Entrepreneurship
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Markus Sattler

Excellence in Innovation Management

A Meta-Analytic Review on the Predictors of Innovation Performance

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Entrepreneurship

„Entrepreneurship“ ist ein noch relativ junger Forschungszweig, der jedoch in Wissenschaft und Praxis stetig an Bedeutung gewinnt. Denn Unternehmensgründungen und deren Promotoren nehmen für die wirtschaftliche Entwicklung einen zentralen Stellenwert ein, so dass es nur folgerichtig ist, dem auch in Forschung und Lehre Rechnung zu tragen.
Die Schriftenreihe bietet ein Forum für wissenschaftliche Beiträge zur Entrepreneurship-Thematik. Ziel ist der Transfer von aktuellen Forschungsergebnissen und deren Diskussion aus der Wissenschaft in die Unternehmenspraxis.

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A Meta-Analytic Review on the Predictors of Innovation Performance

With a foreword by Prof. Dr. Malte Brettel

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Foreword

Every product has a life cycle, making constant renewal a core task of every business. This is especially true of German companies, which are typically forced to create a competitive advantage through being highly innovative rather than through low-cost production. It is, therefore, vital for these businesses to monitor and acknowledge the many academic findings in the field of innovation management. No easy task: there have been countless studies pertaining to innovation management, and it is often difficult to obtain clear and specific results. This is also partly due to the fact that such studies regularly come to different conclusions. For example, Larker (1997) is only able to identify a negative correlation between customer contributions and success in innovation, whereas Slater et al. (2007) conclude the exact opposite. The differences between the various studies and their findings can be explained by a number of factors, and by situational factors in particular. Thus the question remains: What generalizable statements can be derived from these myriad studies? The answer lies in a meta-analysis covering all the individual studies, and so far four prominent meta-analyses have been published in the field of innovation management. However, these meta-analyses manage to raise serious questions themselves, which limits generalizability, which leads to repeated calls for new meta-analyses on this topic.

This is the starting point for Markus Sattler's thesis. This dissertation responds to the overarching research question: What are the key success factors of innovation management at company level? In providing his answer, Mr. Sattler reviewed a number of previous research projects, synthesized the resulting data, and analyzed this data as a whole. As such he was able to filter out overarching findings relevant to innovation management and to resolve, or at least take one step closer to resolving, existing disparities between past studies.

Mr. Sattler took an interesting approach to this project. To begin with he undertook an extremely comprehensive review of the available literature concerning innovation management. As a result, this work is incredibly valuable for subsequent researchers, who will benefit enormously from its discussion of all key studies thus far that deal with success drivers in innovation management at company level.

The subsequent quantitative linking and evaluation of a key section of these studies allowed Mr. Sattler to arrive at his own conclusions. As a result he is in a position to offer valuable advice, to industry practitioners in particular, on how to develop successful innovation management within a company. This dissertation highlights key overarching findings that, al-

though possibly already stated in specific individual studies, have so far certainly not been consistent across all studies.

In line with its tremendous value to both theory and practice, this work truly deserves as wide an audience as possible.

Malte Brettel

Preface

This book was put together with a surge of inspiration, a morsel of talent, and a lot of perspiration. Most importantly, my work has been surrounded and supported by a number of fantastic people. First, I would like to express my appreciation and gratitude to my advocate and doctoral father, Professor Dr. Malte Brettel. Malte, without this incredible environment you have created around the WIN chair at the RWTH Aachen, and without the wonderful people involved in its efforts, this project would have never been such an inspiring, exciting, and passionate experience for me. Thank you for giving me this opportunity and accepting me as an external research assistant to your chair. I would also like to thank Professor Dr. Piller, who was the second advisor to support my dissertation.

In the course of working on this paper, I got to know some amazing people who truly enriched my life. My appreciation goes to Joey and Jasper, who were kind enough to host me at their apartment in Aachen during my stays for the "Lehrstuhltag", and with whom I have shared many fabulous, extremely funny, and often spirited hours. Thanks also to Jens, who spent quite a few lunchtimes with me in Stuttgart giving advice on self-motivation and how to outline the dissertation. A special thank you goes to Petra Findeisen, who joined me on numerous trips from Stuttgart to Aachen and made each 4-hour drive a pleasure. I am also happy to have been accompanied by several other (ex-)PhD colleagues: Annas, Andreas, Christiane, Christian, both the Dominiks, Fabian, Greta, Jessica, Malte, Marten, Niko, Ralf, René, Simon, Stephan, Stephanie, Sven, Tessa, and Wolfgang, to name but a few. I must also thank Alex, Hanno, and Thomas, who spent many extremely exciting and challenging afternoons with me in front of our computers in the office in Stuttgart.

I would also like to thank all those friends who offered their support during this dissertation project. Without your regular encouragement and ongoing motivational efforts this project would never have been finished. Special thank-yous to Axel, Ayhan, Damir, Gerd, Larsen, Marc, Moritz, Nadja, both the Philipps, and Sandi.

I am deeply grateful to my family: to my parents, Hans-Martin and Barbara, who always believed in me and gave me generous and unlimited support throughout my entire education; to my sister Angelika, who was never short of motivating words during the sometimes tortuous

writing phase; and to my grandparents, Martin and Centa, who supported me with utter and complete faith and devotion.

Finally, and above all, I would like to express eternal gratitude to my beloved girlfriend, and future wife, Sina. Without your neverending support while I was immersed in writing this dissertation, without your humor and the way you make me laugh, and without this never-before-experienced true love that we share, this project would never have been so fulfilling or emotional. Thank you for loving me – I dedicate this work to you!

Markus Sattler

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List of Abbreviations

BCS	Business Source Complete
Cf.	confer
DBW	Die Betriebswirtschaft
E.g.	for example (exempli gratia)
et al.	et alii.
f.	and the following
ff.	and the followings
i.e.	that is (id est)
JoM	Journal of Marketing
JMR	Journal of Marketing Research
JPIM	Journal of Product Innovation Management
NPD	new product development
OS	Organizational Science
p.	page
PIMS	Profit Impact of Market Strategies
pp.	pages
SMJ	Strategic Management Journal
ROA	return on assets
ROI	return on investment
ROS	return on sales
RP	Research Policy
vs.	versus
ZfbF	Zeitschrift fuer betriebswirtschaftliche Forschung

1 Introduction

1.1 Research problem and objective

The European Union declared 2009 the "Year of Creativity and Innovation" with the objective of promoting innovation as a route to sustainable development. Apart from innovations that are developed in a social-political and ecological context, innovations by firms in the private sector play an especially important role in ensuring a sustainable development for an economy [1] because innovations are essential ingredients of the business models of firms, which are major actors in an economy. As early as 1954, Drucker emphasized the importance of firm innovation: "Any business has two–only these two–basic functions: marketing and innovation".[2] In today's substantially globalized world, innovations are increasingly important as ongoing economic, technological, and sociological changes dominate the business environment. The dynamic nature of business resulting from a continuous stream of innovations from all over the world leads to the rapid development of completely new markets and the sudden destruction of others.

As Schumpeter[3] pointed out, innovations are a source of creative destruction and the reason that large incumbents lose their traditional markets and small outsiders rush into dominant positions within very short time periods. For example, the market for mobile music players, which was once dominated by products from Sony, Philips, and others, was at that time based on physical sound storage media, but Apple revolutionized it by introducing innovative players in combination with digital music sales. Another good example is Amazon, which massively changed the market for books by offering online purchasing. However, despite their success, even these companies are always under the threat of further innovations that could destroy or transform the business models in their markets. For this reason, firms must innovate continuously; surviving in the global battle for market share, one of the major challenges for businesses today, is closely linked to a firm's ability to manage innovation successfully.[4]

Nevertheless, the failure rate in innovation management is still at an alarming level. Barczak et al. ascertained in 2003 that nearly fifty percent of all innovation efforts turned out to be failures.[5] The reasons are certainly manifold and cannot be reduced to a single effect, but a sound indication of why this is so is available in academic publications in innovation management. Page and Schirr (2008) identified more than 800 relevant publications in the period

[1] Cf. European Communities (2009).
[2] Drucker (1954), p. 37.
[3] Cf. Schumpeter (1943), pp. 81ff.
[4] Cf. O'Connor (2008), p. 313; Cf. Im/Workman Jr. (2004), pp. 118f.; or Pauwels et al. (2004), pp. 142f.
[5] Cf. Barczak et al. (2009), p. 6.

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between 1989 and 2004; more than half of these studies had an empirical background and developed implications based on economic real-life data.[6]

However, a close look at the findings of these studies reveals a significant number of conflicting results, which are confusing both to researchers and practitioners. Inter alia[7], Ittner and Larcker (1997) found a negative correlation between 'customer input' and 'financial innovation performance', while Slater et al. (2007) found a positive relationship between the two variables.[8] Another example is Kropp et al.'s (2006) finding of zero correlation between 'learning orientation' and 'financial innovation performance', while Atuahene-Gima et al. (2005) found a positive correlation.[9] Reasons for such variability in findings can include sampling and measurement errors, methodological differences in the research approach, and the characteristics of the specific samples used in the studies, among others,[10] but all such variability limits the ability to generalize findings across all firms, industry sectors, regions or even innovation objects, like physical products or services.

An integrative approach to reviewing previous results, using either a qualitative or quantitative method, can help resolve the problem of divergent or contradictory findings. In this context, Hunter and Schmidt (2004) wrote, "Scientists have known for centuries that a single study will not resolve a major issue. Indeed, a small sample study will not even resolve a minor issue. Thus, the foundation of science is the cumulation of knowledge from the results of many studies."[11]

Qualitative reviews are especially difficult to conduct with fragmented and inconsistent research topics; they tend to result in findings with limited validity because of subjective study selection or to a descriptive overview of findings. Thus, while they might be appropriate for structuring research and pointing to unresolved issues, they are unlikely to end in precise suggestions related to why there are so many differences in the evaluations of success factors and which of the conflicting findings is likely to be correct.[12] In the field of innovation management in particular, the extant qualitative reviews have used a clear research structure or framework for the identification of issues that need to be resolved in the next analysis, but they cannot provide assured and valid recommendations about the success factors of innovation management.[13]

[6] Cf. Page/Schirr (2008), p. 238.
[7] Cf. for further details see chapter 4.2.2.
[8] Cf. Slater et al. (2007), p. 11; and Ittner/Larcker (1997), p. 18.
[9] Cf. Kropp et al. (2006), p. 512; and Atuahene-Gima et al. (2005), p. 471.
[10] Cf. Hunter/Schmidt (2004), p. 33f.
[11] Hunter/Schmidt (2004), p. xxvii.
[12] Cf. Glass (1976), p. 4f.
[13] Cf. for example the reviews conducted by Adams et al. (2006); Hauser et al. (2006); or Ernst (2002).

As a result, researchers often use quantitative approaches to integrate the findings of previous research. Quantitative approaches, particularly the methods of meta-analysis, account for distortions in single studies through sampling or measurement errors and also reflect the methodological or sample-specific characteristics of the research.[14] The ultimate purpose of a meta-analysis is to reach the most accurate estimation of the true construct-level relationship.[15] Only when most of the variance between findings from single studies can be explained through either errors or relationship-influencing characteristics can the estimated effect be generalized for a specific population, e.g., all firms, firms from a specific industry sector or firms in a region.[16] In the context of innovation management, four such meta-analyses have been conducted with the purpose of understanding the true impact of the success factors identified by single studies. Table 1-1 describes these four meta-analyses, the subjects they examined, the performance measures included, the methodology employed, and the issues identified.

