. As depicted, firms that depended on external financing set out with very limited financial resources. Only 32 of the 151 ventures (21%) secured professional external financial funding at start-up. The majority of NTBFs who depend on external financing undertake exploratory financing activities at start-up.

If the 61 ventures which are cash-flow financed were considered cash-restricted, the data signals that only a very limited number of technological firms have sufficient funding at start-up. 85% of the NTBFs are expected to encounter the hardships of restricted financial resources.⁶¹⁵ This judgment increases the importance of financial-management competence already at the earliest point in a venture's development.

⁶¹⁵ 119 NTBFs have not secured sustainable external financial according to their financial development stage assessment and 61 ventures rely on their own cash-flow which can be considered limited at start-up.

Financing Stage	N	Percent	Cumulated Percent
1.0	70	46.4	46.4
1.5	22	14.6	60.9
2.0	23	15.2	76.2
2.5	4	2.6	78.8
3.0	31	20.5	99.3
4.0	1	0.7	100.0
Total	151	100.0	

Tab. 86: Financing activities at start-up

Tab. 87 presents the relationship between the stage of the Klocke model and the activities which are undertaken in the financing area for those companies that can be classified according to the Klocke model.⁶¹⁶ The first observation is the limited number of cases present. On one hand this is due to the fact that only 59% of the participating firms can be categorized according to the Klocke model at start-up. On the other hand only those companies that fit the suggested financing process were asked to assess their financing activities. Because 78 of the 212 participating firms (37%) were able to finance themselves from the first day without raising external capital, these firms were not captured by the financing dimension. Out of the remaining 89 participants 56 (63%) were consistent with the enlarged stage model. 28 firms (31%) started with a financial head-start, leaving 5 ventures with a finance hold-up.⁶¹⁷ Clearly the data in tab. 86 illustrates that the combination of Klocke stages with the financing stages can not be improved by applying an alternative combination of stages.

⁶¹⁶ For those companies presenting a 0.5 difference in-between the technological and marketing stage, values were attributed to the lower stage.

⁶¹⁷ The correlation between these two presented dimensions is .23, which is significant at the .05 level.

		Financing Stage					Total
		1.0	1.5	2.0	2.5	3.0	
Klocke's Stage in Market & Technology	1.00	38	10	10	1	10	69
	1.50	0	0	0	0	1	1
	2.00	2	3	3	1	6	15
	3.00	2	1	0	0	1	4
Total		42	14	13	2	18	89
		1. Stage	2. Stage	3. Stage	4. Stage	5. Stage	
Technological activities		Basic & Concept related R&D	Improvement of prototype & production process setup	Production process running & minor improvements	Improvement of Technology & Maybe new product lines	Focus on fundamental new technologies	
Market activities		Almost none	Getting to know first customers & minor sales	Focus on sales Establishment of customer base	Satisfying customers Reputation & Brand building	Focus on fundamental new markets	
Financing activities		Estimation of capital needs & limited capital base	Info search about funding sources & presentation	Financial base, Creation of investor relations & cooperation	Securing milestones for financing & improvement of IR	Cash-flow financed or new investment rounds	

Tab. 87: Activities according to the Klocke model and the financing domain at start-up

Interestingly, most NTBFs which commence in stage 2 of the Klocke model at start-up have already secured sustainable finance. However, using the firms that start in stage 3, this finding is not supported. It appears that there is a group of firms which start with financial backing and which are already advanced in the technology and market field. At the same time, another group starts with a customer base and a running production process, but still needs external financing. These firms probably intend to use the external resources to scale-up production and marketing activities to support growth. Fig. 21 presents the graphical illustration of the Klocke and financing stages in the enhanced model.

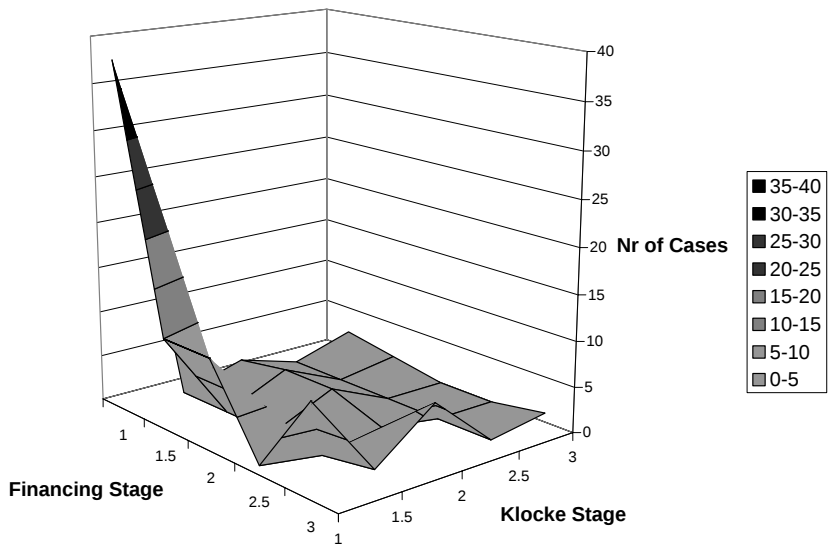


Fig. 21: Start-up activity concerning the Klocke model and financing activities

In order to get a better understanding of the fit between the two dimensions presented by Klocke and the additional finance dimension, correlations were calculated between the development stages of the different dimensions. The correlation between the financing activities and marketing is .26.⁶¹⁸ The correlation between the financing and the technological dimension is .30.⁶¹⁹

8.1.2.1 Current activities

The second time reference pertains to activities the ventures focused on when they participated in the research. Tab. 88 presents the current activities of the firms in the technological and market area. Six firms are involved in activities which can be related to the first stage. 47 ventures (22%) undertake exploration activities in both the technological as well as the market area, while 135 firms (64%) are involved in exploitation activities.⁶²⁰ These numbers in combination with the start-up data

⁶¹⁸ Significance level = .001; N = 148.

⁶¹⁹ Significance level = .001; N = 151.

⁶²⁰ In order to analyze the effects of the competence on the business development in the exploitation stages the 135 firms provided the data for the subsequent calculations.

document the fundamental shift from exploration to exploitation activities as the firms evolve.

		Technological-Stage										Total
		.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	
Marketing-Stage	1.0	0	0	1	0	0	0	0	0	0	0	1
	1.5	1	2	2	0	0	0	0	1	0	0	6
	2.0	0	2	0	2	0	1	0	0	0	0	5
	2.5	0	1	4	4	2	0	2	0	0	0	13
	3.0	0	0	3	10	5	9	2	10	1	0	40
	3.5	0	1	2	1	4	2	5	11	5	0	31
	4.0	0	1	1	1	2	3	6	21	4	3	42
	4.5	0	1	1	0	0	2	4	21	17	3	49
	5.0	0	0	0	1	0	1	1	9	6	5	23
Total		1	8	14	19	13	18	20	73	33	11	210
			1. Stage	2. Stage	3. Stage	4. Stage	5. Stage					
Technological activities			Basic & Concept related R&D	Improvement of prototype & production process setup	Production process running & minor improvements	Improvement of Technology & Maybe new product lines	Focus on fundamental new technologies					
Market activities			Almost none	Getting to know first customers & minor sales	Focus on sales Establishment of customer base	Satisfying customers Reputation & Brand building	Focus on fundamental new markets					

Tab. 88: NTBFS current activities in the technology and market domain

Fig. 22 visualizes the current activities of the NTBFS. The overall peak manifests that many companies advanced in their development. The majority of NTBFS has a functioning production process and mainly sells to an established customer base while intending to deepen customer relationships. Another prominent phenomenon is that many firms have an established customer base. At the same time, these firms are at diverse stages of technological development. This group includes firms that commence with established customer contacts or establish them rapidly while working on special development projects for those customers.

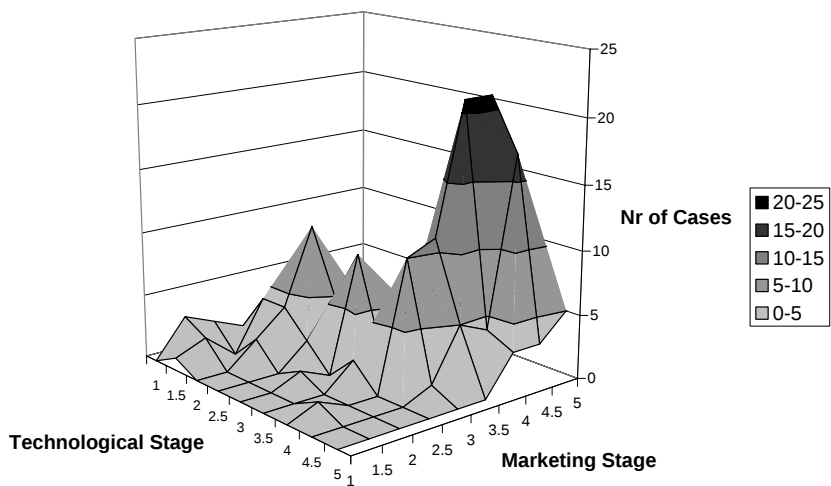


Fig. 22: Current activities in the technology and marketing domain

The fundamental shift of activities in the technology and market domain from start-up to present is reflected as well by high correlations between the age of the NTBFs and the current development stage (technology .40,⁶²¹ marketing .47⁶²²). The NTBFs advance from exploration to exploitation activities in the technology and marketing domain. There is a close relationship between the technological and marketing activities. The correlation is .62.⁶²³

The highlighted 129 firms in tab. 88 (61%) fit the development model at the current stage. 24 (11%) are ahead in technology activities and 57 cases (27%) lead in marketing activities. Tab. 89 presents the progression of the ventures in relation to the Klocke model. The number of cases that fit the Klocke model in both stages is 76 (36%). This depicts the limitations of the Klocke model. While at each time reference a majority of NTBFs can be classified to the Klocke model, only about a third of the firms can be classified accordingly in both instances. A number of firms start according to the Klocke model, but then progress relatively faster in market-related

⁶²¹ Significance level = .001; N = 211.

⁶²² Significance level = .001; N = 209.

⁶²³ Significance level = .001; N = 210.

activities (27%). Out of those venture which commence with a technological head-start, most evolve their activities in later stages into the activity combination suggested by Klocke. Interestingly, none of these achieves a market lead. Considering firms with a market-head, 61% of them revert to the Klocke model, while 32% maintain the market lead. Only a limited number achieve a technology lead (7%).

		At start-up			Total
		Technology Headstart	Klocke Model	Market-Headstart	
At Present	Technology lead	5	13	5	23
	Klocke Model	8	76	44	128
	Market lead	0	33	23	56
Total		13	122	72	207

Tab. 89: Change of development stage relative to the Klocke model

Tab. 90 presents the current situation of the firms in terms of the Klocke model extended by the financing dimension. The fundamental development in the acquisition of funds is illustrated. The figure documents that 83% of the NTBFs have secured financial resources when they achieve a functioning production process. Accordingly, it can be argued that it is generally necessary to obtain financial resource in order to build up production.

The correlation between the financing stage and firm age is .28.⁶²⁴ The correlation between the financing stage and the technology stage is .36.⁶²⁵ The financing stage and the marketing stage correlate at .47.⁶²⁶ This data indicates that ventures also advance from exploration activities to exploitation activities in the financing domain.