Authors	Title of study	Studies included	Main level of success factor	Focus of performance measures in included studies	Methodology applied	Issues
Pattikawa, Verwaal and Commandeur (2006)	Understanding new product project performance	41	Project	Project-level performance	Method of Hunter and Schmidt (1990)	- Analysis of influencing factors very limited - Generalization on project level possible; however, large remaining unexplained variance
Henard and Szymanski (2001)	Why some new products are more successful than others	41	Project/ (Firm)	75% on project-level performance	Method of Hunter and Schmidt (1990)	- Only regression analysis used to identify influencing factors - Only limited possibilty to generalize findings because of large remaining unexplained variances, which are probably caused by the mix of project- and firm-level studies
Balachandra and Friar (1997)	Factors for success in R&D projects and new products	19	Project/ (Firm)	Project-level performance	Vote-Counting	- No correction for errors or differentiation between factors that influence the focal relationships - No generalization of findings because of too simple methodology
Montoya-Weiss and Calantone (1994)	Determinants of new product performance: A review and meta-analysis	12	Project/ (Firm)	80% on project-level performance	Simple averaging of correlations , Fisher Combined Test and Vote-Counting (very simple methods of meta-analysis)	- No correction for errors or differentiation between factors that influence the focal relationships - No generalization of findings because of too simple methodology

Table 1-1: Comparison of meta-analysis publications in innovation management

The meta-analyses published to date have focused substantially on studies that used only project performance measures and project success factors such as product advantage, product launch proficiency, or product innovativeness, making it difficult to generalize findings to the general innovation management problem that firms face. Montoya-Weiss and Calantone (1994) mentioned in their early meta-analysis that studies on the firm level "would inherently increase the generalizability of the findings given that respondents are specifically asked to give general answers. Project specific characteristics may be atypical and widely variable from firm to firm, thus limiting the validity of indiscriminately combining results across pro-

[14] Cf. Hunter/Schmidt (2004), pp. 463f.
[15] Cf. Hunter/Schmidt (2004), pp. 512f.; Eden (2002), p.841; and Rubin (1990), p. 157.
[16] Cf. Kristof-Brown et al. (2005), p. 299; and Cortina (2003), pp. 428f.

jects and across firms".[17] This issue was also documented in Langerak and Hultink's 2005 empirical study, in which they analyzed a medium-positive relationship between the success factor 'cross-functional coordination' and the firm innovation performance measure but also identified a slightly negative effect on a project performance measure.[18] This example highlights another problem in the extant meta-analyses, which included both project- and firm-level data: these analyses showed a high unexplained variance for several factors that finally prohibited generalization of the results.[19] This effect is observable in meta-analyses if relationships are combined that do not actually fit together and should be analyzed separately.[20] Another issue in the extant meta-analyses is related to the success factors included in the analysis. Cooper and Kleinschmidt (1995) found that "vital success factors, more apparent at the company level, are simply not identified in this traditional project-oriented research".[21]

Therefore, the central question about which factors support successful innovation management in a firm cannot be answered by the extant meta-analyses. Although the authors called for studies on a firm level in the mid-1990s, a meta-analysis conducted with only studies that used firm performance measures and including all relevant success factors on a macro level (e.g., firm or program) has not yet been performed. A major reason for this gap may have been the availability of adequate studies on the firm level. The meta-analysis of Henard and Szymanski (2001) identified only eleven relevant studies on the firm level,[22] and about 80 percent of the identified studies on firm level in this dissertation's database were published later than the latest publication included in the 2001 meta-analysis.

Consequently, the following research questions have not yet been answered by an integrated review study:

- What are the true estimated effects of success factors identified in single studies that can predict successful innovation performance on a firm level?

This research question may be detailed into two subquestions:

- Which factors can be generalized and what is their effect direction and magnitude for all firms?
- Which factors depend on specific influences, like innovation object, region, or industry, for their direction and magnitude, and what are the sizes of their true effects?

[17] Montoya-Weiss/Calantone (1994), p. 414.
[18] Cf. Langerak/Hultink (2005).
[19] Cf. Henard/Szymanski (2001), p. 367; for details about the problem of remaining variance, see chapter 3.4.2.1 and 3.5.2.
[20] The factors would be analyzed in so-called subgroup meta-analysis; in the case of Henard/Szymanski (2001), the data should have been split between data on the firm level and data on the project level. Cf. Hunter/Schmidt (2004), p. 401.
[21] Cooper/Kleinschmidt (1995), p. 376.
[22] Cf. the studies included in the meta-analysis of Henard/Szymanski (2001).

Answering these research questions is the objective of the present meta-analysis.
The results of this research will improve understanding of the relationship between different success factors and the dependent variable of innovation performance on the firm level. This understanding may serve as an empirical building-block for a future theory that can explain success in innovation management by firms.[23] The results may also help managers in making decisions about the efficient and effective design of the innovation management systems in their firms.

The next section describes the structure of the dissertation

[23] See Hunter/Schmidt (2004), p. 22 for the role of meta-analysis in theory-building.

1.2 Outline of the dissertation

In answering the defined research questions, the dissertation is divided into seven chapters.

The *second chapter* puts the objective of this dissertation into context with current research in innovation management. Starting with the theoretical foundations of research in innovation management, the chapter overviews the research context, explains the central terms used in this work, and defines the function and system of innovation management in a firm. Next, the chapter addresses the current state of research in the field of innovation management, beginning with the seminal publication of Brown and Eisenhardt (1995).[24] In addition, the general discussion and criticism in the current literature around 'research of success factors' is conveyed to the context of innovation management.[25] Derived from the central points of critics, the need for the present meta-analysis is illustrated in detail.

The *third chapter* explains the methodological approach taken in this dissertation. First, the chapter illustrates how the methodology meta-analysis is set in the context of research review concepts, and the adequate meta-analysis procedure is chosen. Second, the process of meta-analysis is depicted in two natural steps, following Hunter and Schmidt (2004)[26]: (A) identification and coding of studies and (B) estimation and interpretation of true effect sizes. Finally, the general issues in meta-analysis and their concrete handling in this work are discussed.

The *fourth chapter* applies step (A) of the method explained in chapter three. In this process, the literature search is defined in terms of the precise criteria used to identify eligible studies for the meta-analysis. An overview of the identified studies is presented, followed by a description of the comprehensive coding process for each study, in which each success factor from the single studies is described and the identified sizes of the effects to be included in the meta-analysis are illustrated. Then all success factors are categorized in a framework used to guide the coding in the further analysis of the data. The chapter concludes with explanations of the influencing or moderating effects used in chapter five.

The *fifth chapter* contains the analyses and description of the results generated from the formulas derived and explained in step (B) of chapter three. First, the complete data set is analyzed, the results are described, and the next steps regarding the moderator analysis are defined. In the second part, the moderator analysis is conducted for the specific subgroups that

[24] Cf. Brown/Eisenhardt (1995).
[25] Following the discussion started by Nicolai/Kieser (2002).
[26] The method follows the work of Hunter/Schmidt (2004).

were created according to the moderator definitions in chapter four. A summary of all results concludes this chapter.

The *sixth chapter* addresses implications for managerial decision-making and future research, including concrete suggestions regarding how to manage innovations successfully in a firm, areas for further research, and suggestions for improving the research methodology in the field of innovation management. Finally, the limitations of the analysis are detailed to put the findings and implications into perspective.

The *seventh chapter* concludes the dissertation with an overview of the central points in the work.

2 Successful innovation management in current research literature

This chapter lays the theoretical foundation for this dissertation by discussing the theoretical background of innovation management and the current status of research on success factors. Based on this background, the need for the meta-analysis, derived from the criticism on current research, is outlined in detail.

2.1 Theoretical foundations of innovation management

To build a common understanding of innovation management in this dissertation, the following subchapters first define the meaning of innovation and illustrate the internal process of innovation development in a firm. In the second subchapter, the broader context of innovation management is detailed by explaining the definition of innovation management, delineating the functions related to it in a firm, and describing the objective and tasks from a system-theoretical viewpoint.

2.1.1 Innovation as research object

This section explains and defines the term *innovation* as one part of this work's research object, innovation management. The second subchapter illustrates the current view on the process of innovation development.

2.1.1.1 Definition of innovation

Today, the term *innovation* is widely used in both practice and theory, but there is no commonly shared definition in the business literature.[27] From an etymological point of view, innovation[28] is described as something "new, which didn't exist in this form up to now."[29] In the economic environment, the term was introduced in 1939 by Schumpeter,[30] who described

[27] For a detailed discussion of different definitions of the term "innovation," see Hauschildt/Salomo (2007), pp. 3ff.
[28] The term "innovation" is derived from the Latin word "innovatio," which means "novelty."
[29] Cf. Helm (2001), p. 47.
[30] Schumpeter introduced the idea of "innovation" in 1926, but he didn't use the term "innovation." Cf. Schumpeter (1926).

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it as a "new combination of production factors."[31] A more current and broader definition published in 1991 by the OECD[32] stated that "'innovation' is an iterative process initiated by the perception of a new market and/or new service opportunity for a technology-based invention, which leads to development, production, and marketing tasks striving for the commercial success of the invention."[33]

Taking a closer look at the different definitions found in the innovation research literature, Hauschildt and Salomo (2007) remarked that, even if researchers do not have a uniform and detailed understanding of the concept, all of the definitions that have been offered share two characteristics: Innovations are "qualitatively new products or processes," and they are "considerably different from the former status."[34]

Product and process, which could be described as the objects of innovation, are differentiated along the two aspects of "target" and "implementation." In the target aspect, *product innovations* have the purpose of improving product effectiveness by combining features and benefits in a novel manner and serving the customer to a new purpose or to an existing purpose in a new way. In contrast, *process innovations* seek to advance the efficiency of the firm by improving the production process of a specific commodity. In the implementation aspect, a *product innovation* must be introduced to the marketplace and face the market's economic-allocation conflict, while a *process innovation* is introduced only in-house.[35] Actually, there is a strong link between product and process innovations, as Utterback showed.[36] In many cases, a process innovation is just an improvement in the efficiency of the production process for product innovation; often, process and product innovations appear together, especially for innovations in the service industry.[37]

As a consequence, the meaning of the terms *product innovation* and *product innovation* in this work will be based on a broad definition, describing a product as a bundle of utility-providing components and attributes,[38] so physical products as well as services are subsumed in the notion of *product*.[39]

[31] Cf. Schumpeter (1939), p. 87.
[32] Cf. Garcia/Calantone (2002), p. 112.
[33] OECD (1991), p. 303.
[34] Cf. Hauschildt/Salomo (2007), p. 7.
[35] Cf. Hauschildt/Salomo (2007), p. 9 and Gerpott (2005), pp. 38ff.
[36] Cf. Utterback (1996), pp.124ff.
[37] Cf. Hauschildt/Salomo (2007), p. 9; Schuh/Friedli (2005), pp. 659ff.; Voeth/Gawantka (2005), pp. 470 ff.; and Totterdell et al. (2002), p. 351.
[38] Cf. Homburg/Krohmer (2003), p.459 and Brockhoff (1999b), p.13.
[39] This work covers innovation management on a firm level, so it must also cover products and services as the innovation focus of firms.

In addition to product and process innovations, the literature addresses two subordinated categories of innovations. Changes in social relationships in a firm caused by process innovations are called *social innovations*. These social innovations lead to modifications in the organizational context or to the introduction of new organizations, which changes are called *organizational innovations*.

To differentiate innovations along the *degree of change* of the new product or process, the literature uses the construct *innovativeness*. Innovativeness has been the topic of numerous research studies that have divided innovation into incremental and radical.[40] *Incremental innovations* are products or processes that are modified by enhancing existing technology but that target the same customers.[41] *Radical innovations* are totally new to the market and are competence-destroying, since the technological trajectory is changed fundamentally.[42]

Finally innovation should be distinguished from *imitation* and *invention*, terms that are commonly used in the context of innovation management. While imitation is the reproduction of a product or problem-solving process developed in another firm, invention is the conceptual design and technical realization of a novel product or process on the basis of new scientific findings or a combination of existing knowledge.[43] In addition, Garcia and Calantone (2002) noted that "it is important to elucidate that an invention does not become an innovation until it has processed through production and marketing tasks and is diffused into the marketplace."[44] As a result, the development of an innovation could be seen as a process, starting with an idea that evolves over several steps until it either reaches introduction to the marketplace or drops out of development.[45]

2.1.1.2 The innovation process

Generally speaking, a process transforms specific input into output.[46] The transformations in innovation processes are complex mixtures of activities that usually last a longer period of

[40] The following studies, for example, have dealt with the construct of innovativeness: Calantone et al. (2006);Danneels/Kleinschmidt (2001);Garcia/Calantone (2002);Green et al. (1995);Olson et al. (1995);Salomo (2003);Schlaak (1999);Song/Jinhong (2000). Several studies have discussed the differences between radical and incremental innovations in detail: e.g., Atuahene-Gima (2005);De Brentani (2001);Song/Montoya-Weiss (1998).
[41] Cf. Sandvik/Sandvik (2003), p. 357; Song/Montoya-Weiss (1998), p. 126; and Olson et al. (1995), p. 52.
[42] Cf. Sandvik/Sandvik (2003), p. 357; Song/Montoya-Weiss (1998), p. 126; Green et al. (1995), pp. 203ff.; Olson et al. (1995), p. 52; and Tushman/Anderson (1986), pp. 440ff.
[43] Cf. Schewe (2000), p. 58; Siemers (1997), p. 38; Pleschak/Sabisch (1996), p. 6; Haß (1983), p. 2; Kern/Schroeder (1977), p. 23.
[44] Garcia/Calantone (2002), p. 112; and cf. analog Gerpott (2005), pp. 40ff. and Brockhoff (1989), pp. 18f.
[45] Cf. Cooper (1998b), p. 96.
[46] Cf. Schmidt (1997), p. 1.

time because of their complexity.[47] Several researchers in the field of innovation management have classified these activities using their own conceptual models of the innovation process,[48] but the different process models share three overarching phases, as shown in figure 2-1.