At present, 45 firms (53%) fit the proposed NTBF development model with financing activities added. 19 (22%) firms are ahead and 21 (25%) lagging behind with regards to finance. The model fit cannot be improved by shifting the combination of stages: if the Klocke stages are combined with financing stages that are one stage ahead with relative to the present model, 27 firms fit the resulting model. When stages of the Klocke model are merged with financing stages that are one step behind, the

⁶²⁴ Significance level = .001; N = 146.

⁶²⁵ Significance level = .001; N = 147.

⁶²⁶ Significance level = .001; N = 146.

resulting model includes only 20 firms. These figures indicate that the presented model of NTBF development represents the most frequent activity combination.

		Financing Stage									Total
		1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	
Klocke's Stage in Market & Technology	1.00	0	0	2	0	0	0	0	0	0	2
	1.50	0	1	0	1	0	0	0	0	0	2
	2.00	0	1	1	0	3	0	1	0	0	6
	2.50	0	0	0	0	1	0	0	0	0	1
	3.00	2	0	0	0	6	0	3	0	1	12
	3.50	0	0	0	0	0	0	1	0	1	2
	4.00	4	0	2	1	8	3	7	7	7	39
	4.50	1	0	2	0	2	3	0	2	3	13
	5.00	0	0	0	0	1	1	1	0	5	8
Total		7	2	7	2	21	7	13	9	17	85
	1. Stage	2. Stage		3. Stage		4. Stage		5. Stage			
Techno-logical activities	Basic & Concept related R&D	Improvement of prototype & production process setup		Production process running & minor improvements		Improvement of Technology & Maybe new product lines		Focus on fundamental new technologies			
Market activities	Almost none	Getting to know first customers & minor sales		Focus on sales Establishment of customer base		Satisfying customers Reputation & Brand building		Focus on fundamental new markets			
Financing activities	Estimation of capital needs & limited capital base	Info search about funding sources & presentation		Financial base, Creation of investor relations & cooperation		Securing milestones for financing & improvement of IR		Cash-flow financed or new investment rounds			

Tab. 90: NTBFs current activities concerning the Klocke model and the financing domain

Fig. 23 presents the graphical relationship between the current financing activities and the development along the Klocke dimensions. While the sample size limits reliability, it appears that the stages of financing correlate relatively weak with the development in the technology and market domain.

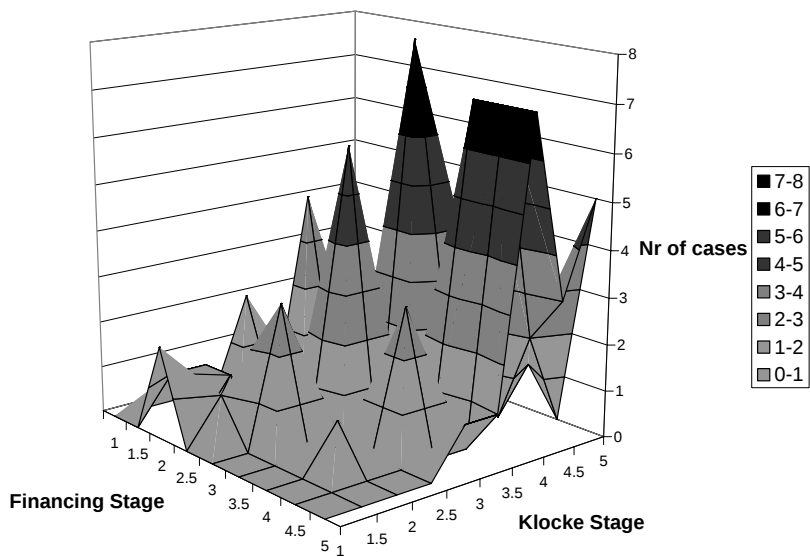


Fig. 23: Current activities concerning the Klocke model and financing activities

With regards to the model fit at both time instances, the data is limited due to the restrictions that the firms have to fit the Klocke model at both instances and have to seek external financing. The 46 cases which fit these criteria illustrate that only about one third of the firms follow the development model at both time instances. The data illustrates that there is not a development model which is followed by the majority of firms.

NTBFs do not jump from one stage to another along the three functional dimensions, but follow an incremental path. This development path is also illustrated by a chronological analysis of the stage advancement and sales growth (see fig. 24).

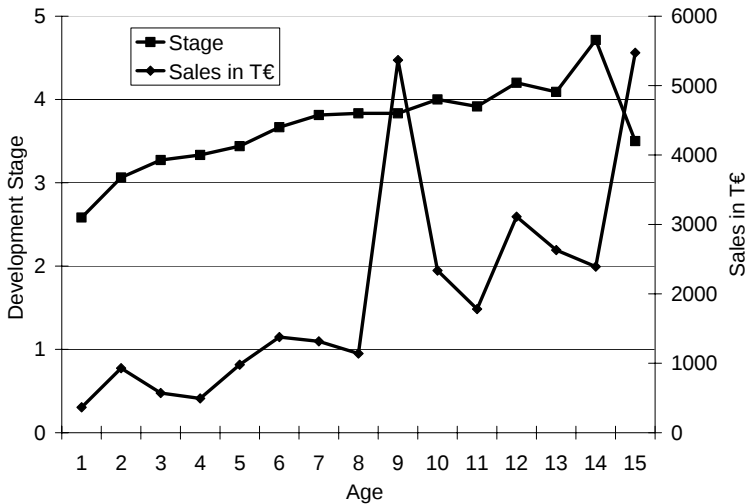


Fig. 24: Development of sales and stage advancement

As depicted a positive fairly-linear relationship exists between the aging of the venture and its passing through the stages.⁶²⁷ Ventures in early years of existence enter rapidly in advanced development stages, followed by an incremental stage progression. This development is paralleled by sales growth.⁶²⁸ Because these numbers are based on a fairly representative sample, they can be applied as a benchmark for production-based high-technology firms. Based on the chronological development, Klocke proposes a speed-measure. The absolute speed is calculated based on the formula presented in figure 25 where $y(t)$ refers to the stage at the respective point in time:⁶²⁹

$$c(t_1, t_2) = \frac{y(t_2) - y(t_1)}{t_2 - t_1}$$

Fig. 25: Calculation of absolute development speed

⁶²⁷ The overall stage was calculated as an average of the three development dimensions. The spike in year nine shows an outlier due to the small samples sizes.

⁶²⁸ Additionally the employee or product line growth has been calculated. These two dimensions are not displayed, but show similar dynamics.

⁶²⁹ Klocke, B., 2004, 24-29. This measure assumes an equal stage length.

Tab. 91 describes the relation between stage development, venture-age and the average absolute development speed of the firms in the respective stage.⁶³⁰ The average speed indicates that the NTBFs need per average about 3 years to change from one stage to another. However, it has to be noted that the initial speed in the first years is likely to be higher and diminishes gradually. Thus, the average age and the average development speed per stage have to be interpreted with caution.⁶³¹

Development Stage	Age	Absolute Development-Speed (Stage/Year)	Firms in the relevant stage
1	3		4
2	4	0.33	23
3	5	0.43	57
4	7	0.35	96
5	9	0.42	31
Total	7	0.38	211

Tab. 91: Development stage and absolute development speed

Overall, the presented data concerning the development of the NTBFs suggests three main insights:

1. NTBFs generally start with exploration activities. They have to develop a technology, create a product, establish a production process, gain a market understanding, acquire customers, and obtain financial resources for growth.
2. In their development the focus of their activities in the technological, market, and financing area shifts from exploration to exploitation activities as they develop.
3. The proposed enlarged model is an adequate reflection of the NTBF's development. Yet, the initial Klocke model and the enlarged model reflect only a minor part of all the developments NTBF undertake. Many firms follow paths

⁶³⁰ The speed for the first stage was not computed, because the numerator is zero. The speed of the average relative speed was not documented, because is 1 by definition.
⁶³¹ Additionally, correlations between the absolute and the relative development speed were computed. In accordance to Klocke's findings the absolute and relative speeds are correlated by .98. Klocke, B., 2004, 141.

that diverge from the standard path. The data suggests that a standard path of development does not exist, but broad development stages have to be formed in order to encompass a fair majority of the firms. The general distinction between exploration and exploitation activities represents such a broad distinction.

As illustrated a fundamental trade-off exists between the “width” of the stages and the percentage of cases which fit the model. These two poles reflect two different, yet insightful, research objectives. The use of a model with limited stage-ranges, which implies that many cases are not conforming to the model, could seek to investigate the causes and outcomes of the divergence from a proposed “standard-path”. On the other pole, research would extend the stages or combine stages in order to accommodate more cases to aim for conclusions about these general stages. This research has followed the first path to illustrate in detail the development of the ventures according to the two functional dimensions presented by Klocke and by adding a third dimension which refers to the financing of the NTBFs.

This research follows the second path for the evaluation of the impact of competence on the firms' development. Klocke's two development domains - technology and market-related activities – are selected to classify ventures. These domains have the closest empirical linkage. The inclusion of the financing dimension implies a severe loss of cases, because a large share of participating companies which were able to finance their operations from cash-flow could not be included in the analysis. Instead, the broader classification of exploration and exploitation activities is applied to group the ventures. This amplification of the stages is needed to obtain sample sizes which are large enough to calculate path models.

At start-up only those ventures are included that carry out exploration activities. These are considered typical start-up activities. Companies that are already advanced in their development at start-up - indicated by a working production process and/or an established customer base - are not included. At the second point of analysis only those ventures are included which carry out exploitation activities. These firms presently have a functioning production process and an established customer base. At both points a structural equation model is calculated to determine

the impact of the different competence domains on the success measures. Thus, the analysis is geared to investigate which competencies are important with regards to the respective activities. Additionally, it can be illustrated how the importance of the competence areas evolves with the development of the firms.

8.1.3 Development of entrepreneurial-management-competence

An evolution of the competence of the TMT can be expected parallel to the development of the NTBFs. This chapter is directed to portray the competence profile of those teams at start-up which undertake exploration activities. As a second point of reference, the competence profiles of teams are illustrated which have passed on to exploitation activities. The change of competence in this process reflects the learning which takes place as the teams propel their firms. In order to obtain specific information about the learning of the firms as they pass on from exploration to exploitation activities, only those firms are investigated which started with exploration activities and which now are involved in exploitation activities. 115 NTBFs of the sample meet this requirement. Overall, this design enables an analysis of three aspects of competence development: a) which are the self-assessed strengths and weaknesses of the executive teams at start-up when firms carried out exploration activities, b) which are the self-assessed strengths and weaknesses at an advanced stage when firms carried out exploitation activities, and c) which competencies changed most when passing from exploration to exploitation activities.

This study uses two ways to assess competence development. The first approach is to assess the functional competence with "objective" data that reflects the functional background of the executive team members. Respondents were asked to specify how many of the team-members had a functional background experience.⁶³² It is also differentiated whether this functional background is academic or professional. This data enables an analysis of how the team characteristics changed over time.

The second approach uses self-assessment data referring to functional competencies, entrepreneurial and social competencies. While the first approach illustrates the functional background of each team member, the second approach refers to the resulting competence level of the team as a unit. The second approach is more

⁶³² Refer to the questionnaire in the appendix.

comprehensive than the first approach. The objective data can also be used to validate the subjective assessments. The combination of both approaches allows a detailed understanding of the evolution of competence.