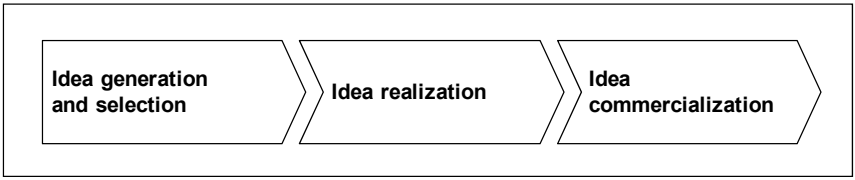

Table 2-1: Primary phases of the innovation process[49]

The first phase, idea generation and selection, is comprised of the internal and external search for new ideas and the selection of these ideas for innovation. The ideas can result from a supply-induced technology push or from a demand-driven market pull.[50] Following the technology- and market-related feasibility assessment of these ideas, the second phase contains the technological realization of the new ideas and the evaluation of their potential economic success in the target market. The final phase is the production and introduction of the innovation into the market.[51]

These process phases can be found in practical applications. The most diffused and sophisticated innovation process in current practice is the Stage-Gate® process developed by Cooper in 1998.[52] Figure 2-2 illustrates the Stage-Gate process embedded into the three overarching phases of the innovation process.

[47] Cf. Wheelwright/Clark (1992), p. 187.
[48] For a detailed discussion of the different innovation process models, see Heinemann (2007), pp. 22ff. and Billing (2003), pp. 36ff. In accordance with the Anglo-American literature on innovation management, the terms "innovation process," "new product development process" and "R&D process" are used interchangeably in this thesis.
[49] Adapted from Gerpott (2005), pp.51ff.
[50] Cf. Hauschildt/Salomo (2007), p. 7.
[51] Cf. Gerpott (2005), pp. 51ff.
[52] Cf. for the following description Cooper (1983); Cooper (1993); Cooper (1994); Cooper/Kleinschmidt (1996); Cooper (1998b); Cooper (2001); and Cooper (2008).

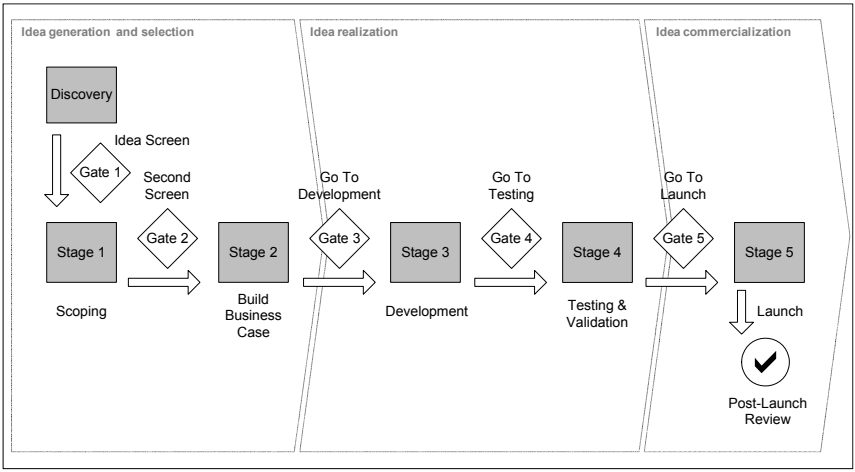

Table 2-2: Primary phases of the innovation process and Cooper's Stage-Gate® process[53]

The Stage-Gate process contains five phases: scoping, building the business case, development, testing and validation, and launch, each of which is associated with different cross-functional activities. Moving from one stage to the next requires that a specific set of requirements or recommended best practices be performed. Between the stages, gates must be passed that "serve as quality-control check points, go/kill and prioritization decisions points, and points where the path forward for the next play or stage of the project is agreed to."[54] The stages and gates are not static but should be adapted to the specific innovation process; Cooper described them as overlapping and fluid gates, with stages that are more conditional or that have fuzzy "go" conditions.[55]

Innovations as the main outcome of innovation management and the innovation development process as a central part of the tasks of innovation management have been defined and illustrated in this section. The following section clarifies in detail how innovation management is defined in the context of this dissertation.

[53] Cooper (2008), p. 215. Stage-Gate® is a registered trademark of the Product Development Institute Inc.
[54] Cooper (2008), p. 215.
[55] For detailed examples of adjustment in firms, cf. Cooper (2008), pp. 223ff.

2.1.2 Innovation management as a function and system

This section seeks to define a common understanding of innovation management in the context of this dissertation. First, innovation management will be defined from an institutional and functional perspective, and then it will be differentiated from related management terms. Finally, the objective and tasks of innovation management will be discussed from a system-theoretical viewpoint that does not reduce innovation management to designing the innovation process only. Innovation management is seen as a system that influences and is influenced by other firm systems.

2.1.2.1 Institutional and functional perspective on innovation management

The business literature defines management from institutional and functional perspectives. The *institution* of management is the central source of operational power in the company from an organizational and content viewpoint.[56] In terms of the innovation activities of a firm, this central authority serves as the source of information, consulting and decision-making.[57] The hierarchy or function of central authorities, and their responsibilities, competences or responsiveness[58] are not of primary interest here; in this thesis, the institutional perspective of innovation management plays a secondary role[59] but is included in the analysis to the extent that it amends or extends the functional perspective of innovation management.[60]

The *functional perspective* on management, which is the primary perspective used in this work, interprets innovation management either, in its narrowest sense, as the intentional design of efficient innovation processes or, in a broader sense, as the intentional design of a complete innovation system, including the innovation processes.[61] The literature defines the intentional design of efficient innovation processes as the "process view," and the intentional design of the complete innovation system as the "system-theoretical view." [62] Because this work will build on the broader interpretation, the system-theoretical view, the objective and tasks of innovation management from this viewpoint will be detailed after a discussion of how innovation management is separated from related management activities.

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[56] Cf. Hauschildt/Salomo (2007), p. 32.
[57] Cf., for example, Benkenstein (1987), p. 126; Frese (1992), p. 220; and Staehle et al. (1994), pp. 485ff.
[58] Cf. Corsten et al. (2006), p. 41. A detailed examination of possible dimensions of the institution perspective can be found in Billing (2003), pp. 105 ff.
[59] Based on the defined research question, the focus of this dissertation is less on innovation management as a source of operational power than on the understanding of a successful design of the innovation management function.
[60] Cf. the general approach of Hertweck (2002), p. 63; or Heinemann (2007), p. 33.
[61] See also figure 2-1.
[62] Cf. Hauschildt (2004), p. 32; Brockhoff (1995), cols. 986f.; and Marr (1991), p. 357.

2.1.2.2 Separation of innovation management from technology and research and development management

Technology, research and development, and innovation management are often used as synonyms or complements in academic and practical linguistic contexts. The next paragraphs will delineate the three terms in terms of terminology and content.[63] Figure 2-1 illustrates the differences.

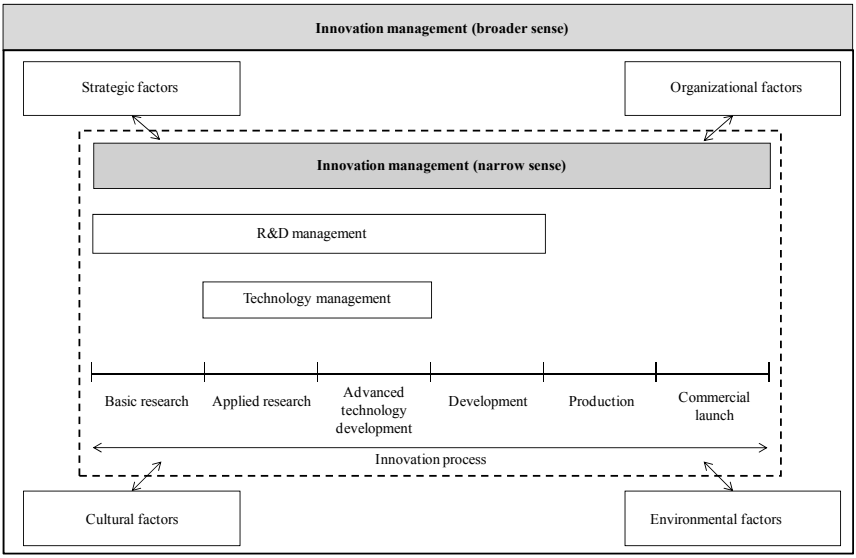

Figure 2-1: Delineation of innovation management[64]

Research and development management describes the purposeful (re-)combination of production factors to invent new knowledge.[65] Even if it is the terms *research* and *development* that are most often mentioned together, they encompass the four activities of basic research, applied research, advanced technology development and development.[66] The overall objective

[63] There is no consensus in the extant literature about how or where technology, research and development, and innovation management overlap. For a detailed discussion, cf. Gerpott (2005), p. 54ff. This thesis follows the general argumentation of Macharzina/Wolf (2008) and Vahs/Burmester (2005).
[64] Adapted from Macharzina/Wolf (2008), p. 752.
[65] Cf. Brockhoff (1999a), p. 48 and Kern/Schroeder (1977), p. 16.
[66] The objective of basic research is the experimental and/or theoretical generation of elementary new scientific expertise, but practical application of the new knowledge is not the main focus of this kind of research. Building on the new knowledge from basic research, applied research seeks concrete solutions for precise technical and economical problems, so its primary concern is the practical application of new ideas. The development steps lead to the systematic application of new expertise generated through research, with the objective of gaining new

of research and development (R&D) is the systematic and target-oriented generation of new scientific and technical expertise that can be applied to precise and economically valuable solutions.[67] Therefore, R&D management is a subset of innovation management[68] that is located mainly in the first phase of the innovation process (management of invention and exploitation).[69] However, in comparison to innovation management, R&D is focused on the scientific-technical process and follows a clear, systematic and predictable approach that simplifies the institutionalization of these processes.[70]

The objective of *technology management* is to ensure and expand the technological competitive advantage of a firm.[71] The activities of technology management center on analysis and development of internal technology capabilities through continuous monitoring of external technology developments (i.e. systematic prognoses, evaluation and selection of future technologies and the formation of technology alliances).[72] Unlike innovation management, technology management is not focused on a precise innovation process or the realization and commercialization of a novelty; instead, the conceptual effort is in the technology domain. This effort could be innovative in nature, but it also has a strategic component that focuses on the preservation and expansion of the firm's existing technologies.[73] Therefore, technology management can be a part of innovation management that provides an initial impetus for the innovation process,[74] but the implementation and exploitation of the innovation is the task of innovation management. Technology management is responsible for the phases of "applied research" and "advanced technology development" in innovation management and, as a result, is part of R&D management.[75]

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or improved materials, equipment, systems, procedures, products, or services. Cf. Bürgel et al. (1996), pp. 9ff.; Brockhoff (1999a), pp. 51ff.; Corsten et al. (2006), pp. 4f.; Vahs/Burmester (2005), p. 38; Blessin (1998), p. 9; OECD (1997), p.36; and for the historical evolution, cf. Brockhoff (2002), p. 389f.; Pleschak/Sabisch (1996), p. 7; and Gerybadze (1995), who remark on the shift of the focus of R&D management from pure efficiency control to greater effectiveness.