8.1.3.1 Competence development based on functional background experiences of the different team members

The composition of the team and its functional background is an indicator of its competence. Tab. 92 presents the composition of the TMT at start up. The average NTBF of the study had between two and three members at start-up. The mean and ratios indicate the dominance of the technological management background of technological venture leaders. 68 percent of the members have a technological management background with an almost equal share of academic and practical experience. Less than a third of the founders have significant expertise in marketing. Team-members with a financial management background also represent less than one third at start-up. The team members who have a marketing and/or financial management background have gained their expertise predominantly by business experience. Only a small fraction has an academic background in these two functional fields (<10%). However, teams which consist exclusively of members with a technology management background are a minority. Those teams represent one third of all teams. The rest of the teams have at least one person with a non-technology background.

Criteria	Mean	Median	SD	Min	Max	Ratio
Nr of TMT-members	2.60	2	0.90	2	5	1.00
Nr of Team-members with Technology management background	1.77	2	0.91	0	4	0.68
Nr of Team-members with practical Technology management background	1.32	1	0.94	0	4	0.51
Nr of Team-members with academic Technology management background	1.35	1	0.97	0	4	0.52
Nr of Team-members with marketing background	0.71	1	0.79	0	3	0.27
Nr of Team-members with practical marketing background	0.60	0	0.73	0	3	0.23
Nr of Team-members with academic marketing background	0.27	0	0.52	0	3	0.10
Nr of Team-members with finance management background	0.68	1	0.72	0	3	0.26
Nr of Team-members with practical finance management background	0.57	0	0.72	0	3	0.22
Nr of Team-members with academic finance management background	0.34	0	0.60	0	3	0.13
N=211						

Tab. 92: Composition of the TMT at start-up

Tab. 93 displays the background of the team members as they carry out exploitation activities in an advanced development stage. It indicates that the size of the TMT has hardly changed (<10%) with the transition from the exploration to the exploitation stage. The background of the executive team members before entering the firm displays that marketing and financial persons have gained a bigger share, while the part of the technology-managers has remained constant. Still, after almost 7 years top management in the NTBFs is dominated by executives who have a technological background.

	Mean	Median	SD	Min	Max	Ratio
Nr of TMT-members	2.85	2	1.24	2	8	1.00
Nr of Team-members with Technology management background	1.94	2	1.06	0	5	0.68
Nr of Team-members with marketing background	1.08	1	0.98	0	4	0.38
Nr of Team-members with finance management background	0.93	1	0.91	0	5	0.33
Firm Age	8.09	8	3.52	1	15	
N=211						

Tab. 93: Composition of the TMT at present

The small change in team size signals that competence development at the executive level is not realized by team enlargement. Next to learning aspects of the team-members within the firm, team expertise can be development by a systematic replacement of executives. Tab. 94 presents the changes which take place within the TMT from start-up to the current stage. Half of the ventures do not change their team at all. The percentage of teams which add members with experience in the marketing or financial field is not notably higher than the team-members that enter with a technology-related background. The teams also do not lose significantly more technology-related members in comparison to departing members with financial experience. Though, significantly fewer people who leave the teams have a marketing background in contrast to members with a technological management background. Only 10 percent of the teams split up with a technological team member and add a team member with either prior marketing or financial experience. These numbers indicate that competence development within the executive team is generally not intended by a replacement of team members according to their functional background.

	Either adding or losing	Add one member	Add two members	Add three members	Loosing a member	Loosing two members	Loosing three members
Technology Management	27%	23%	8%	3%	28%	3%	0%
Marketing	34%	31%	10%	3%	14%	0%	1%
Financial Management	33%	28%	6%	1%	23%	0%	0%
In any of these domains	50%	47%	20%	3%	24%	3%	1%

Tab. 94: Percent of firms that change their team-members

Overall, the description illustrates that the vast majority of the venture team members have a technological background and limited experiences in marketing and finance. As the firm develops, this characteristic changes only slightly. Neither are the teams significantly enlarged nor are members exchanged to complement lacking functional experience. Other considerations like cultural fit or personal relationships might determine the decision to add new team-members. About half of the teams do not make any change at all which illustrates a considerable amount of stability over almost seven years.

If competence development is not realized by enlargement or alteration of the team composition, then two ways of competence development could take place. The first is to hire employees who possess the lacked functional experience, but not include them in the top management team. The second is to gain competence within the executive team by learning on the job. While the data of this study is not suitable to address the first, the competence development within the team will be investigated in the following chapter.

8.1.3.2 Development of entrepreneurial-management-competence based on team-characteristics

In order to evaluate the competence of the TMT in detail, respondents were requested to assess the weaknesses and strengths of their teams in all of the conceived domains of the entrepreneurial management construct. Fig. 26 presents the results of this self-assessment. Three aspects of competence development are explored. First, the self-assessed strengths and weaknesses of the teams at start-up

are illustrated.⁶³³ Only those teams are included in this analysis that carried out exploration activities at start-up. Second, the self-assessed strengths and weaknesses at the current development stage are presented. In this stage all included firms undertook exploration activities. Third, the change of competence that occurred from start-up to present which represents the learning in the process of growing the venture from an exploration to an exploitation stage.

At start-up, the teams rate their general entrepreneurial skills as strong. Conceptual, innovation, and enforcement competence receive high ratings. Overall, enforcement competence is their greatest strength along with teamwork-competence. Functional competencies receive considerably lower ratings. In line with the functional background statistics, the teams are relatively strong in technology management while marketing and especially financial management skills are weak. Network competence is also a major weakness of the start-up companies.

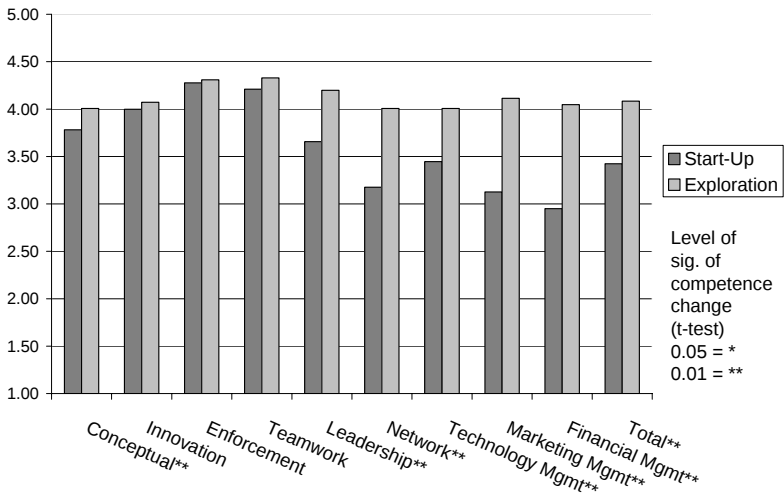


Fig. 26: Change of competence profile from start-up to present

The skill profile at the exploration stage changed notably. The functional competencies are at a similar level like the general entrepreneurial and social competencies.

⁶³³ As outlined above only those teams are included in the analysis that carry out explorational activities at start-up.

Enforcement and teamwork abilities still represent absolute strengths, but no major weaknesses are identified.

With regards to the development of competencies, teams learned most in marketing and financial management (support for hypotheses 24.2 und 24.3). This finding is only partly supported by the change in the background of the team members. Thus, learning on the job appears to be a key-element of functional competence development within the TMT. Significant learning also takes place concerning technology management (support for hypothesis 24.1) Parallel to the learning in the functional domains, a strong competence gain is found in networking abilities (rejection of hypothesis 23.3). *Klocke, B., 2004*'s analysis of an actively managed network development may explain this observation. The TMTs learn significantly by their network activities. Leadership skills increase also significantly as the firm grows (rejection of hypothesis 23.2). This can be attributed to increased leadership experience as firms increase their staff from an average of 5 to 23. The general entrepreneurial and the teamwork competence remain fairly stable. The change of innovation, enforcement, and teamwork competence are not significant at the .10-level (support for hypotheses 22.2; 22.3, and 23.1). Teams do not improve their teamwork abilities significantly, even after the team has headed the venture together for almost seven years.⁶³⁴ The teamwork-characteristics can be understood as traits which can be influenced, but tend to be rather stable over time.⁶³⁵ The conceptual competence changes significantly with the evolution of the firms (rejection of hypothesis 22.1).

This analysis supports the conclusion that functional competencies are central domains of learning (support for hypothesis 24). The results concerning learning effects in the non-functional domains are mixed, because the competence increases significantly in some domains (conceptual, leadership, and networking), while it remains stable in other areas (innovation, enforcement, and teamwork). The general statement that competencies in the non-functional domains remain stable needs to be rejected (hypotheses 22 and 23).

⁶³⁴ As presented teams exist per average for eight years (refer to chapter 6.1.2.)

⁶³⁵ *Lepisto, L., 1985.*

8.2 Analysis of the effects of entrepreneurial-management-competence on the development of new technology-based firms

The preceding chapter presented how the NTBFs develop and how the competencies change along with this development. In this chapter the effects of the competence of the TMT on the firm's development are analyzed at two points in its development. First, the effects of competence at start-up are presented when firms undertake exploration activities. Second, the impact of the different competencies is presented when the NTBFs have entered the exploitation stage.

8.2.1 Effects of entrepreneurial-management-competence on the development of new technology-based firms at start-up

Tab. 95 presents the results of the structural equation model using PLS at the start-up stage. The impact of the different competence domains on the complexity of the first product development, functional success, and business growth are assessed.

With regards to the impact of competence on the complexity of the first product development the results are mixed. Technology management competence has a significant positive effect on the technological complexity of the first product development task. A higher technological management competence increases the demands of the technological development. Thus, hypothesis 13 can be confirmed. The effect of marketing management competence on the market complexity is not significant. More abilities in marketing do not imply that the TMT aims for more complex markets which require higher marketing skills. Hypothesis 14 is rejected. An interpretation of this finding is that teams that are more knowledgeable about markets and the demands of marketing might refrain from taking-up more challenging tasks. These firms know about the difficulties and risks involved in launching new offerings in complex market structures. Meanwhile, other competent teams might believe that they can handle the difficulties and that they can obtain a competitive advantage in these markets.

Independent variables: competencies		Dependent variables: first product development complexity and success												
		Subjective variables										Objective variable		
		First product development complexity				Success								
		Tech. complexity (R² .05)		Market complexity (R² .00)		Tech. Success (R² .13)		Market Success (R² .04)		Financial Success (R² .10)		Growth (R² .17)		
		coefficient	t-value	coefficient	t-value	coefficient	t-value	coefficient	t-value	coefficient	t-value	coefficient	t-value	
General Entrepreneurial Competencies	Conceptual												-0.25	1.01
	Innovation												.10	.60
	Enforcement												-.04	.28
Social Competencies	Teamwork												.04	.25
	Leadership												.21	.95
	Networking												.02	.15
Functional Competencies	Technology Management	.21**	2.07			.36***	4.16						-.08	.40
	Marketing Management			-.01	.12			.20**	1.97				-.08	.45
	Financial Management									.32***	3.35	.34**	2.03	
* p < .10; ** p < .05; *** p < .01 N = 135														

Tab. 95: Effects of EMC on venture development at the exploration stage

The impact of the functional competencies on functional success conveys a clear picture. All functional competencies have significant positive effects on their respective success measure. The effects of technology management and financial management on their success-measures are significant at the .01-level while the effect of marketing competence on market success is significant at the .05-level. For the exploration stage, hypotheses 7, 9, and 11 can be approved. Additionally, these results underline the nomological validity of the functional competence measurement.

The only initial competence domain which impacts long-term growth of the new venture is financial management competence. The relationship is significant at the .05-level. Hence, hypothesis 12 is approved. This corresponds well with the situation depicted earlier that NTBFs start out with very limited resources.⁶³⁶ Thus, the raising of resources and their adequate administration fosters growth. Interestingly, all other competencies do not have a significant impact on long term growth (rejection of hypotheses 1, 2, 3, 4, 5, 6, 8, and 10 for the exploration stage). From a statistical point of view, this result could be partly caused by positive correlations between the different competence constructs. A strong effect of one competence domain might be overemphasized at the expense of other correlated constructs.⁶³⁷ Yet, a reconfiguration of the model to test these effects did not support this interpretation.⁶³⁸ The high self-evaluations especially of the general entrepreneurial and social competencies also might cause that the variance of these independent variable is too limited to provide strong explanatory power.⁶³⁹ In order to create a structural equation model based on more variant cases, an alternative sample was created that consisted only of the top third and bottom third firms with regard to an overall average competence measure. The subsequent PLS calculations depicted a very similar picture to the one outlined above. If ceiling effects impede more significant findings, future studies should incorporate broader scales (e.g. seven-point Likert scales, 10-point-scales). Based on the correlation analysis at the construct level, however, there is support that all competencies except the conceptual and innovation competencies are positively correlated to growth. The effect strengths of these correlations are in the range of earlier empirical studies.⁶⁴⁰

From a theoretical point of view, the finding that technology management competence might not be as crucial to a firm's growth could be explained by a negative 'crowding-out-effect' that mixes with the general positive effect of technology management competence. The TMTs consist mainly of members with a technology management background.⁶⁴¹ The teams also possess a relatively high competence

⁶³⁶ Refer to chapter 8.1.2.1.

⁶³⁷ Refer to the correlation table in the appendix.

⁶³⁸ Different models were analyzed e.g. the exclusive analysis of the general entrepreneurial and social competencies on growth yields similar effect estimations.

⁶³⁹ Refer to correlations in the appendix.

⁶⁴⁰ E.g. Meier, A., 1998; also refer to chapter 4.

⁶⁴¹ Refer to chapter 8.1.3.1.

level in these domains compared to other functional areas.⁶⁴² Extremely technology competent teams might overstress their activities in the technology field at the expense of other important functional activities. The two-sided character of technology management was presented in the discussions of earlier findings which also supported this interpretation.⁶⁴³ The surprising non-significant effect of marketing competence on growth conflicts with earlier findings and can only be interpreted with difficulty. Perhaps some more competent firms might consciously select fields of activity that are not as demanding in order to safeguard the existence of the firm. Those marketing-savvy teams might trade-off high growth paths for less attractive - yet more secure - alleys of development. This might dilute the overall positive effect of marketing competence on growth. It needs to be highlighted, however, that marketing competence is important as it secures market success which is related to growth as subsequent discussions will illustrate.

The impact of conceptual competence on growth is negative, but non-significant. Negative signs are also illustrated in the correlation analysis. This is in accordance with prior empirical findings and theoretical considerations⁶⁴⁴ that advanced planning as a result from advanced conceptual competence does not necessarily increase growth, but can hinder it. Detailed planning consumes valuable time, might create a distorted perception of reality, or discourage subsequent actions which might yield valuable learning experience. Detailed planning might also be of limited value in highly dynamic market conditions.⁶⁴⁵ Hence, it is too early to derive finite conclusions. More research needs to focus on this aspect.

The hybrid role of innovation competence and innovation as a firm orientation was stressed in previous chapters.⁶⁴⁶ This hybrid character might also be reflected in the non-significant path between innovation competence and growth. Correlation analysis even signals a negative impact. Thus, the weak signs may mean that innovation competence leads to innovative concepts which are, however, harder to realize. In order to test possible effects of innovation competence on the two dimensions of task complexity, an additional path model was calculated. This

⁶⁴² Refer to chapter 8.1.3.2.

⁶⁴³ Refer to chapter 4.3.1.

⁶⁴⁴ Refer to chapter 4.1.1.

⁶⁴⁵ *Vesper, K.H., 1993.*

⁶⁴⁶ Refer to chapter 4.1.2 and chapter 5.3.1.2.

calculation depicts that the initial innovation competence increases the market complexity with a path coefficient of .19 at a .10-level of significance, while it has no significant effects on technological complexity. Thus, supplementary evidence signals that innovation competence has complex effects. While innovation competence might indeed facilitate the finding of innovative concepts, these innovative solutions in consequence might imply more difficulties and risks when they are brought to the market with possible detrimental effects on growth.⁶⁴⁷

The non-significance of the enforcement competence is hard to interpret.⁶⁴⁸ Negative effects of enforcement competence could result from too little prior planning and an excessive rush to 'get-things-done'. Enforcement competence also might have negative effects as it limits flexibility in the implementation process or enforces unsustainable levels of activity or growth and an excessive use of resources. The mix of positive effects envisaged earlier⁶⁴⁹ with these hypothesized negative effects might result in non-significant overall effects. However, prior studies indicate overall positive effects of enforcement-related abilities or activities.⁶⁵⁰

In accordance with earlier empirical findings, more leadership competence seems to increase firm-growth. Yet, this relationship is not significant.⁶⁵¹ The limited impact might be attributed to the observation presented earlier that the teams start out with very few employees.⁶⁵² The close and direct interaction coupled with a general entrepreneurial spirit in early days might make leadership less important.

The finding that teamwork competence and network competence do not impact growth significantly at the exploration stage is surprising as both reflect important social skills.⁶⁵³ Concerning teamwork competence there might be a survivor bias: Teams that had very little competence in working together broke apart causing the ventures to fail. These failed ventures were not surveyed in the study. The limited size of these teams also might explain why good teamwork might not have the strong

⁶⁴⁷ Refer also to Hauschildt, J. and Salomo, S., 2005.

⁶⁴⁸ Correlation analysis signals a slight positive association with growth.

⁶⁴⁹ Refer to chapter 5.3.1.3.

⁶⁵⁰ Refer to chapter 4.1.3.

⁶⁵¹ The correlations between leadership competence and growth are significantly positive. Refer to the appendix.

⁶⁵² Refer to chapter 6.2.

⁶⁵³ The correlations with growth are slightly positive for the teamwork competence construct and significantly positive for the network competence construct. Refer to appendix. The strength of the network competence construct is comparable to findings by Klocke, B., 2004.

positive effects it has in larger teams.⁶⁵⁴ Also, negative network competence effects, which were depicted earlier (e.g. resource consumption, lock-in/lock-out effects), might interfere with the positive effects resulting in limited overall effects at the exploration stage.⁶⁵⁵ Figure 27 illustrates the encountered relationships in a graphical form.

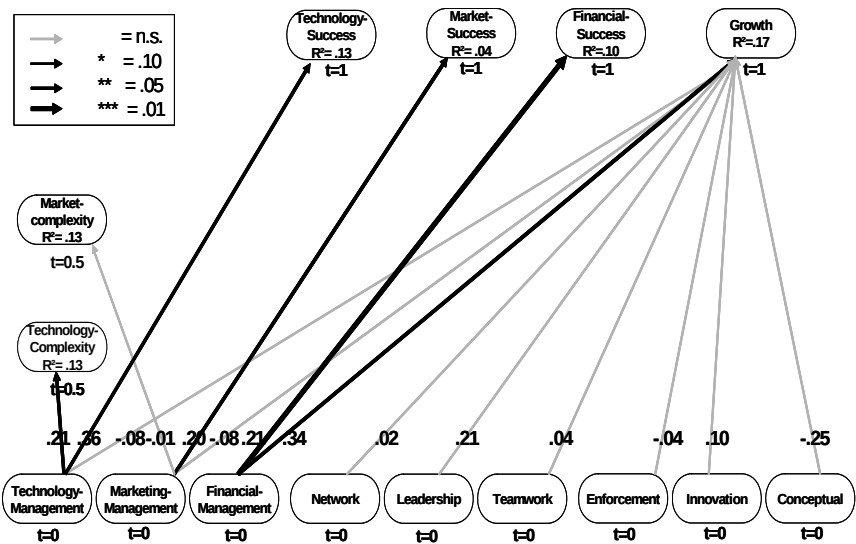


Fig. 27: Effects of EMC on venture development at the exploration stage

8.2.2 Effects of entrepreneurial-management-competence on the development of new technology-based firms at the exploitation stage

At the exploitation stage the effects of the present EMC on functional success measures and growth are analyzed. Additionally, the impacts of product and market complexity of the first product development on functional success and growth of the NTBFs are assessed. The effects between the different success dimensions are also evaluated. Tab. 96 presents the results of the structural equation model.

⁶⁵⁴ Hoegl, M., et al., forthcoming.

⁶⁵⁵ Refer to chapter 4.2.3.

Independent variables		Dependent variable: performance							
		Subjective variables						Objective variables	
		Technology Success (R ² .08)		Market Success (R ² .15)		Financial Success (R ² .25)		Growth (R ² .21)	
		coefficient	t-value	coefficient	t-value	coefficient	t-value	coefficient	t-value
Entrepreneurial Competencies	Conceptual							-.04	.22
	Innovation							.03	.17
	Enforcement							.06	.36
Social Competencies	Teamwork							.01	.07
	Leadership							-.04	.21
	Networking							.25***	2.20
Functional Competencies	Technological Management	.28**	2.07					-.09	.39
	Marketing Management			.33***	2.90			-.04	.18
	Financial Management					.29***	2.81	.26**	2.06
Complexity of the first product development	Technological complexity	-.01	.06					.16**	1.90
	Market complexity			-.10	1.12			-.12*	1.29
Success dimension	Technological Success			.12	.90				
	Market Success					.32***	2.92		
	Financial success							.13*	1.32
* p < .10; ** p < .05; *** p < .01 N = 186									

Tab. 96: Effects of EMC on venture development at the exploitation stage

The complexity of the first product development has no significant effects on the functional success dimensions. Technological and market success are not influenced by the degree of task complexity in the technological and market domain. Hypothe-

ses 15 and 17 are rejected. Technological complexity significantly favors growth; yet, market complexity hinders growth. The effect of market complexity on growth is only significant at the .1-level. Hence, hypothesis 16 is confirmed, while hypothesis 18 is rejected. Earlier discussions depicted the dual character of task complexity,⁶⁵⁶ which may explain the weak effect strengths. The findings suggested that task complexity indeed is a multi-facet concept.⁶⁵⁷ Market complexity might lead to decrease growth, yet, a complex technology might augment growth.