[67] Cf. Weidler (1997), p. 15, Specht et al. (2002), p. 14. The formal task of R&D management is similar to that of innovation management: leadership, organization and the acquisition, effective use of resources as well, and implementation of the research and development processes, including planning, monitoring and control, cf. Vahs/Burmester (2005), p. 48f.

[68] Cf. Weidler (1997), p. 15; Specht et al. (2002), p. 14; Hauschildt/Salomo (2007), p. 33; and Gerpott (2005), p. 54.

[69] Cf. Schrader (1996), col. 745.

[70] Cf. Hauschildt/Salomo (2007), p. 33.

[71] Cf. Hauschildt/Salomo (2007), p. 34; Corsten et al. (2006), p. 38; Brockhoff (2002), p.388; Blessin (1998), p.11; Vahs/Burmester (2005), p. 49. Technology management also contains the tasks of planning, organization, implementation and control of all activities for the realization of new technologies; cf. Strauss (2001), p. 316.

[72] Cf. Hauschildt/Salomo (2007), p. 34; Specht et al. (2002), p.17; Hübner (2002), p. 144ff.; and Cleland/Bursic (1992), p. 23; for a highly detailed overview of the activities, cf. Gerpott (2005), pp. 99ff.

[73] Cf. Macharzina/Wolf (2008), pp. 751f.; Hauschildt/Salomo (2007), p. 34; Vahs/Burmester (2005), p. 49; and Specht et al. (2002) , p. 17.

[74] Cf. Hauschildt/Salomo (2007), p. 34.

[75] Cf. Macharzina/Wolf (2008), pp. 751f.

Summarizing, innovation management includes the functions of R&D and technology management, but it is also responsible for the complete innovation process, including the production and launch phases. From a broader perspective, innovation management also interacts with other functions in the firm and in the external environment. The concrete objective and tasks from the broader or system-theoretical perspective are detailed in the following section.

2.1.2.3 Objective and tasks of the innovation management from a system-theoretical approach

The system-theoretical approach sees the firm as a system, an integrated network of elements that are in mutual interaction.[76] A system can be subdivided into sub-systems and is itself part of a superordinate system.[77] The system properties result from the interfaces of its elements,[78] so a shift in one element affects all the others; therefore, system thinking focuses on basic principles of organization and not on basic building blocks.

Systems can be characterized as open or closed: *A closed system* is subject to entropy because of its clear boundaries; it moves toward chaos or disorganization until it fails.[79] An *open system* has semi-permeable boundaries, so it avoids entropy by ensuring a continual flux of matter and energy to stay alive.[80] However, open systems need interfaces into the superordinate, larger system and the ability to govern themselves and to learn through feedback loops, networks and interfaces. Open systems move toward orderliness or a "flowing equilibrium" by self-regulation associated with their environments.[81]

In the modern management literature, firms are described as open systems because they interact continuously with their environmental contexts. Each strategy or action taken by the management of a firm will affect its internal and external system, and vice versa.[82] Hausschild and Salomon (2007) described the innovation system, which is a part of the system *firm*, that is the result of the "position and competence patterns, as well as the communication and interaction patterns in the innovation management."[83] The innovation system is comprised of all persons who are directly involved in the innovation development process, such as the development team members and the management levels in this function, and of all persons who are

[76] Cf. Scott (1961), p. 21.
[77] Cf. Bertalanffy (1960), pp. 11f.
[78] Cf. Capra (1996) and Kast/Rosenzweig (1972), pp. 449 ff.
[79] Cf. Kast/Rosenzweig (1972), p. 450.
[80] Cf. Miller (1978), p. 18; Bertalanffy (1972), p. 412; and Bertalanffy (1968), pp. 137 f.
[81] Cf. Felix (2003), pp. 25f. and Bertalanffy (1968), pp. 137 f.
[82] Cf. Macharzina/Wolf (2008), p. 70. For a detailed discussion of the system-theoretical approach, compare Willke (1993) and Ulrich (1970).
[83] Hauschildt/Salomo (2007), p. 105

indirectly affected by the innovation and who add to the success of the innovation by their reactions. These persons could be internal, like human resources personnel, or external, like suppliers or customers (figure 2-2). In respect to this differentiation, this work will follow the argumentation of Hausschild and Salomon (2007), who limited the system to the internal firm environment and the direct external partners or competitors.[84]

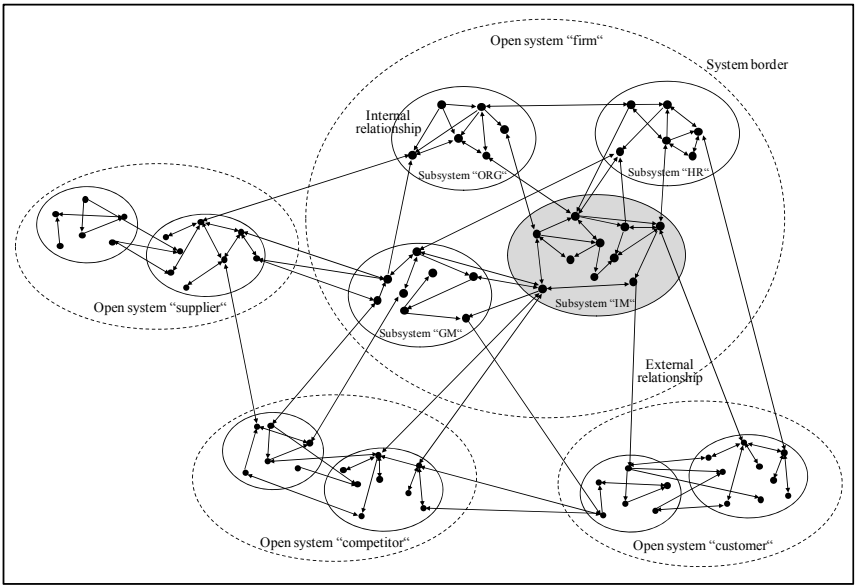

Figure 2-2: The subsystem innovation management (IM) embedded in the open system *firm* and its external relations to other systems[85]

Because the relationships between those internal persons and between external and internal system participants emerge (in most cases) spontaneously, the innovation system should be set up to allow for gathering, testing, development and institutionalization of spontaneous interactions. As in all open systems, self-governing is one of the most important principles in the innovation system.[86]

[84] Cf. Hauschildt/Salomo (2007), p. 105. Other authors have also included the national and sociopolitical environment in the innovation system of a firm; cf. Pleschak/Sabisch (1996), pp. 35 ff.
[85] Figure 2-2 is a simplified illustration of the systems and subsystems of a firm, so it is not comprehensive in the sense of including all external and firm internal subsystems. The following abbreviations are used: IM = Innovation Management, HR = Human resource management, ORG = Organization, GM = General management.
[86] Cf. Hauschildt/Salomo (2007), pp. 105 f. and Bleicher (1981), p. 86.

Innovation management, one of *firm*'s subsystems, has the overall objective of successfully developing and commercializing innovation by coordinating within the innovation system and between the innovation system and the surrounding systems. Innovation management is thereby conceived in the management literature as an original abandonment of the top management.[87] The following tasks are related to innovation management[88]:

- Formulation and implementation of innovation targets and strategies
- Decision-making related to the implementation of innovations under economically reasonable conditions
- The planning, monitoring and control of the innovation processes
- Creation of an innovation-stimulating organizational structure and culture and an incentive scheme (especially the development of all employees in the direction of thinking and acting in support of innovation)
- Establishment of an information system in which the complete innovation process is embedded
- Promotion of internal and external social networks

The current work is based on this broad view of innovation management as being responsible for the innovation process and for the organization in which those processes run. This broad view influences the selection of success factors in the later chapters to include process-specific success factors as well as those from strategic, organizational, cultural and external environmental dimensions.

The next section reviews the current research on factors that influence the success of an innovation management system.

[87] Cf. Macharzina/Wolf (2008), p. 751; Marr (1991), p. 57.
[88] Cf. Vahs/Burmester (2005), p. 50; Pleschak/Sabisch (1996), p. 45; and Marr (1991), p. 58.

2.2 Research on success factors in innovation management

The following sections provide an overview of the research on success factors in innovation management. They begin with a definition of success factors and success in the research domain and then review the current status of the empirical research in innovation management. The current critical discussions about the research on success factors and these discussions' implications for further research on innovation management are discussed.

2.2.1 Success factors and success in the empirical research on innovation management

The term *success factors* was first used in 1961 in a publication that suggested managers should be provided with information about the factors that significantly influence company success.[89] Based on this idea, Rockart (1979) developed the concept of *critical success factors*: „Critical success factors thus are, for any business, the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organization. They are the few key areas where 'things must go right' for the business to flourish."[90] A later, broader definition extended the focus on internal factors by adding the external factors that influence the success of firms.[91] Gutenberg (1983) defined success factors in the context of an input-output relationship, where input factors like resources and competences are success factors when their output (the result) is success.[92] Although there has been no generally accepted list or definition of what constitutes a success factor, all studies and definitions in this area share the underlying assumption that there are only a limited number of factors that have a significant and enduring influence on the success of a firm.[93]

The practical relevance of success factors on a general management level was first explored in the comprehensive studies of Peters and Waterman (1982) with their 7-S model and the Profit Impact of Market Strategies' (PIMS) project, which was based on a long-term database.[94]

In the research context of innovation management, the first publication about success factors in innovation management was by Myers and Marquis (1969),[95] although this work did not receive the same attention as the studies that followed it. The first broadly accepted milestone

[89] Cf. Daniel (1961).
[90] Cf. Rockart (1979), p. 85.
[91] Cf. Hildebrandt (2001), p. 420.
[92] Cf. Gutenberg (1983), p. 302 and p. 326, and also Krueger (1988), p. 28.
[93] Cf. Haenecke (2002), p. 166.
[94] For details, cf. Peters/Waterman (1982) and Buzzell/Gale (1987).
[95] Cf. Myers/Marquis (1969).

in the research stream was the SAPHO project, conducted in 1972 by a group of researchers at the University of Sussex in Brighton, UK.[96] Cooper and Kleinschmidt (1979) extended the findings from the SAPHO project through a comparable approach called Newprod.[97] This research sparked a worldwide search for success factors in innovation management, and several studies on the subject were published in the following years.[98]

Identifying and empirically analyzing the effect of success factors in innovation management is linked with the measurement of success. Since the current work refers in the meta-analysis only to studies that use measures of success, the definition of the success measure plays an important role in the selection criteria for studies eligible for analysis. The next paragraphs discuss the aspects of a definition of success in innovation management.

Although the list of publications that have reported on success factors in the context of innovation management is long, "there is very little consensus within the literature over the way in which success should be defined."[99] Based on this shortcoming, several studies in the empirical innovation management research have reviewed the construct of success and have suggested avenues for further application of success measures.[100] A comprehensive conceptual systematization of the aspects of success measurement was developed by Hauschildt (1991), who used six criteria to measure innovation success:[101]

1. *Evaluation object:* This criterion describes the reference object of the innovation success in terms of micro and macro levels.[102] While the micro level focuses on the innovation project as an object of analysis, the macro level uses the aggregation of projects at the firm or industry level as the reference object for innovation success. (Only studies on the firm level are included in the current meta-analysis.)