At the exploitation stage all functional competencies increase their respective functional success measures significantly. All effects are highly significant at the .01-level. Accordingly hypotheses 7, 9, and 11 are confirmed for both the exploration and exploitation stages. With regard to growth of the venture, financial management competence and network competence have significant positive effects (support for hypotheses 6 and 12 at the exploitation stage). This finding is especially interesting, because network competence did not have a significant impact at the exploration stage. Thus, it appears that the importance of network competence increases as the firm develops.⁶⁵⁸ The importance of resource acquisition and administration abilities is underlined. In line with previous work, this study also indicates that while some tasks remain important throughout the firm's development, others change in importance.⁶⁵⁹

The other competence domains have no significant effect on growth.⁶⁶⁰ Hypothesis 1, 2, 3, 4, 5, 8, and 10 are rejected at the exploitation stage. The overall high levels of competence and the resulting limited variance within the data might be one reason for these non-significant relationships. Theoretical interpretations presented for the exploration stage apply here as well. Thus, different negative effects of high levels of competence and subsequent actions appear to exist and diminish the aggregate effect strength. Additionally, it must be noted that the direct effects of competence on growth are weak. More focus on the activity level that connects competence at the team level and the final success at the firm level might provide a more comprehensive understanding.

⁶⁵⁶ Refer to chapter 5.4.3.

⁶⁵⁷ Refer also to *Salomo, S., 2003, 402-407.*

⁶⁵⁸ For a dynamic understanding of networks in entrepreneurial contexts refer to *Klocke, B., et al., 2003.*

⁶⁵⁹ *Kazanjan, R.K., 1988.*

⁶⁶⁰ The correlations with growth are all positive at moderate levels. The only negative correlation is found between conceptual competence and growth. Refer to the appendix.

The analysis indicates that market success favors financial success which in consequence increases growth. However, the relationship between financial success and growth is only significant at the .1-level. While the path coefficient of the effect of technological success on market success is positive, as expected, the relationship is not significant. Figure 28 depicts these encountered relationships. Thus, hypotheses 20 and 21 are confirmed while hypothesis 19 is rejected.

Due to the issues regarding causality presented in chapter 5.1, an additional path model was calculated without the path connecting financial success and growth. The overall model remains very similar. All significant paths remain significant again and the non-significant paths remain non-significant. The explained variance of growth drops slightly ($R^2 = .20$). This shows that this link does not distort the other effects, but can be understood as an indicator about a possible slightly positive effect between financial success of a new firm and its growth performance. To complement the picture, additionally, the other two functional success dimensions were related to growth by adding respective paths. The results illustrate that the effect of market success is positive at .22 and significant at the .05-level. The effect of technological success on growth is .11, yet not significant. Thus, this additional analysis illustrates that success indeed is a complex phenomenon. Market success is closely linked to growth, while the effects between technology and financial success on growth seem to be weaker.

Next, a more complete picture of the competence effects on venture success is depicted as the findings in the exploration and exploitation stages are merged.

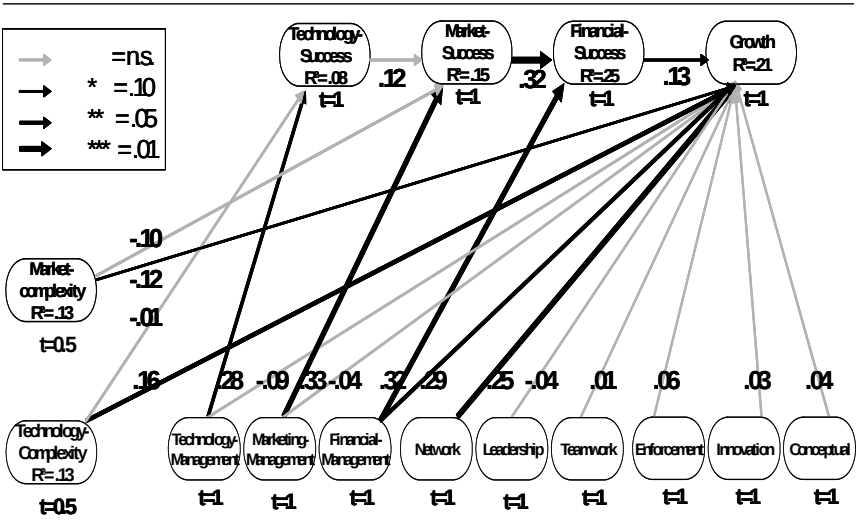


Fig. 28: Effects of EMC on venture development at the exploitation stage

8.2.3 Combined effects of entrepreneurial-management-competence on the development of new technology-based firms at the exploration and exploitation stage

Combining the findings of the two structural equation models, the direct and mediated effects of EMC on venture success can be determined. Figure 29 shows the graphical illustration of the combination of both structural equation models.

Functional competencies have direct effects on the functional success measures at both development stages. Financial management competence has a significant positive impact on growth at both stages. Network competence does not impact growth at the earliest development stage, but becomes significantly important for growth at the exploitation stage.

With regards to mediated effects of EMC on success of new firms, the importance of functional competencies at both stages is highlighted. Because functional competencies increase functional success at both instances and the functional success dimensions are interrelated and ultimately increase growth, there is an indirect effect of the functional competencies on growth. In order to evaluate these relationships

more specifically, each functional competence is directly related to growth, and indirectly by introducing their respective success measures as intermediate steps. The resulting structural equation model supports only the mediated effect of marketing competence on growth. Marketing competence increases market success with a path coefficient of .19 at a significance level of .05. The subsequent path from market success to growth is .20 and also significant at the .05-level. At the same time, the coefficient of the direct effect of marketing competence on growth is .05 and not significant. Thus, initial marketing competence has a positive indirect effect on growth while its direct effect on growth is non-significant. Indirect effects of the other two functional competencies on growth are not supported by incorporating the technology and financial success respectively. Both competencies increase their functional success measure significantly; yet, the relationships between those success measures and growth are non-significant.

Additionally, an indirect effect of technology management competence on growth can be identified. This involves the complexity of the product development task. Technology management competence increases the degree of complexity of the first product development, which in turn favors growth. A separate calculation of the indirect effect of technology management on growth illustrates that the path from technology management to technological complexity remains significant at the .05-level (path coefficient = .21). The path from the technological complexity to growth is significant at the .10-level (path coefficient = .16). The direct path from technology management competence to growth remains non-significant. Thus, initial technology management competence is an important indirect growth antecedent. The effects of marketing management competence on the market complexity are not significant. However, increased market complexity limits the growth prospects of NTBFs.

Overall, it is apparent that the competence of the TMT is one factor that significantly impacts new firm's growth directly and indirectly. Financial management competence has a direct impact at both development stages. Network competence increases growth at the exploitation stage. At the exploration stage technology management competence increases growth by raising the technology complexity which in consequence impacts growth. The initial marketing competence increases market success, which subsequently effects growth positively. Additionally, at both stages all

functional competence measures increase their respective success measures which correlate positively with growth. Thus, the competence of the TMTs affects the development of their NTBFs positively in various ways.

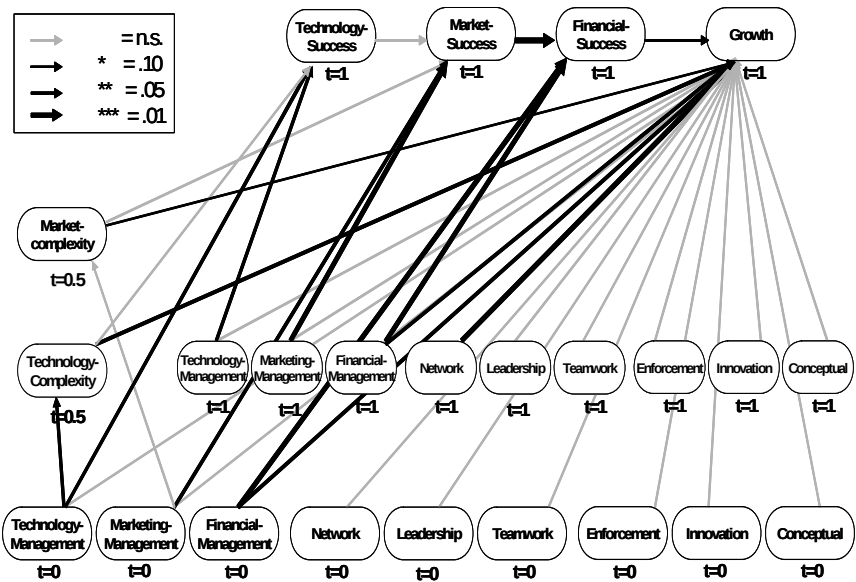


Fig. 29: Effects of EMC on venture development at both stages

9. Discussion of central findings and implications

9.1 Central research findings

The founding and successful development of NTBF is a central aim of entrepreneurs, private corporations, governmental institutions, business associations, and market-oriented societies. Despite the recent downturn of the new economy, venture creation continues at a high level. However, at the same time the failure rate of new firms remains high. This work aimed to address this problem by analyzing the development of NTBFs from a competence perspective. The goal was to find competencies that TMTs needed to start and grow a venture and to understand how the importance of the competencies changes as firms develop. Five research objectives were proposed at the beginning of this study.⁶⁶¹

The first objective regarded the development of a comprehensive competence construct that structures relevant competencies needed to found and grow a NTBF. Based on an extensive review of entrepreneurship and management literature, an entrepreneurial-management competence construct was derived which is composed of functional, social, and general entrepreneurial competencies.

Next, three venture development models and four theoretical streams of management literature were presented to understand NTBF development and explain why and how competence relates to venture development at a general level. Additionally, the current state of empirical research was reviewed to find initial evidence of links between development success and competence at a general as well as at a sub-domain specific level.

Based on this theoretical and empirical foundation, a conceptual framework was conceived that depicts the development of the NTBFs and the competence of their TMTs. This conceptual framework links the entrepreneurial-management competence construct to the product development task and new venture success at the exploration and exploitation stages.

⁶⁶¹ Refer to chapter 1.2.

The second major objective of this study regarded the operationalization and validation of a measurement concept of TMT's competence in NTBFs. The entrepreneurial literature and preliminary interviews were used to obtain a questionnaire to measure the relevant competencies, the development characteristics of NTBFs, and the new venture success. The data that was gathered from 212 new venture teams during this study was used to confirm reliability and validity of the measurement concept.

After confirming the measurement validity, the third and forth research objectives were addressed. These concerned the understanding of the development of NTBFs and also of competence and its interrelationships. The analysis of the development of the NTBFs illustrated that new ventures progress from initial exploration activities to exploitation activities. The advances in the technology, marketing, and financial domains are significantly related though there is diversity in the development. A popular combination of functional activities in the technology and marketing domains which *Klocke, B., 2004* identified for nanotech-firms is also found in this study which comprises ventures with more diverse technologies. An additional dimension was added to the Klocke model. This concerns external financing. Although a considerable number of ventures can finance their start-up internally, the rest undertakes explorational and exploitation financing activities. Partly, these NTBFs follow the model developed in this study which links the financing activities to combinations of technological and marketing activities of the Klocke model. However, the data shows that a standard path of NTBF development can only be drafted roughly, because many companies diverge from the model path.

The description of the competence development focused on two dimensions. The first referred to the functional background of the TMT by drawing on objective data while the second relied on an intensive self-assessment of the entrepreneurial-management competence domains. Concerning the functional background of the TMT members, the two to three person teams consist predominantly of persons with a technological background and limited experience in marketing and finance at start-up. The size and composition of the TMT hardly changes as ventures develop. No systematic replacement of team-members to add lacking skills was observed.

The functional composition of the TMTs is also reflected in their self-assessed competence profile at start-up. Teams are more competent in technology management than in marketing or finance at start-up. Still, the functional competencies are relatively weaker than their general entrepreneurial and social competencies. With the transition from exploration to exploitation activities, the competence profile changes. Significant learning takes place especially in those functional areas which are self-assessed weaknesses at start-up. At the exploitation stage, the competence profile shows a fairly even distribution of competencies in spite of the technological background of the team members. On-the-job-learning of the new venture TMT appears to be a crucial source of this competence development.

Subsequent calculations of structural equation models for the exploration and exploitation stages illustrate that special competence domains are important antecedents of venture success. Functional competencies have significant positive effects on their respective functional success measures at both stages. The technology and financial success are weakly linked to growth. The marketing success has a significant positive impact on venture growth. An indirect growth effect of marketing competence on growth is identified. The initial marketing competence increases market success which subsequently effects growth positively. Another indirect growth impact is identified for technology management competence. The initial technology management competence affects the technological task complexity positively which in consequence increases growth. The importance of financial management competence for growth is documented at both development stages. Additionally, at the exploitation stage, network competence resulted in significantly higher venture growth. Beyond these findings, direct growth effects of the other competence domains are not significant.

The fifth research objective of offering PLS as an alternative evaluation method in empirical entrepreneurial research was addressed. PLS is still hardly used in the entrepreneurship field, but offers advantages compared with more commonly applied methods like correlation analysis, regressions, or LISREL. The discussion and application of PLS provide insights about the utility and applicability of this method.

9.2 Implications

This scientific study provides insights for different stakeholders of entrepreneurial activity. For three major stakeholder groups – researchers, entrepreneurs, and support institutions/educators - central implications are proposed based on the findings of this study.

9.2.1 Implication for researchers

In spite of the interest of entrepreneurship researchers in personal attributes of venture-leaders, competence-oriented research is hardly undertaken and scientific insights remain very limited.⁶⁶² This study shows that competence is a multi-faceted issue that has explanatory power for venture development and success.

Research should go beyond a rough evaluation of human capital, but investigate in detail which specific competencies are needed at what point in time. In this regard this study offers initial insights. It deduces a comprehensive competence concept. Different competence domains are identified. They are expected to translate into actions which shape the new organization and impact success.

Research needs to focus on a broader understanding of competence. Competence itself involves more dimensions than regularly considered. Different domains like conceptual, network, or technology management abilities have largely been ignored in prior empirical entrepreneurship research, but should be included to understand venture success. There are hardly any empirical studies available which comprehensively depict the different competence domains, which impact growth. The proposed concept of entrepreneurial-management competence can serve as a general framework to identify relevant competence domains in the entrepreneurship field.

This research signaled that functional competencies - especially marketing and financial management – are important. Though some studies have investigated certain aspects of these functional competence domains, little effort was directed toward comprehensively analyzing these domains.

⁶⁶² Röpcke, J., 2002.

Prior research frequently related competence directly to success. This study illustrates that there is a task level between those two dimensions. Research settings should incorporate this intermediate level to better understand how competence influences success.⁶⁶³ This study investigates the effects between technology management and marketing management competencies and technology and market complexity. A positive relationship was found between technological management competence and the complexity of the first development task, while the marketing competence had no significant effect on market complexity. This suggests that contingent factors might determine how competence transfers into task characteristics. At the same time, while research frequently investigates success implications of certain activities, it often ignores the antecedents of these activities; yet this study shows that the antecedent factors are important for success.

Another frequent shortcoming of research is the static analysis of venture creation. This research depicts in various ways that new venture creation is a process. New firms evolve in various directions on qualitative and quantitative dimensions. Thus, research settings should reflect this characteristic. Entrepreneurship research should analyze venture creation as a dynamic phenomenon. This calls for longitudinal studies, comparative static frameworks, careful sample selection, and controlling for development factors. The development model for NTBF conceived in this study can serve to analyze the development of new ventures.

Compared to other research areas, the construct development in entrepreneurship is in its infancy. Few constructs have been validated. Single-item operationalizations are commonplace. Without a validated measurement, however, results can become doubtful. In this study different steps were taken to obtain a validated measurement tool. Future research should continue to enhance and improve the measurement tools. This study especially intended to use objective data to validate more-subjective scales. In light of the findings, it appears useful to apply more of these objective validation concepts. The conceptual framework also indicated how the incorporation of nomological frameworks can assist in evaluating subjective measurements. Few of these design features are present in current entrepreneurship research.

⁶⁶³ Refer also to *Walter, A. and Gemünden, H.G., 2002.*

This study primarily applied the PLS method to evaluate the conceived relationships. Prior entrepreneurship research generally applied basic methods which do not allow assessing the validity, reliability, causality, or even multivariate interactions. Yet, as this study illustrates, more-advanced statistical tools provide opportunities to analyze complex models which can offer insightful findings about the entrepreneurship process. Because entrepreneurship is a complex phenomenon, methodological advance appears useful. This would not only improve the results of the individual study, but also facilitate a quantitative meta-analysis of the effect strengths in different areas.

9.2.2 Implications for entrepreneurs

Various theoretical arguments and empirical findings delineated throughout this work illustrate that entrepreneurs should focus on their competencies.⁶⁶⁴ The competence concept which was developed in this work can offer a better understanding about various competence domains. The presented measurement tool can be used for self-evaluation of the team's competence.

The empirical study of 212 NTBFs shows that at start-up self-assessed weaknesses of the TMTs exist mainly in the functional competence domains. Especial weaknesses are attributed to the marketing and financial management domain. This competence deficit can be unfortunate, because the results show that marketing and especially financial management abilities are prime antecedents of venture success. The founding teams should assure that they possess marketing and finance competence already at start-up. In later stages of development, network competence becomes significantly more relevant for success. Thus, TMTs should assure that they have members with strong networking abilities.

Previous studies suggest that the outcome of planning and innovation competence can be two-fold.⁶⁶⁵ On one hand, basic planning is needed to evaluate the business opportunities, different strategies, or operational practices. On the other hand, planning is a resource-consuming task which might limit strategic flexibility, lead to a distorted perception of reality, and which can be of limited value in highly-dynamic

⁶⁶⁴ The following implications are derived from the findings of this research work with is primarily of academic nature. For a more specific analysis of findings for practitioners refer to *Brinckmann, J., 2005*.

⁶⁶⁵ Refer to chapter 4.1.1 and 5.3.1.1.

market conditions.⁶⁶⁶ In this study, conceptual competence does not impact the growth of the NTBFs significantly, but a slight negative effect is indicated. Thus, a prudent assessment seems advisable concerning which areas should be thoroughly planned and which should be approached more intuitively. Similarly, in literature innovation is depicted as a two-sided sword.⁶⁶⁷ It can be used to obtain a competitive advantage, but at the same time it might imply bigger challenges concerning issues such as product development, market entry, and market development. In this study no significant effects of innovation competence on venture growth were found. Yet, the complexity of the first development task, which is conceptually closely linked to innovation, impacted the growth of the new firms. Technology complexity had a positive effect on venture growth, while market complexity had a negative outcome. Thus, caution is advised when defining the goals and tasks of a new firm.

While direct and indirect effects of competence are at the core of this study, the descriptive analysis of venture development suggests that learning – being the positive change in the competence profile – is linked to the focal activities of NTBFs. More research is needed to explore the learning effects and antecedents of learning in ventures. The initial observations indicate an importance for TMTs to engage in different activities early-on in order to develop competencies in the respective fields.

9.2.3 Implication for policy makers and educators

In spite of various governmental attempts in Germany to support new venture creation through training, founders still have a significant lack of different competencies. At the same time these competencies are crucial for venture success. This implies that more effort should be placed on entrepreneurship education.

Concerning the content of the entrepreneurship education, this work presented a comprehensive construct that can be used to focus the educational effort. Utmost importance should be given to the training of functional skills especially in marketing, in financial management, and in the management of technologies. The networking competence should be another major educational focus. Beyond these competencies, theoretical discussions and empirical research highlight the importance to

⁶⁶⁶ Vesper, K.H., 1993.

⁶⁶⁷ Hauschildt, J. and Salomo, S., 2005.

develop additional competence areas that are encompassed in the entrepreneurial-management competence construct developed in this study.

With regards to the format of the entrepreneurial education, practical experience is essential. Traditional educational approaches of transferring knowledge through oral presentation of information might have to be replaced by forms that allow the participants to obtain hands-on experience in real-world environments. At the same time, entrepreneurial support could facilitate networking events. In the initial stage of venture creation, the aim of networking should be to bring people from different functional backgrounds together that form venture teams. Thus, prospective founders with a strong technology background could mix with potential team members that have a business background. In later stages, the aim of networking could be to facilitate functional-network building for the crucial tasks at hand.

9.3 Limitations and further research

9.3.1 Limitations

This research has inherent limitations. Since only functioning firms are evaluated, this study can only determine development implications for surviving firms. The unfortunate ventures which cease to exist and the reasons for their failure go undocumented. Future research could aim to obtain large samples of competence profiles of persons who intend to found a company and document their founding progress longitudinally. Alternatively, studies which specifically analyze firm failures and prior competence indicators could offer further insights.

Another limitation concerns the assessment of many independent variables by one person. In this study, objective data was used to validate the subjective evaluation. It would have been preferable to include additional team-members and persons outside the TMT to aim for a 360-degree evaluation. However, the field characteristics and the intended sample size have prevented this design. It needs to be noted, however, that studies such as *Müller, T.A., 2003; Chandler, G.N. and Jansen, E., 1992; Chandler, G.N. and Hanks, S.H., 1994; Erpenbeck, J. and von Rosenstiel, L., 2003b; Baron, R.A. and Markman, G.D., 2003* found no fundamental difference using multiple respondents. Yet, it is acknowledged that the assessment of competence remains a challenge.

Further critique of this study might concern the semi-longitudinal design. Because respondents had to evaluate their initial competence, a recall bias can be expected. The comparison with objective data was intended to focus on this problem. It would have been preferable to assess competence directly at start-up. Yet, due to the duration of the research project and the lack of contacts to start-ups in the initial development stage this design was not feasible.

9.3.2 Further research

At the outset of this study, the competence dimension of entrepreneurship was presented as a neglected research area. Notwithstanding the results of this study, a lack of insight concerning entrepreneurs' competence remains. This work suggests that research in the competence field of entrepreneurship bears fruit. However, the comprehensiveness of the research design limited the possibilities to investigate various areas in detail. Several research questions were addressed, but could not be answered conclusively. At the same time, this research revealed new intriguing research questions.

The comprehensiveness of the investigation of the various competence domains implied that each competence domain could only be investigated at a general level. Especially in the functional domains, a more-specific analysis of important competence areas and crucial management activities appears insightful. This study offers a framework for structuring three functional domains. Further research may reveal which competencies of the sub-domains are more important for the success of new ventures and how their importance changes over time. Especially the financial management and technology management functions are important, yet largely ignored, areas of new venture research. With regard to many of the general entrepreneurship and social competencies, previous findings document contradictory effects. Unfortunately, different of these competencies have non-significant effects on growth in this study. Thus, a challenge remains for future research to investigate these areas more in detail. Questions arise such as how conceptual competence relates to the quality and intensity of planning activity and other constructs such as strategic flexibility, creativity, and intuition. Innovation is widely considered to be an

essential component of successful entrepreneurship.⁶⁶⁸ However, some empirical findings do not support this general statement.⁶⁶⁹ Innovation research signals that innovation consists of various dimensions which might have different antecedents and effects at different stages of development.⁶⁷⁰ Entrepreneurial research should devote more attention to such dimensions.