2. *Evaluation criteria:* This dimension defines the characteristic used to measure the success of the innovation object. Hauschildt (1991) differentiated between financial, technical and other effects: Financial effects are directly influenced financial ratios like ROI, ROS or revenue growth and indirectly influenced impacts on competitors measured through indicators like patents or other industrial property rights.[103] Finan-

[96] Cf. Rothwell et al. (1974) and Rothwell (1972).
[97] Cf. Cooper (1979b).
[98] Cf. Page/Schirr (2008), p. 237.
[99] Craig/Hart (1992), p. 9, and cf. Hart (1993) , p. 24.
[100] Cf. Cordero (1990); Hauschildt (1991); Griffin/Page (1993); Griffin (1997).
[101] Cf. Hauschildt/Salomo (2007), pp. 529ff. or, in a prior version with five criteria, cf. Hauschildt (1991), pp. 466ff. Gerpott also used a comparable systematization; cf. Gerpott (2005), pp. 67ff. This thesis follows the systematization of Hauschildt because most other categorizations are covered in this criteria model; cf. Gruner (1997), p. 93.
[102] Cf. Johne/Snelson (1988), p. 116; or Cooper/Kleinschmidt (1995), pp. 375f.
[103] Cf. Hauschildt/Salomo (2007), pp. 531ff.

cial effects, especially direct effects, are of paramount importance from an economic point of view,[104] so this thesis includes only those studies that measure performance with direct financial ratios. Technical effects are specific to each individual innovation project and are, therefore, rarely investigated in academic literature.[105] Other effects are measurements on an individual or social level using indicators like publications, number of citations or other measures of individual innovation. These effects are used only occasionally in the literature.[106]

3. *Evaluation design:* Three different evaluation designs have evolved in scientific research. Following Pappas and Remer, they are defined as a qualitative, quantitative and semi-quantitative.[107] In the qualitative design, the researcher interviews people who are directly involved in innovation development by asking about their personal judgments of a specific case of innovation. These qualitative measures have a high degree of subjectivity and lack traceability. The quantitative approach uses precise indicators and calculation algorithms, but assessing the mainly financial ratios is often difficult because of the time lag between a single innovation project and its effect on performance. The semi-quantitative technique, which is "basically characterized by judgments that are converted to numbers,"[108] compresses subjective experiences queried through survey items to quantitative measures. According to Hauschildt (1991), semi-quantitative evaluation design is advancing in the literature.[109] The methodology of meta-analysis requires quantified research data, so the success measures used in the integrated studies must have either a quantitative or a semi-quantitative nature.[110]

4. *Evaluation date:* The evaluation date defines when the success measurement will be conducted. An evaluation date is especially relevant for analysis of single products or projects, where success depends heavily on the evaluation date. Obviously, the date needs to be after the market introduction of the innovation, but a clear definition of the optimal evaluation date is missing in most of the project-level studies.[111] On a firm level, the specific evaluation date has less relevance because the focus is generally not on a specific occasion, as it is with a product introduction. Thus, empirical analyses on the firm level use primarily financial ratios on a yearly basis or evaluate semi-

[104] Cf. Griffin/Page (1993), p. 305.
[105] Cf. Hauschildt/Salomo (2007), p. 531. Hauschildt refers to Gemünden, who offers an impression of a study based on technical effects, cf. Gemuenden (1981), pp. 208ff.
[106] Cf. Hauschildt/Salomo (2007), p. 531.
[107] Cf. Pappas/Remer (1985), p. 15.
[108] Pappas/Remer (1985), p. 15
[109] Cf. Hauschildt/Salomo (2007), p. 535; also compare the discussion of Heinemann (2007), pp. 42ff.
[110] Cf. Lipsey/Wilson (2001), p. 2.
[111] Cf. Hauschildt/Salomo (2007), p. 535 and Hauschildt (1991), p. 469.

quantitatively the subjective judgment on the financial performance of the company.[112]

5. *Reference for evaluation:* Hauschildt (1991) defined the reference for evaluation as the initial situation to which the present situation should be compared, which method he termed the only rational way for the evaluation to proceed. On a firm level, two different reference situations are possible:[113] a defined situation (e.g., an earlier point in time or a competitor)[114] and a predefined target.[115] This dissertation includes all studies that were based on one of the two reference situations.

6. *Informant:* The evaluation of success often relies on the subjective perception of an individual person, whether internal or external to the company. This single-source evaluation could lead to significant differences in the judgments about success, depending on distortion factors like the evaluator's occupation, hierarchical level or management philosophy. This kind of information distortion is well known in the academic literature and is not only a problem in the measurement of success but is also a discussion topic for the whole of empirical research on innovation management.[116] For the present analysis the informant will play a minor role, due to methodological problems. Nevertheless, only studies based on internal informants are used.

The innovation success measure used to select studies for this thesis can be summarized as follows: Only those studies are used that measure success on a company level with subjective or objective direct financial ratios and that have a quantitative or semi-quantitative design. In the meta-analysis conducted later in the theses, this measure is denoted as *financial innovation performance*.

The following section reviews the current research done in the research field of innovation management.

[112] Cf., for example, the studies of Kleinschmidt et al. (2007) or Li/Atuahene-Gima (2001a).
[113] The third opportunity described by Hauschildt does not fit with analysis on company level in general; cf. Hauschildt/Salomo (2007), pp. 536f.
[114] Cf. the studies of Calantone et al. (1995) or Slater/Narver (1994).
[115] Cf. the studies of De Luca/Atuahene-Gima (2007) or Bart/Pujari (2007).
[116] Cf. the detailed study of Ernst (2001), who analyzed the information distortion in the empirical innovation management research and suggested improvement opportunities.

2.2.2 Current status of the empirical research in the field of innovation management

The following paragraphs first provide an overview of the research direction in the context of success factors in innovation management. Then the evolution of the research structure and issues are discussed.

One of the most influential efforts to structure the research in innovation management was made by Brown and Eisenhardt (1995),[117] who divided the research into three research streams: the rational plan, the communication web, and disciplined problem-solving.[118] In the *rational plan* research stream, product development[119] is understood as a structured and rational sequence of steps to develop a successful innovation. Simply planning carefully, implementing the plan competently and with good coordination, and being in the focus of top management will result in an innovation's success. This research stream focuses on indentifying which of the many independent factors are correlated with the financial success of innovation management. The analyses conducted in this research stream are often exploratory and have a broad perspective. Typically, the respondents to surveys are well placed single respondents who are asked about the firm's internal handling of a wide spectrum of external and internal variables.

The rational plan approach leads to an exceptional and comprehensive overview of the innovation process and emphasizes features such as the internal organization and the market, but it also has some weaknesses. First, the breadth of the approach dilutes its contributions somewhat; the results of some studies in this stream read like "a 'fishing expedition'–too many variables and too much factor analysis."[120] It is not unusual for a single survey to report 10 to 20 important findings, and some even report 40 or 50.[121] Second, the use of bivariate analysis is common in this research stream, but this kind of analysis overlooks potential multivariate relationships. Third, the research stream relies in many cases on single respondents who are asked to recall complex past processes and to quantify subjective judgments about process-influencing internal and external factors. Relying on single respondents exacerbates the methodological problems of retrospective sense-making.[122] Fourth, the theoretical understanding of identified relationships is usually limited because the results often deal only with empirically observed correlations with success. Finally, this stream often presents findings without relying on well defined constructs.

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[117] Cf. Brown/Eisenhardt (1995).
[118] Cf. Brown/Eisenhardt (1995), pp. 344ff. for a detailed discussion of the research streams.
[119] In the present work, "product development" and "innovation management" are used interchangeably in accordance with the Anglo-American literature.
[120] Brown/Eisenhardt (1995), p. 353.
[121] For example, Hise et al. (1990) or Rubenstein et al. (1976).
[122] This problem is commonly known as key informant-bias and will be discussed in the subsequent chapters. For further details see Kumar et al. (1993);Tversky/Kahneman (1974), pp. 1124ff.

Despite these shortcomings, the rational plan research stream contributes enormously to the understanding of success factors that are essential to successful innovation management. The most important representatives of the research stream are Cooper, Kleinschmidt, Maidique, Marquis, Myers, Rothwell, and Zirger.[123]

The second research stream, *communication web*, focuses on the internal and external communications of the firm. Evolving from the pioneering work of Allen in the 1970s, this research stream assumes that the performance of development teams depends heavily on communication among project team members and with external partners.[124] The findings from this research stream belong to two theoretical themes in the literature. The first, an information-processing view, highlights that, through appropriately structured and frequent task communication (both external and internal), the information flow to team members will be more varied and comprehensive and so will lead to a higher performing innovation process. From the findings belonging to the second theory, a resource dependence view, the researchers infer that the use of communication as a political instrument increases the resources available to the team and thereby improves the performance of the development process.[125]

In contrast to the broad-brush approach of the rational research stream, the communication web approach is narrowly focused on the single independent variable of communication. Consequently, as Brown and Eisenhardt (1995) stated, "the result is excellent theoretical understanding of a narrow segment of the phenomenon."[126] Further, methodological improvements in the analysis, such as the use of multiple respondents and multivariate analysis, set this stream apart from the rational stream. Criticism of this research stream is based on the extreme focus on communication only, which neglects all other important factors in product development. In addition, from a methodological point of view, the use of highly subjective performance measures and the missing differentiation along the degree if innovativeness of the developed products have been criticized.[127] Despite these problems, the communication web research stream has had particular influence in terms of the theory-driven, in-depth analysis linked to the empirical results achieved and the methodological improvements in the studies. Well known representatives of this research stream are Allen, Ancona, Caldwell, Doughtery, Katz, Keller and Tushman.[128]

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[123] Cf. Zirger/Maidique (1990); Maidique/Zirger (1985); Maidique/Zirger (1984); Cooper/Kleinschmidt (1987), Cooper (1979a); Rothwell et al. (1974); Rothwell (1972); and Myers/Marquis (1969).
[124] Cf. Allen (1977), pp. 99ff. and Allen (1971), pp. 16ff.
[125] Cf. Ancona/Caldwell (1992a), p. 656.
[126] Brown/Eisenhardt (1995), p. 354.
[127] Katz observed in 1982 that the distinction between incremental and radical innovations may affect appropriate types of communication. Cf. Katz (1982), pp. 97f.
[128] Cf. Dougherty (1992a); Ancona/Caldwell (1992a); Ancona/Caldwell (1992b); Dougherty (1990); Ancona/Caldwell (1990); Keller (1986); Katz/Allen (1985); and Katz/Tushman (1981).

The third research stream in the area of innovation is *disciplined problem-solving*, which assumes that the success of innovations depends on the interaction of the project team and the leadership. In this approach, top management disciplines autonomous problem-solving by the operational, cross-functional development team by providing an overarching vision of the future product. This research stream is based on studies the Japanese researchers Imai et al. conducted in the mid-1980s.[129] Comparing this research stream to the rational plan and communication web reveals several differences. First, the conceptual design of the variables analyzed in the disciplined problem-solving stream is much more detailed and accurate than is the conceptual design for the constructs used in the rational plan stream. Second, the researchers in the disciplined problem-solving stream choose wider system boundaries for the analysis than do communication web researchers and capture the role of external partners or top management. Third, methodologically, the data gathered on innovation management in this research stream have a broader scope and are more detailed than the single-key-respondent data used in the rational plan stream. Finally, the findings of the research in the disciplined problem-solving stream extend the theories underlying the communication web stream by including the need for internal organization of information in development processes.

The shortcomings of the disciplined problem-solving research stream include the absence of an understanding of political realities. In contrast to the communication web approach, the disciplined problem-solving approach does not see communication as a political instrument to improve resource availability for the development team. What's more, the missing conceptualization of people's motivations and efficient cross-functional teams of communication points out that this perspective is missing psychological realism. In addition, the conceptual design of some variables in this stream is vague and difficult to comprehend; as Brown and Eisenhardt (1995) pointed out, concepts like subtle control, product vision, system focus, and heavyweight project leader are hazy.[130] Finally, the close focus of the studies on the Japanese economic environment limits the ability to generalize results, especially those related to supplier networks, which are affected by the specific Japanese industrial infrastructure.

Nevertheless, in total, the methodological and theoretical advancements of the disciplined problem-solving research stream outweigh its shortcomings. In addition to Imai, representatives of this research stream include Chew, Clark, Fujimoto, Hayes, Iansiti, Nonaka, Quinn, Takeuchi and Wheelwright.[131]

[129] Cf. Imai et al. (1985).
[130] Cf. Brown/Eisenhardt (1995), p. 365.
[131] Cf. Iansiti (1993); Clark/Fujimoto (1991); Nonaka (1990); Hayes et al. (1988); Clark et al. (1987); Takeuchi/Nonaka (1986); and Quinn (1985).