This study depicted the development of a TMT's competence. The change in competence reflects learning that takes place within the team. It can be expected that the learning of the TMT relates to venture success. Although this complex topic was not specifically addressed in this study, it appears to be another promising area of research into the human side of entrepreneurship.

Another largely unexplored area regards the development aspects of NTBFs. This research presented a three-domain development model based on the Klocke model of nanotechnology-based venture development. Diverging development paths were illustrated. It remains to be analyzed what determines the development path taken by the NTBF. Other questions concern how the different dimensions interrelate and which development path promises more success. While the data of this study offers some insights, a research project focusing exclusively on development issues may be rewarding.

While this work focused on NTBFs, other types of new ventures represent important research objects as well. The outlined competence framework can be expected to apply to non-technology ventures as well. The technology management dimension may have to be replaced by other important functional competencies. In addition, alternative development models may need to be developed to specifically capture the development of these ventures.

From a methodological perspective, scientific advances might be propelled by longitudinal studies where researchers follow the development of new ventures in order to gain a more detailed understanding of the development dynamics of new firms, practices, and development antecedents. Next to meticulous qualitative

⁶⁶⁸ Schumpeter, J., 1993.

⁶⁶⁹ Reid, G.C. and Smith, J.A., 2000; Heunks, F.J., 1998.

⁶⁷⁰ Salomo, S., 2003; Hauschildt, J. and Salomo, S., 2005; Schlaak, T.M., 1999.

studies, the quantitative research needs to be strengthened. This refers especially to the use of advanced statistical methods which are commonplace in other scientific areas. The application of different statistical methods can yield more profound insights about measurement characteristics and the suspected relationships between constructs. Additionally, this approach promises a better understanding of the advantages and disadvantages of the respective statistical method applied.

The various suggestions for future research illustrate that the young entrepreneurship field remains an open and rewarding area for scientific discovery. Academic entrepreneurship research still is in its infancy. Future findings may benefit various stakeholders and increase societal welfare as proclaimed at the beginning of this research.

Appendix

I. Distribution and correlation of constructs at the exploration stage

	Mean	SD	1.	2.	3.	4.	5.	6.	7.
1. Conception	3.80	0.80	1.00						
2. Innovation	4.04	0.64	0.33	1.00					
3. Enforcement	4.37	0.69	0.33	0.40	1.00				
4. Teamwork	4.26	0.80	0.35	0.49	0.47	1.00			
5. Leadership	3.62	0.88	0.29	0.37	0.49	0.33	1.00		
6. Networking	3.17	0.91	0.11	0.18	0.12	0.19	0.22	1.00	
7. Tech. Strategy	3.71	0.75	0.35	0.52	0.39	0.45	0.34	0.14	1.00
8. Tech. Analysis	3.73	1.00	0.40	0.44	0.41	0.47	0.37	0.14	0.61
9. Tech. Intern. Dev.	3.24	0.94	0.37	0.40	0.37	0.31	0.50	0.25	0.52
10. Tech. External dev.	3.58	0.79	0.27	0.43	0.31	0.35	0.53	0.29	0.47
11. Tech. Protection	3.23	0.92	0.30	0.32	0.23	0.30	0.33	0.27	0.41
12. Tech. Use	2.88	0.98	0.24	0.36	0.32	0.35	0.44	0.30	0.44
13. Tech. Controlling	3.65	0.96	0.33	0.35	0.39	0.40	0.42	0.24	0.47
14. Total Tech. Mgmt. Comp.	3.45	0.65	0.42	0.52	0.45	0.48	0.54	0.30	0.73
15. Marketing Strategy	3.06	0.94	0.23	0.30	0.28	0.34	0.49	0.46	0.36
16. Marketing Analysis	3.03	0.82	0.26	0.32	0.31	0.33	0.45	0.30	0.40
17. Transaction Marketing	3.01	0.94	0.20	0.30	0.27	0.30	0.47	0.47	0.29
18. Relationship Marketing	3.22	0.95	0.19	0.22	0.25	0.24	0.35	0.48	0.30
19. Total Mktg Mngt Comp.	3.04	0.80	0.24	0.32	0.31	0.34	0.50	0.49	0.38
20. Fin. Strategy	2.95	0.98	0.39	0.22	0.33	0.26	0.35	0.44	0.31
21. Financing	3.15	1.06	0.31	0.28	0.37	0.27	0.28	0.41	0.36
22. Liquidity Mngmt	3.01	0.94	0.21	0.21	0.27	0.30	0.36	0.51	0.22
23. Accounting	2.88	1.14	0.20	0.27	0.24	0.33	0.35	0.55	0.22
24. Total Fin. Mgmt. Comp.	3.07	0.84	0.31	0.28	0.34	0.34	0.39	0.56	0.31
25. Growth ⁶⁷¹	146.3 1.99	189.5 2.80	-0.10	-0.13	0.10	0.11	0.22	0.19	0.01
26. Tech. Success	3.99	0.56	0.23	0.23	0.15	0.15	0.05	0.03	0.31
27. Tech. Complexity	3.81	1.08	0.12	0.08	0.06	-0.03	0.10	0.04	0.18
28. Market Comp.	3.33	1.22	0.07	0.15	0.10	0.14	-0.03	-0.01	0.10
29. Market success	3.40	0.76	0.02	0.13	0.17	0.09	0.19	0.04	0.21
30. Financial Success	3.28	0.87	0.15	0.02	0.04	0.12	0.15	0.14	0.06

⁶⁷¹ Formative construct build from annual sales and employment growth. First row refers to sales growth; second row refers to employment growth.

Appendix

	8.	9.	10.	11.	12.	13.	14.	15.	16.
8. Tech. Analysis	1.00								
9. Tech. Intern. Dev.	0.57	1.00							
10. Tech. External dev.	0.56	0.55	1.00						
11. Tech. Protection	0.47	0.48	0.62	1.00					
12. Tech. Use	0.51	0.61	0.64	0.60	1.00				
13. Tech. Controlling	0.51	0.54	0.50	0.35	0.58	1.00			
14. Total Tech. Mgmt. Comp.	0.78	0.79	0.82	0.74	0.81	0.72	1.00		
15. Marketing Strategy	0.57	0.59	0.54	0.48	0.53	0.49	0.66	1.00	
16. Marketing Analysis	0.60	0.58	0.51	0.46	0.50	0.50	0.66	0.75	1.00
17. Transaction Marketing	0.45	0.52	0.45	0.36	0.48	0.40	0.55	0.76	0.71
18. Relationship Marketing	0.42	0.46	0.46	0.38	0.46	0.39	0.53	0.70	0.61
19. Total Mktg Mngt Comp.	0.57	0.60	0.55	0.47	0.55	0.50	0.67	0.90	0.86
20. Fin. Strategy	0.34	0.40	0.31	0.37	0.43	0.48	0.48	0.46	0.38
21. Financing	0.30	0.40	0.24	0.26	0.33	0.33	0.41	0.40	0.32
22. Liquidity Mngmt	0.33	0.39	0.35	0.28	0.39	0.36	0.43	0.52	0.39
23. Accounting	0.35	0.40	0.37	0.29	0.45	0.39	0.45	0.56	0.43
24. Total Fin. Mgmt. Comp.	0.38	0.46	0.37	0.35	0.46	0.45	0.52	0.57	0.45
25. Growth	0.04	0.06	0.16	0.14	0.11	0.02	0.11	0.15	0.04
26. Tech. Success	0.31	0.26	0.33	0.28	0.27	0.18	0.36	0.19	0.18
27. Tech. Complexity	0.11	0.14	0.21	0.19	0.13	0.16	0.21	0.07	0.02
28. Market Comp.	0.06	0.10	0.06	0.11	0.12	0.07	0.12	-0.06	0.05
29. Market success	0.16	0.08	0.27	0.16	0.22	0.11	0.23	0.17	0.18
30. Financial Success	0.12	0.18	0.23	0.13	0.25	0.24	0.22	0.17	0.07

Appendix

	17.	18.	19.	20.	21.	22.	23.	24.	25.
17. Transaction Marketing	1.00								
18. Relationship Marketing	0.78	1.00							
19. Total Mktg Mngt Comp.	0.92	0.87	1.00						
20. Fin. Strategy	0.50	0.50	0.52	1.00					
21. Financing	0.42	0.38	0.43	0.60	1.00				
22. Liquidity Mngmt	0.51	0.48	0.54	0.60	0.67	1.00			
23. Accounting	0.56	0.50	0.58	0.59	0.62	0.82	1.00		
24. Total Fin. Mgmt. Comp.	0.58	0.54	0.61	0.80	0.83	0.91	0.89	1.00	
25. Growth	0.21	0.14	0.16	0.13	0.28	0.31	0.28	0.30	1.00
26. Tech. Success	0.16	0.19	0.20	0.20	0.19	0.19	0.21	0.23	0.11
27. Tech. Complexity	-0.02	-0.03	0.01	0.09	0.01	0.05	0.04	0.06	0.13
28. Market Comp.	-0.05	0.01	-0.01	0.02	-0.01	-0.06	0.02	-0.01	0.00
29. Market success	0.16	0.20	0.20	0.19	0.12	0.08	0.12	0.15	0.26
30. Financial Success	0.20	0.17	0.17	0.31	0.19	0.32	0.26	0.32	0.19

	26.	27.	28.	29.	30.
26. Tech. Success	1.00				
27. Tech. Complexity	0.10	1.00			
28. Market Comp.	0.03	0.41	1.00		
29. Market success	0.25	0.02	-0.07	1.00	
30. Financial Success	0.29	0.03	-0.17	0.31	1.00