Brown and Eisenhardt pointed out that the three research streams have several overlapping and complementary methodological and content elements, supporting the integration of the three research streams.[132] In the *extended rational plan*, the rational plan is extended by the theoretical and methodological advantages of the communication web perspective and the disciplined problem-solving approach. This extension has already been incorporated into a considerable number of recent publications in the empirical research on success factors in innovation management;[133] in fact, all reviews published after the work of Brown and Eisenhardt (1995) have incorporated the central findings of the extended rational plan perspective.[134] Over time, the extended rational plan approach has been improved by adding cultural and organizational structure perspectives, as shown in figure 2-3.[135] The latest published reviews in innovation management have also included theory on the contingency of study results[136] and have documented substantial improvement in the research area's precision.[137] Conditioning factors like innovativeness, environmental turbulence and company size are used to get more accurate results,[138] but the use of conditioning factors in the search for success factors in innovation management further complicates the ability to generalize success factors identified in individual studies and the ability to aggregate results in qualitative reviews.[139]

A further extension of the extended rational plan, first used in a 1995 analysis, moved the focus of the innovation studies from a very close project and product view to a broader scope by analyzing the success factors of innovations on a firm level.[140] Thus, the factors generated by the extended rational plan approach differ from those on the project level because those "vital success factors, more apparent at the company level, are simply not identified in this traditional project-oriented research."[141] This advancement added a second level of variables on a macro level to the extended rational plan perspective.

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[132] Cf. in detail Brown/Eisenhardt (1995), p. 348, p. 359 and pp. 365ff.
[133] More than 400 publications refer to the publication of Brown/Eisenhardt (1995) in the literature database EBSCO.
[134] Cf. the reviews of, e.g., Ernst (2002); Verhaeghe/Kfir (2002); or Krishnan/Ulrich (2001).
[135] Cf. the review of, e.g., Cormican/O'Sullivan (2004).
[136] "The contingency approach says that the effect of one variable on another depends upon a third variable, W. Thus the effect of X on Y when W is low differs from the effect of X on Y when W is high[...].The third variable, W, moderates the relationship between X und Y and can therefore be called a moderator of the relationship or a conditioning variable of the relationship" (Donaldson (2001), p. 5f.).
[137] Cf. the reviews of, e.g., Adams et al. (2006) and Hauser et al. (2006).
[138] Cf. Langerak/Jan Hultink (2006); Calantone et al. (2003); Danneels/Kleinschmidt (2001); Song/Jinhong (2000) and Liker/Collins (1999).
[139] Cf. Fricke/Treinies (1985), p. 12.
[140] Cf. the central publication of Cooper/Kleinschmidt (1995) and the remarks of Johne/Snelson (1988), p. 116. Further publications on firm level are, e.g., Calantone et al. (1995); Li/Atuahene-Gima (2001a); Im et al. (2003); or Kleinschmidt et al. (2007).
[141] Cooper/Kleinschmidt (1995).

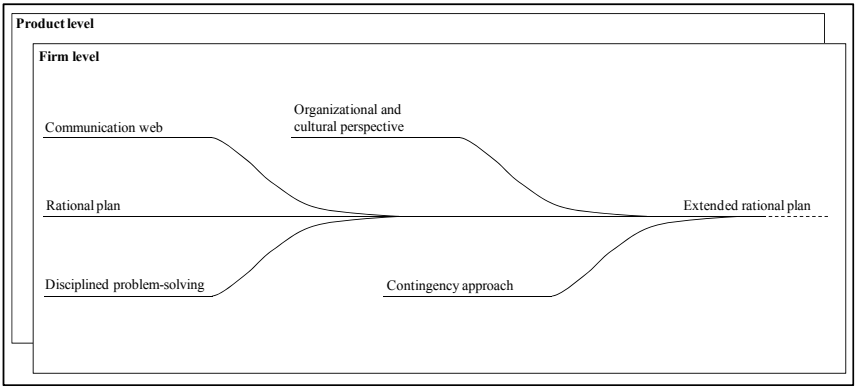

Figure 2-3: Evolution of empirical research in innovation management

However, this extension of the rational plan also created a great many conflicting findings.[142] For example, Ittner and Larcker (1997) found a negative correlation between *customer input* and *financial innovation performance*, while Slater et al. (2007) found a positive relationship between them.[143] The reason for this kind of conflict may be found in the methodological and conceptual shortfalls of the current research or in other, more general problems in research on success factors in innovation management that are discussed in the following section.

2.2.3 Critical discussion of research on success factors in innovation management

This section discusses the success factors identified by March and Sutton in 1997 and the dialogue among German researchers begun by Nicolai and Kieser in 2002 and published in *Die Betriebswirtschaft* (DBW).[144] The main points of criticism are illustrated and reflected in the context of innovation management.

The research on success factors has been debated regularly among researchers. The general point of contention lies in the usefulness of empirical findings as practical guidelines for successful corporate strategies, but agreement with the critics of the research on success factors means that the transfer of empirical results into managerial recommendations would not be valid. While most of the criticism is on a very general level, is without substance, and/or lacks

[142] See also the range of identified effect sizes for a single construct in chapter 4.2.2.
[143] Cf. Slater et al. (2007), p. 11 and Ittner/Larcker (1997), p. 18.
[144] Cf. March/Sutton (1997) and Nicolai/Kieser (2002).

understanding of the practical application of success factors and can be largely discounted,[145] some points of criticism have merit and should be used for further, mainly methodological improvements in the research on success factors. The following paragraphs highlight the major points of criticism on the research on success factors and link these criticisms to the research stream in innovation management.

A central argument of the critics sees the methodological improvement process of research on innovation as an effort to rescue a disabled basic idea, namely the origin theory.[146] Following this argumentation raises the question of whether ideas that require continuous improvement to survive in a complex environment are basically misguided. The argument also implies that each scientific theory must describe complex relationships adequately and differentiate them in their first draft. However, this argument is countered by the established scientific paradigm that describes theory as an approximation of reality that can never describe reality completely and that is never reached in the first draft.[147] The search for success factors in innovation management is complex, so it is characterized by the continuous improvement process[148] that is common to most research areas.

The research on success factors takes place in seven successive phases.[149] In the first phase, success factors are explored and identified based on cases only. In the second phase, researchers specify where the identified factors appear in other firms and industries. The third phase transfers the basic paradigm of a cause-effect relationship to other sub-disciplines of economic science, e.g., from organization into strategic management theory, and from there into marketing. In the fourth phase, classic empirical (i.e., econometric or multivariate) analysis is used to identify functional relationships between success or indicators of success as dependent variables and their determinants. In the fifth phase, researchers validate the functional relationships using methods such as regression analysis. In the sixth phase, both sides of the equation function are extended by varying the performance measure or the performance indicators, and the number of determinants increases significantly. In the last phase, situational variables as moderators for a further detailing of the theoretical relationship are introduced. Accompanying this improvement process with meta-analysis, which gives guidelines for methodological improvements, allows results to be generalized and contributes to the search for a future comprehensive theory.[150] The search for a theory of success factors in the field of innovation

[145] Cf. the answers to the publication of Nicolai/Kieser (2002) by, e.g., Bauer/Sauer (2004); Homburg/Krohmer (2004); or Fritz (2004a).
[146] Cf. Nicolai/Kieser (2002), p. 581.
[147] Cf. Vollmer (1985), pp. 177f.; Popper (1994), p. xxv; and Bauer/Sauer (2004), p. 622.
[148] See section 2.2.2 for the evolution of the research in innovation management.
[149] Cf. Nicolai/Kieser (2002), pp. 580f. and Bauer/Sauer (2004), p. 622.
[150] Cf. Hunter/Schmidt (2004), pp. 22f.

management, which still has several theoretical and methodological shortfalls, still has several stages to traverse.[151]

Another aspect of the criticism of innovation research challenges the search for success factors with the argument that knowledge about success factors would undermine the efficacy of those same success factors since their effects will be overridden when virtually all companies use the factors, thereby eliminating their uniqueness and their links to competitive advantage.[152] However, this argument is based on the assumption that researchers are trying to identify any kind of factors that influence the success of companies, while the purpose of the research on success factors is the identification of critical or strategic success factors characterized as inimitable in the short-term[153] and based on company-specific resources and capabilities that allow the company to gain a competitive advantage, and that can be developed only over the long-term.[154] Thus, success factors underlie the dynamic of competition and cannot lose their competitive advantage in the short run.[155]

This aspect is closely linked with the well known "paradox of generalizeable success factors,"[156] which is another argument against the research for success factors. Nicolai and Kieser (2002) criticized the research on success factors as being of the opinion that the management needs only to implement the results of the research to improve performance.[157] However, this mechanistic mode of operation has not actually been suggested by researchers because success factors are results of statistical analysis, so they do not allow for deterministic statements about a single object, e.g., a firm or business unit.[158] Empirical research on success factors cannot give general instructions that would guarantee success to any particular company. The simple transfer of "best practices" is not applicable because the implementation of success factors is closely linked to the capacities and competences available in the firm.[159] Consequently, academic research divides the practical implementation of research finding into *instrumental* and *conceptual* utilization. *Instrumental utilization* of success factors applies if empirical findings can be directly applied to management problems or strategic decision-making, while *conceptual utilization* describes the application of research findings to improve understanding of real phenomena. Since researchers of success factors allocate their findings mainly to the category of conceptual utilization, the criticism is misdirected.[160]

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[151] Cf. Hauschildt/Salomo (2007), pp. 38f., as well as chapter 2.2.3.
[152] Cf. Nicolai/Kieser (2002), p. 585.
[153] Cf. Leidecker/Bruno (1984), p. 23.
[154] Cf. Annacker (2001), pp. 44ff. and Grunert/Ellegaard (1993), p. 264.
[155] Cf. Bauer/Sauer (2004), p. 622.
[156] Cf. Annacker (2001), p. 42.
[157] Cf. Nicolai/Kieser (2002), p. 588.
[158] Cf. Homburg/Krohmer (2004), p. 628.
[159] Cf. Homburg/Krohmer (2004), p.628 and Kirsch/Knyphausen (1993), pp. 106f.
[160] Cf. Homburg/Krohmer (2004), p. 629.

The third central criticism from a content perspective alludes to the contradictory findings of the research on success factors. Critics have noticed that almost no reliable findings have emanated from research on success factors.[161] However, there are no "certain findings" in empirical sciences at all, whether from a critical-rational or a system-theoretical constructivist point of view. Empirical findings can only stand the test of time and be tentatively accepted; empirical sciences do not claim certainty for any hypothesis or theory but assess their trustworthiness using the "degree of establishment" as an indicator of their quality.[162] In line with Popper, Alfred Kieser (1993) described this indicator as "Instead of defining the validity of a theory […,] one talks about the 'degree of establishment,' which increases with the number of passed empirical tests. The increase will be greater, the more critical and different tests are conducted."[163] Thus, following Popper (1994), any degree of establishment of a theoretical statement is by no means an indicator of certainty, likelihood, or truth, but, rather, a relational criterion for assessing the viability of theories and hypotheses. Those theories and hypotheses that pass more stringent tests than others are better adapted to reality and are of higher resistibility. The degree of establishment serves as a "rule for assessing the relative benefits of two or more competing theories in the light of their critical discussion."[164] These considerations are also valid for the theories and hypotheses applied in the general research on success factors, which include the innovation management research stream.[165] The finding of conflicting results and the resulting low degree of establishment are frequent topics in the empirical innovation management research. Several researchers have already pointed to this issue and have called especially for methodological improvements.[166]

Methodological deficits in the empirical social research are measurement errors, which have strong influence on the reliability and, consequently, the validity of the research findings.[167] Measurement errors are divided into systematic and random errors. Random errors—incidental fluctuations during the data collection, specific situational influences or personal factors[168]—are the incidental variance from the observed theoretical "true" value and have serious implications for the reliability of study results. While reliability is necessary to reach high validity in research findings, it is not sufficient. Validity depends to a large extend on the magnitude of the systematic error, which is the systematic variance of the observed theoretical "true" value.[169] Examples of factors that frequently cause systematic errors are "archival biases, key informant prejudices or limitations, halo effect, social desirability, and acquiescence

[161] Cf. Nicolai/Kieser (2002), p. 581f.
[162] Cf. Fritz (2004b), pp. 12f. and Popper (1994), pp. 211ff.
[163] Kieser (1993), p. 10 (direct translation from German).
[164] Popper (1994), pp. 198ff. and cf. Fritz (2004b), pp. 13f.
[165] Cf. Fritz (2004b), p.14.
[166] Cf. Henard/Szymanski (2001), p. 362 and p.374, or Gatignon et al. (2002), p. 1103.
[167] Cf. Ernst (2001), p. 81.
[168] Cf. Hunter/Schmidt (2004), pp. 33ff. and Bagozzi (1998), pp. 70ff.
[169] Cf. Bagozzi (1998), p. 71.

and are of high importance."[170] To overcome especially random measurement errors researchers developed the use of multiple item scales in the operationalization of constructs.[171] However, in the research context of innovation management, several studies have been based on "single-item" scales,[172] even though such single-item scales are not sufficient for reaching validity in research findings.