II. Distribution and correlation of constructs at the exploitation stage

	Mean	SD	1.	2.	3.	4.	5.	6.	7.
1. Conception	4.01	0.61	1.00						
2. Innovation	4.07	0.56	0.34	1.00					
3. Enforcement	4.49	0.56	0.32	0.38	1.00				
4. Teamwork	4.36	0.66	0.37	0.48	0.45	1.00			
5. Leadership	4.19	0.57	0.31	0.36	0.51	0.35	1.00		
6. Networking	4.01	0.63	0.08	0.16	0.11	0.18	0.22	1.00	
7. Tech. Strategy	4.03	0.65	0.36	0.52	0.37	0.44	0.34	0.11	1.00
8. Tech. Analysis	4.42	0.51	0.41	0.44	0.40	0.47	0.36	0.08	0.61
9. Tech. Intern. Dev.	4.02	0.62	0.38	0.40	0.35	0.31	0.48	0.20	0.52
10. Tech. External dev.	4.10	0.56	0.27	0.42	0.30	0.35	0.52	0.26	0.47
11. Tech. Protection	3.76	0.69	0.30	0.32	0.22	0.30	0.32	0.22	0.41
12. Tech. Use	3.51	0.79	0.25	0.36	0.31	0.36	0.42	0.26	0.44
13. Tech. Controlling	4.38	0.58	0.35	0.35	0.39	0.40	0.44	0.22	0.48
14. Total Tech. Mgmt. Comp.	4.03	0.44	0.43	0.52	0.44	0.49	0.53	0.25	0.73
15. Marketing Strategy	4.04	0.56	0.24	0.30	0.26	0.35	0.47	0.39	0.36
16. Marketing Analysis	3.95	0.59	0.26	0.32	0.30	0.32	0.44	0.24	0.40
17. Transaction Marketing	4.07	0.59	0.20	0.30	0.26	0.30	0.45	0.40	0.29
18. Relationship Marketing	4.23	0.53	0.19	0.22	0.25	0.24	0.34	0.41	0.30
19. Total Mktg Mngt Comp.	4.04	0.46	0.25	0.32	0.30	0.34	0.48	0.41	0.37
20. Fin. Strategy	4.01	0.74	0.39	0.21	0.32	0.26	0.37	0.40	0.31
21. Financing	3.97	0.70	0.32	0.28	0.36	0.27	0.31	0.39	0.36
22. Liquidity Mngmt	4.15	0.57	0.22	0.20	0.26	0.30	0.35	0.48	0.22
23. Accounting	4.18	0.63	0.20	0.26	0.24	0.33	0.36	0.53	0.22
24. Total Fin. Mgmt. Comp.	4.15	0.50	0.32	0.27	0.34	0.34	0.40	0.53	0.31
25. Growth ⁶⁷²	210.5 2.16	335.7 3.01	-0.10	0.11	0.11	0.12	0.21	0.21	0.02
26. Tech. Success	4.01	0.51	0.24	0.24	0.15	0.15	0.07	0.01	0.33
27. Tech. Complexity	3.75	1.10	0.12	0.09	0.06	-0.03	0.08	0.04	0.18
28. Market Comp.	3.30	1.19	0.08	0.15	0.10	0.14	-0.03	-0.03	0.10
29. Market success	3.52	0.68	0.02	0.11	0.16	0.08	0.22	0.03	0.20
30. Financial Success	3.36	0.82	0.16	0.02	0.04	0.12	0.17	0.13	0.07

⁶⁷² The formative construct is build from annual sales and employment growth figures. The first row refers to sales growth, the second row refers to employment growth.

Appendix

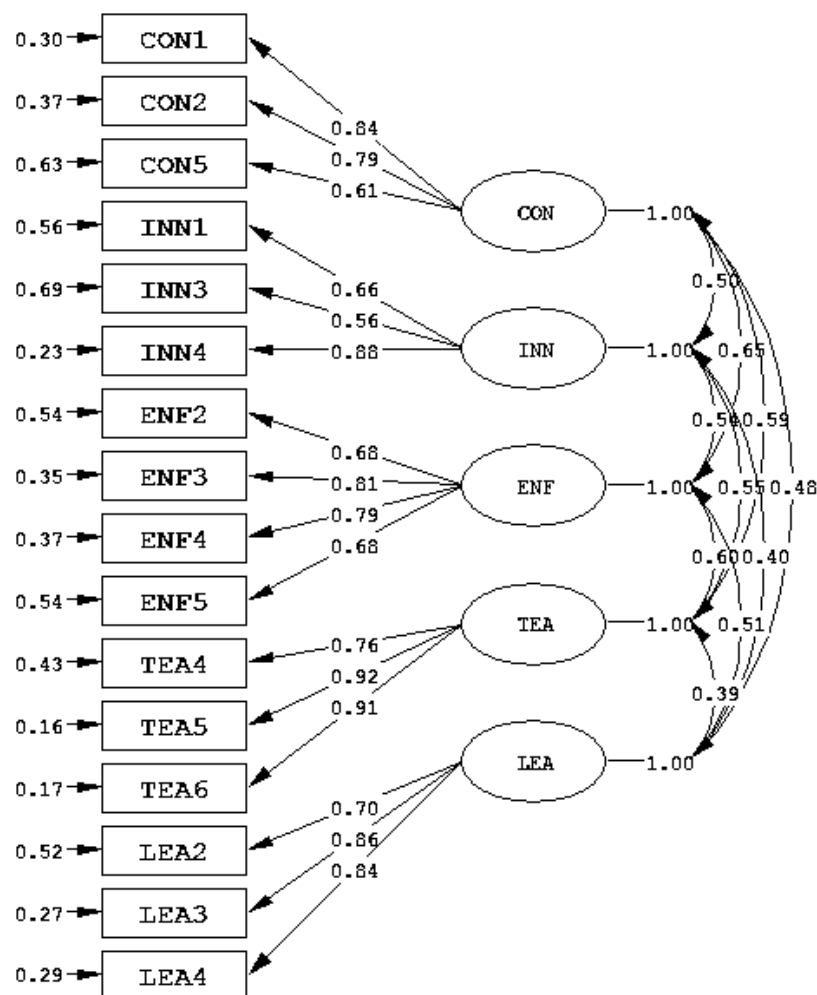
	8.	9.	10.	11.	12.	13.	14.	15.	16.
8. Tech. Analysis	1.00								
9. Tech. Intern. Dev.	0.57	1.00							
10. Tech. External dev.	0.56	0.55	1.00						
11. Tech. Protection	0.47	0.48	0.62	1.00					
12. Tech. Use	0.50	0.61	0.64	0.60	1.00				
13. Tech. Controlling	0.51	0.54	0.50	0.35	0.58	1.00			
14. Total Tech. Mgmt. Comp.	0.78	0.79	0.82	0.73	0.81	0.73	1.00		
15. Marketing Strategy	0.57	0.59	0.54	0.48	0.53	0.49	0.66	1.00	
16. Marketing Analysis	0.60	0.58	0.51	0.46	0.50	0.50	0.65	0.75	1.00
17. Transaction Marketing	0.45	0.52	0.45	0.36	0.48	0.40	0.55	0.76	0.71
18. Relationship Marketing	0.41	0.46	0.46	0.38	0.46	0.39	0.53	0.70	0.61
19. Total Mktg Mngt Comp.	0.57	0.60	0.55	0.47	0.55	0.50	0.67	0.90	0.86
20. Fin. Strategy	0.34	0.40	0.31	0.37	0.43	0.49	0.48	0.46	0.38
21. Financing	0.30	0.40	0.24	0.26	0.33	0.33	0.41	0.40	0.32
22. Liquidity Mngmt	0.33	0.39	0.35	0.28	0.38	0.36	0.43	0.52	0.39
23. Accounting	0.35	0.40	0.37	0.29	0.45	0.39	0.45	0.56	0.43
24. Total Fin. Mgmt. Comp.	0.38	0.46	0.37	0.35	0.46	0.45	0.51	0.57	0.45
25. Growth	0.01	0.04	0.15	0.12	0.07	0.00	0.08	0.12	0.04
26. Tech. Success	0.29	0.25	0.32	0.25	0.25	0.20	0.35	0.17	0.16
27. Tech. Complexity	0.11	0.14	0.21	0.19	0.13	0.16	0.22	0.07	0.02
28. Market Comp.	0.06	0.10	0.06	0.11	0.12	0.07	0.12	-0.06	0.05
29. Market success	0.16	0.07	0.27	0.15	0.22	0.11	0.23	0.16	0.17
30. Financial Success	0.12	0.18	0.23	0.12	0.24	0.24	0.22	0.17	0.09

Appendix

	17.	18.	19.	20.	21.	22.	23.	24.	25.
17. Transaction Marketing	1.00								
18. Relationship Marketing	0.78	1.00							
19. Total Mktg Mngt Comp.	0.92	0.87	1.00						
20. Fin. Strategy	0.50	0.50	0.52	1.00					
21. Financing	0.42	0.38	0.43	0.60	1.00				
22. Liquidity Mngmt	0.51	0.48	0.54	0.60	0.67	1.00			
23. Accounting	0.56	0.50	0.58	0.59	0.62	0.82	1.00		
24. Total Fin. Mgmt. Comp.	0.58	0.54	0.61	0.80	0.83	0.91	0.89	1.00	
25. Growth	0.22	0.15	0.16	0.14	0.25	0.30	0.25	0.28	1.00
26. Tech. Success	0.15	0.17	0.18	0.21	0.19	0.20	0.20	0.23	0.11
27. Tech. Complexity	-0.02	-0.03	0.01	0.09	0.01	0.05	0.04	0.05	0.10
28. Market Comp.	-0.05	0.01	-0.02	0.02	-0.01	-0.06	0.02	-0.01	-0.04
29. Market success	0.15	0.20	0.19	0.19	0.11	0.08	0.12	0.14	0.30
30. Financial Success	0.21	0.17	0.18	0.31	0.20	0.32	0.26	0.32	0.20

	26.	27.	28.	29.	30.
26. Tech. Success	1.00				
27. Tech. Complexity	0.10	1.00			
28. Market Comp.	0.05	0.41	1.00		
29. Market success	0.25	0.02	-0.08	1.00	
30. Financial Success	0.25	0.01	-0.19	-0.37	1.00

III. Confirmatory factor analysis at the exploration stage



Chi-Square: 130.12

df: 94

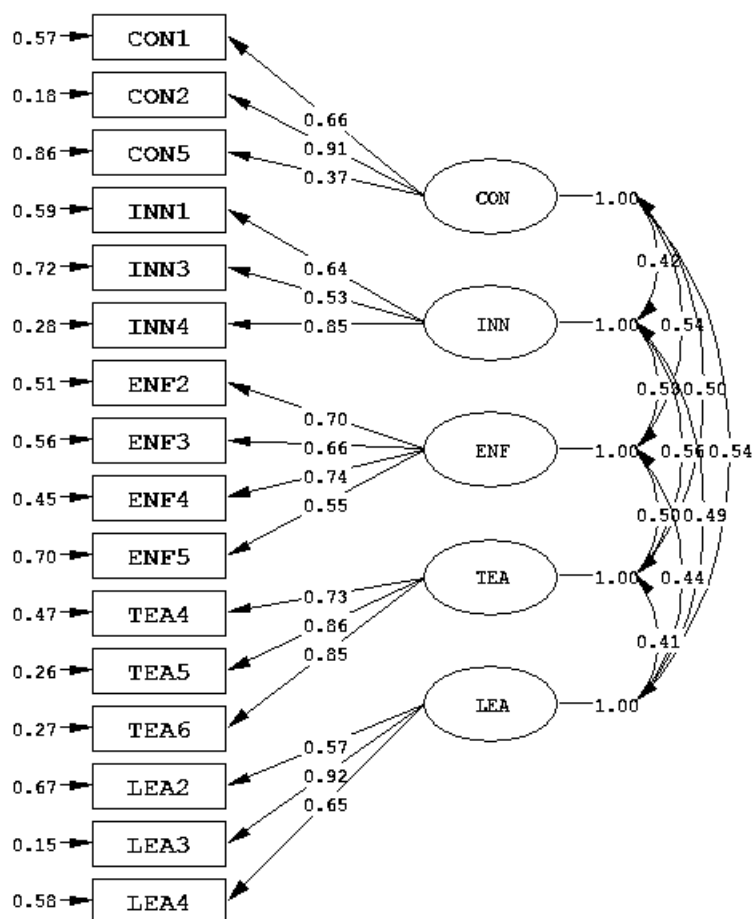
RMSEA: 0.057

Goodness of Fit Index (GFI) = 0.88

Adjusted Goodness of Fit Index (AGFI) = 0.82

N=118

IV. Confirmatory factor analysis at the exploitation stage



Chi-Square: 108.00

df: 94

RMSEA: 0.035

Goodness of Fit Index (GFI) = 0.90

Adjusted Goodness of Fit Index (AGFI) = 0.86

N=124

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