In this context of systematic errors, the key-informant bias has been a central methodological criticism of empirical social research.[173] The results of the surveys of key informants might be unreliable because the informants have only limited perspectives from which to interpret reality. In fact, such informants are likely to suffer from a host of attributional and other biases, memory lapses, and myopia, all of which are associated with subjective, retrospective sense-making tasks. Ernst (2001) examined the problem of distorted information with the specific example of empirical research on innovation management and demonstrated a significant impact by these kinds of informant biases. Ernst also observed that this impact varied greatly with the functional and hierarchical position of the informant and with the facts assessed.[174] Nevertheless, empirical social research depends on these survey data and, as in many analyses, only a limited group of people can provide the necessary information. To address this methodological weakness, Ernst suggested the use of multiple informants and a focus on only those who are highly familiar with the subject of the analysis and who may be likely to have a neutral point of view.[175]

Another methodological problem concerns sampling error, a common problem in empirical research.[176] The random sampling error, which is determined by the sample size, is a particularly common problem in organizational studies. The size of this error decreases with the number of survey objects included in the analysis[177] but, since researchers in the social sciences have limited opportunities to increase the number of respondents and the error is of a non-systematic nature, these deficits cannot be addressed in single correlations and should be solved by the statistical method of meta-analysis.[178]

Finally, the methodological critiques refer to further general problems of hypothesis-driven empirical research: endogeneity, simultaneity, unobserved heterogeneity, "regression to the mean," survival bias, and reference to the past. All these general problems are commonly

[170] Cf. Bagozzi et al. (1991), p. 421.
[171] Cf. Homburg/Giering (1996), p. 6 and Churchill (1979), pp. 478ff.
[172] Cf. Henard/Szymanski (2001), p. 370 and Griffin/Page (1996), pp. 478ff.
[173] Cf. Kumar et al. (1993), pp. 1633f.
[174] Cf. Ernst (2001), pp. 87ff.
[175] Cf. Ernst (2001), pp. 90ff. and Kumar et al. (1993), pp. 1635ff.
[176] Cf. Hunter/Schmidt (2004), p. 17.
[177] Cf. Assael/Keon (1982), p. 114.
[178] Cf. Jensen/Mertesdorf (2006), p. 657 and Hunter/Schmidt (2004), p. 34.

known in the research community, have been addressed in current research methods, and are generally no longer seen as arguments against empirical research. [179]

Clearly, the research on success factors in innovation management suffers from several deficits from a content and methodological point of view. Using these deficits as a starting point, the next section discusses the implications for further research on success factors in innovation management and illustrates the necessity for an integrated quantitative review method like the meta-analysis to advance the research field in innovation management.

2.2.4 Implications of criticism for further research in innovation management

Although many of the points of criticism on the research on success factors are unfounded, others provide hints about needed improvements and alternatives to improve the research. In particular, improved methodological concepts will impact the research on success factors in general, and that on innovation management in particular. However, shortfalls will remain that can influence the reliability or validity of the results.

The lingering diversity in the operationalization of constructs, the small and varying sample sizes, surveys based on regional samples only or the persistent use of single respondents are just a few of the remaining deficits in the empirical research on innovation management. In particular, the requirement for increased sample sizes is difficult to meet in organizational studies and will remain a source of variances in results.[180] The increased sophistication of innovation research from a content perspective (e.g., through inclusion of the contingency view) will produce results in conflict with former studies. To overcome this natural development in a mature academic research stream like innovation management, a method should be used that can summarize and review the findings using adequate procedures. This method should be capable of correcting the deficits of individual studies and should provide guidelines for further research. However, in mature research areas such as innovation management, which has many publications and conflicting results,[181] the use of alternative review methods like qualitative or narrative reviews has a great many limitations that restrict the general explanatory power of these reviews. Different study designs or measures complicate and even eliminate the ability to summarize the findings of qualitative reviews.[182] In innovation management, recent qualitative reviews have been used primarily to give a structured overview of the topics

[179] For details, cf. Nicolai/Kieser (2002), pp. 584f.
[180] Cf. Jensen/Mertesdorf (2006), p. 657.
[181] In the last few decades, more than 400 empirical primary studies in the area of innovation management have been conducted. Cf. Page/Schirr (2008), pp. 238f.
[182] For a detailed discussion of the deficits of narrative reviews, see Hunter/Schmidt (2004), pp. 445f., Glass (1976), p. 4, and the delimitation of meta-analysis from other reviews in section 3.1.

analyzed, but they have avoided presenting clear conclusions about the true effect, size, direction and magnitude of the success factors.[183]

However, an integrative, quantitative review like a meta-analysis could be the appropriate approach. A meta-analysis has the statistical power to explain the conflicting results and large variances between the single studies through the application of statistical methods, helping to correct to the so-called study artifacts and the use of moderator analysis.[184] Consequently, several meta-analyses have been published recently in the field of innovation management to fill the gap in clear statements about the efficiency of success factors. However, the available meta-analyses also have two central shortcomings. First, although all meta-analyses published have focused on studies that have observed how success factors influence the success of innovation projects, most of them have also added some firm-level analysis to extend the number of studies included in the analysis.[185] Because there are substantial differences in the effects of the success factors between the firm-level and the project-level, the results of these analyses cannot be applied to the understanding of innovation success on a firm level, and can be applied only with restrictions to the project level.[186] Montoya-Weiss and Calantone (1994) commented on this issue by calling for studies on the firm level to "inherently increase the generalizability of the findings given that respondents are specifically asked to give general answers. Project specific characteristics may be atypical and widely variable from firm to firm, thus limiting the validity of indiscriminately combining results across projects and across firms."[187]

On a conceptual level, the inclusion of studies from different levels, the "apples and oranges" problem, aggregates different operationalizations of constructs from individual studies into a single factor in the meta-analysis.[188] The effect of this mixture is to distort the calculated sizes of effects in the meta-analysis, resulting in a large unexplained variance. The results of the analysis by Henard and Szymanski (2001) showed this distortion particularly clearly since the explained variance for their factors remained high for most of the corrected success factors and so did not allow the estimated sizes of the success factor effects to be generalized.[189] The approach chosen by Henard and Szymanski (2001) is in substantial contrast to the claim of a sophisticated meta-analysis, which has the ultimate objective "to estimate as accurately as

[183] For example, cf. Adams et al. (2006) or Hauser et al. (2006).
[184] Cf. Hunter/Schmidt (2004), pp. 17ff.
[185] See the studies included in the analysis of Henard/Szymanski (2001); Balachandra/Friar (1997); and Montoya-Weiss/Calantone (1994).
[186] See chapter 2.2.2 and the detailed discussion by Cooper/Kleinschmidt (1995), pp. 375f. and Johne/Snelson (1988), p. 116 regarding the differences between these levels. Since the studies are mainly on a project level, one might assume a limited application of these results on a project level. (E.g., 75 percent of Henard/Szymanski (2001) studies were from this level).
[187] Montoya-Weiss/Calantone (1994), p. 414.
[188] Cf. Hunter/Schmidt (2004), S. 471; Franke (2001), p. 189 and chapter 3.5.2.
[189] Cf. the table in the publication of Henard/Szymanski (2001), p. 367.

possible the construct-level relation in the population, because these are the relationships of scientific interest. […] Doing this requires correction for sampling error, measurement error, and other artifacts that distort study results."[190] This purpose also implies the effort to explain the remaining variance completely.[191] To overcome the problem of mixing data, Pattikawa et al. (2006) conducted a meta-analysis that focused solely on the project level.[192]

Closely linked to the issue of mixing macro- and micro-level performance measures is the issue of including mainly project-specific success factors, such as *product advantage* or *product launch proficiency* in these meta-analysis. However, as indicated in Montoya-Weiss and highlighted in section 2.2.2, the success factors on the firm level are clearly not entirely the same as those on the project level. On a firm level, factors like the role of learning and knowledge, cultural and organizational factors or the implications of using external networks have more relevance.[193] Hence, several success factors from a firm level are missing in extant meta-analyses.[194]

The second issue related to the existing meta-analyses is the methodology used.[195] While Balachandra and Friar (1997) simply counted the number of mentions in other studies, Montoya-Weiss and Calantone (1994) used weighted averages of correlations between success factors and the measure of success.[196] Henard and Szymanski (2001), were first to correct the included studies for sample and measurement artifacts and to conduct a moderator analysis.[197] A quantitative review without correction for at least sampling and measurement deficits often leads to false conclusions, and the results should not be viewed as valid.[198] Although the analysis of Henard and Symanski (2001) corrected for sample and measurement errors, it also showed some serious methodological shortfalls. Their moderator analysis was the first done in the context of innovation management, but they applied the multiple regression approach to moderator analysis even though the sub-group approach is seen as superior so long as categorical moderating elements are used.[199] The advantage of the sub-group approach is an im-

[190] Hunter/Schmidt (2004), pp. 512f. and cf. Rubin (1990), p. 157.
[191] Hunter and Schmidt argued that at least 75% of the variances in study results could be explained either through artifacts or moderator variables. Cf. Hunter/Schmidt (2004), p. 54 and pp. 401ff..
[192] Cf. Pattikawa et al. (2006).
[193] Cf. the table explaining the predictors used by Henard/Szymanski (2001), p. 364. For details on the role of knowledge and learning, cf., e.g., Mavondo et al. (2005) or Kropp et al. (2006). For cultural and organizational aspects, cf., e.g., Kleinschmidt et al. (2007) or Im et al. (2003). For the use of external networks, cf., e.g., Tuominen/Anttila (2006) or Belderbos et al. (2004).
[194] Cf. Cooper/Kleinschmidt (1995), p. 376, who stated that project level studies cannot identify all success factors on firm level.
[195] Cf. Hauschildt/Salomo (2007), p. 36ff.
[196] Cf. Balachandra/Friar (1997) and Montoya-Weiss/Calantone (1994).
[197] Cf. Henard/Szymanski (2001).
[198] Cf. Hunter/Schmidt (2004), pp. 446ff.
[199] Cf. Hunter/Schmidt (2004), p. 390.

proved estimate of the true effect size and, as a result, there is the possibility of generalizing the size of the effect in direction and magnitude for the sub-group population.[200]

In short, extant meta-analyses have not covered the macro-level success factors of innovation management and have used an inadequate methodology. These central issues do not allow for generalization of the results, either in general or for sub-groups. To overcome these shortfalls and to allow the effect of success factors on a firm level to be generalized, the meta-analysis in this dissertation will fulfill the following requirements.

- Inclusion of individual studies only when firm-level performance measures are used
- Inclusion of all relevant success factors from individual studies that influence firm-level innovation management systems
- Application of a sub-group analysis to confirm moderators and to allow for generalization of the sizes of effects in sub-groups

The following chapter will introduce the quantitative review meta-analysis with a detailed explanation of this statistical approach.

[200] Details about the moderator analysis are discussed in section 3.4.2.3.

2.3 Summary of current research literature

The second chapter overviewed the theoretical foundations of innovation management research and derived the following definitions to be used throughout the thesis:

> **Innovation:** A qualitatively new product or process that is considerably different from the former status. The term *products* comprises physical products as well as intangible services.

> **Innovation management:** Intentional design of the complete innovation system, including the innovation processes (functional perspective in the broader sense).

Deriving them from the broader system-theoretical functional perspective on innovation management, the second chapter also defined the functions of technology management and research and development management as part of the innovation management system. Finally, the objective of innovation management was determined to be successfully developing and commercializing innovation by coordinating within the innovation system and between the innovation system and the surrounding systems.

The second part of the chapter reflected the current status of research on success factors in innovation management and defined the terms *success factors* and *success* for use in the meta-analysis:

> **Success factors:** The limited number of factors that have a significant and enduring influence on the success of a firm.

> Only those studies that **measure success** on the company level with subjective or objective direct financial ratios and that have a quantitative or semi-quantitative design will be used in the meta-analysis. This measure will be denoted **financial innovation performance**.

The current research structure on success factors in innovation management was also reviewed based on the *extended rational plan* perspective developed by Brown and Eisenhardt in 1995. This perspective promotes a structured and rational sequence of steps to developing successful innovation; however, factors related to internal and external communication, hierarchical communication, and top management support also contribute to success and should be considered. In the last years, the cultural and organizational parameters that influence the

rational plan and other situational perspectives (e.g., size or the market environment) have been added to the rational plan perspective.

The general discussion about conducting research on success factors was reflected from the perspective of innovation management, and the current issues of conflicting results and methodology were highlighted. The need for using meta-analysis in this dissertation was derived from these issues. The shortfalls of the available meta-analyses were listed as:

- Mix of project-level performance constructs with firm-level performance constructs
- Only limited coverage of firm-level success factors
- Applied methodology during moderator analysis in most cases that was not adequate to calculate precise results that can be generalized

These issues preclude generalized statements about the effect of success factors in innovation management at the firm level, so a more sophisticated meta-analysis that fulfills the following requirements is necessary:

- Inclusion of individual studies only when firm-level performance measures are used
- Inclusion of all relevant success factors from individual studies that influence firm-level innovation management systems
- Application of a sub-group analysis to confirm moderators and to allow for generalization of the sizes of effects in sub-groups

3 The method of the quantitative review "meta-analysis"

A meta-analysis is one of several ways to summarize, integrate and interpret a set of research publications.[201] Glass (1976) differentiated meta-analysis from primary and secondary analysis in this way: "*Primary analysis* is the original analysis of data in a research study. […] *Secondary analysis* is the re-analysis of the data for the purpose of answering the original research question with better statistical techniques, or answer new questions with old data. […] *Meta-analysis* refers to the analysis of analyses […,] the statistical analysis of a large collection of analysis results from individual studies for the purpose of integrating the findings."[202]

Thus, the central goal of a meta-analysis is to estimate the size of a specific relationship (e.g., a cause-effect relationship) between variables in a population by integrating findings from several primary studies.[203] The variance in the size of the effect found in the study sample is important, since the meta-analysis seeks to explain as much as possible of the variance that was caused either by inaccuracies in single primary studies included in the meta-analysis or by moderating the elements that work to vary the sizes of the effect. The meta-analysis approach is limited to quantitative findings from empirical research studies; theoretical, conceptual or qualitative empirical papers do not lend themselves to meta-analysis.[204]

This chapter provides an overview of the general field of review approaches, furthers the argument for the approach chosen in this work, and illustrates the process of meta-analysis. The chapter concludes with general issues in the application of meta-analysis.

3.1 Meta-analysis in the context of research review concepts

Methods for reviewing research can be classified into four main categories: 1) a review can be used to identify and discuss new developments in a research field; 2) the reviewer can use empirical evidence to emphasize, illustrate, or assess a specific theory or to preliminarily propose a new theoretical framework; 3) a review can organize knowledge from divergent research directions; or 4) a review can be integrative,[205] where the primary interest is "in inferring generalizations about substantive issues from a set of studies directly bearing on those

[201] Cf. Lipsey/Wilson (2001), pp. 1f.
[202] Glass (1976), p. 3.
[203] Cf. Hunter/Schmidt (2004), pp. 512f. and Rubin (1990), p. 157.
[204] Cf. Lipsey/Wilson (2001), p. 2.
[205] Cf. Bangert-Drowns (1986).

M. Sattler, *Excellence in Innovation Management,* DOI 10.1007/978-3-8349-6158-7_3,

issues."[206] The meta-analysis belongs to the fourth group, but integrative reviews also include *narrative reviews*, the *vote-counting* method and the *cumulation of p value*.[207] In the following, these three integrative review approaches are described and the advantages of the meta-analysis are highlighted.

The *narrative review* provides descriptions of study results with a focus on overarching theories, frameworks and elementary factors. However, with the increasing number of available studies, using this approach to integrate extant studies will become more and more complex as studies diverge in their designs, measures, results, and so on.[208] Another complication for narrative reviews is the absence of a structured approach, so researchers are relatively free to design their reviews as they see fit in terms of categorizing research characteristics, selecting relevant papers and framing outcomes.[209] Glass (1967) concluded (in a somewhat exaggerated statement) that "a common method of integrating several studies with inconsistent findings is to carp on the design or analysis deficiencies of all but a few studies–those remaining frequently being one's own work or that of one's students or friends–and then advance the one or two 'acceptable' studies as the truth of the matter."[210] Therefore, the results of narrative reviews may improve understanding of the research field, but the results are not always assured and are difficult to replicate. In comparison with this procedure, the meta-analysis follows a structured approach, allows for inclusion of all available studies, and accounts for different sample sizes, so it eschews distortions.[211]

In the *vote-counting* approach, the researcher counts the number of positive significant results, the number of negative significant results and the number of results without significance and declares the category with the highest number the winner. This method eases the integration effort when a large number of studies is available in the research field but, in addition to neglecting sample sizes when accumulating studies, this method can lead to false conclusions. Especially in any set of studies with small to medium effect sizes, increasing the number of studies included leads to misleading results through second-order errors.[212] In this context, Hunter and Schmidt (2004) stated that "the typical conclusion of reviewers using the voting method is that the research literature is in deplorable shape. Some researchers get results; others do not."[213] In contrast, the meta-analysis integrates all effect sizes into one estimated true effects size, so it allows findings to be generalized across the complete research field.

[206] Jackson (1980), p. 438.
[207] Cf. Hunter/Schmidt (2004), pp. 445ff.
[208] Cf. Fricke/Treinies (1985), p. 12.
[209] Cf. Rosenthal/DiMatteo (2001), pp. 61f.
[210] Glass (1976), p. 4.
[211] Cf. Glass et al. (1981), p. 13.
[212] Cf. Fricke/Treinies (1985), p. 14.
[213] Hunter/Schmidt (2004), p. 447.

Finally, the *cumulation of p value* approach aggregates significant levels across all eligible studies to produce an overall p value and, when a sufficiently small overall significance level is reached, the researcher concludes that the effect is demonstrated. However, this approach uses the fixed-effects model, which is less sophisticated than the random-effects model commonly used in meta-analysis.[214] Moreover, the cumulation of p values may indicate the significance but, unlike meta-analysis, it cannot determine the effect size. In response to these issues, the National Research Council even recommended discontinuing use of the cumulation of p values method.[215]

In summary, meta-analyses are superior to the other three integrative review methods because meta-analyses are more powerful in estimating true effect sizes and because they provide a structured overview of extremely complex topics with several conflicting findings extant in single studies.

[214] Cf. Hunter/Schmidt (2004), p. 447, and see section 3.2.1 regarding the model assumptions.
[215] Cf. National Research Council (1992), p.182.

3.2 Selection of an adequate meta-analysis method

A closer look at meta-analytic reviews published over the last 30 years reveals the variety of approaches available to this method.[216] This section describes first the two assumptions which further differentiate these approaches – random vs. fixed effect models – and second the differentiation of the approaches along the corrections applied. Finally, the adequate method for this dissertation is selected.

3.2.1 Fixed-effects vs. random-effects models of meta-analysis

Meta-analyses are distinguished by how they understand the variance in effect size in studies of a specific relationship observed in a given population. They are divided into *fixed-effects* and *random-effects models* as shown in figure 3-1.[217]. Fixed-effects models are dominated by the works of Hedges and Olkin (1985) and Rosenthal and Rubin (1982),[218] while the field of random-effects models is driven primarily by the work of Hunter and Schmidt (2004), but also by Hedges and Olkin (1985), Calender and Osburn (1980) and Raju and Burke (1983).[219]

[216] Cf. Schulze (2007), p. 90 or Field (2003), p. 106. As examples, compare Song et al. (2008), Kirca et al. (2005), and Capon et al. (1990).
[217] Cf. Field (2003), p. 105; for more details, see e.g., Hedges/Olkin (1985), pp. 149ff. for fixed effects models and pp. 191ff. for random effects models; and also Hunter/Schmidt (2000)
[218] Cf. Hedges/Olkin (1985) and Rosenthal/Rubin (1982).
[219] Cf. Hunter/Schmidt (2004), Hunter/Schmidt (1990b). Hedges/Olkin (1985), Raju/Burke (1983), Hunter et al. (1982) and Callender/Osburn (1980).

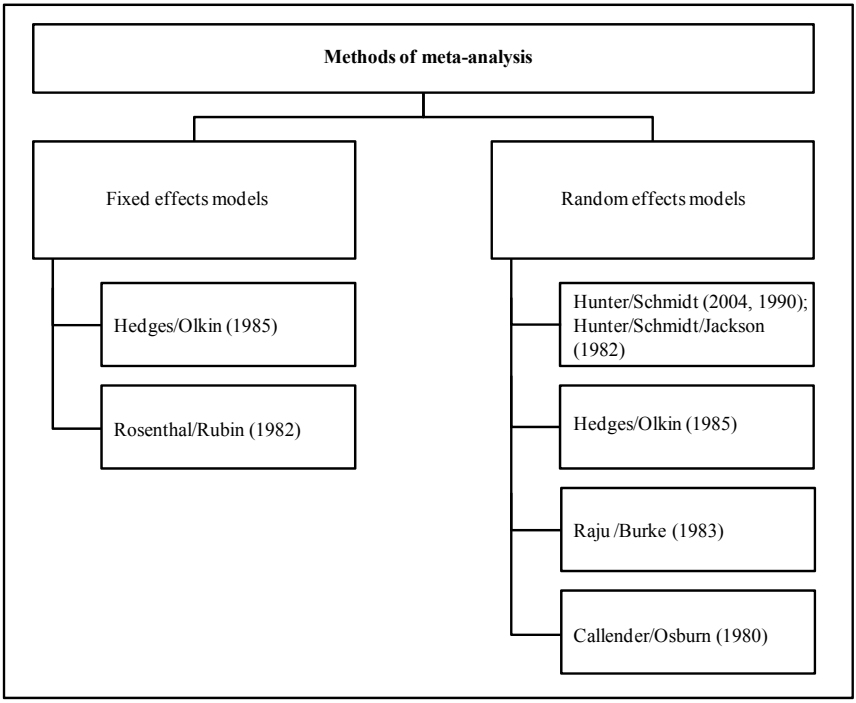

Figure 3-1: Methods of meta-analysis along model assumptions

Fixed-effects models assume that the underlying population for all studies in the meta-analysis is identical, so all study samples are taken from one homogenous population. Therefore, a relationship has only one fixed effect, so the standard deviation of the effect in the studies taken from this population is supposed to be zero and any difference in the effect in the studies is assumed to be due to sampling error.[220] This model is the simplest in the context of meta-analysis in terms of interpretation and calculations, so it is used commonly in quantitative reviews.[221] However, there are strong arguments against the use of fixed-effects models because of the implausibility of a homogenous population. Different design of studies and measures are common in research and it is quite counterintuitive that those study characteristics are without influence on effect sizes. [222] In contrast, the random-effects models assume random variations in an observed relationship in the studies of a particular population; that is,

[220] Cf. Schulze (2007), pp. 90f.; Field (2005), p. 445; and Field (2003), p. 107.
[221] Cf. Schulze (2007), p. 91; Hunter/Schmidt (2000), p. 276; Cooper (1997), p. 179 and National Research Council (1992), p. 52.
[222] Cf. Field (2003), p. 110

random-effects models assume that the standard deviation of an effect does not equal zero.[223] Field explained that "population effects sizes can, therefore, be thought of as being sampled from a universe of possible effects–a 'superpopulation.'"[224]

Random-effects models are largely supported by real-world data that allow for varying population parameters, so random-effects models are seen as superior to fixed-effects models.[225] In addition, as Hunter and Schmidt argued, when random-effects models are applied in a homogenous real population, they will become, mathematically, fixed-effects models. Nevertheless, since the random-effects models are in general more complex in terms of their interpretation and computational details, the meta-analyst should also take into account the intent of the review before choosing the random-effects model as a given. While fixed-effects models allow for generalizations only in the included group of studies, random-effects models allow generalizations beyond them.[226]

The objective of this dissertation is to generalize success factors in innovation management beyond the generalizations achieved by the included studies, so the random-effects models are more appropriate. Furthermore, the fixed-effects models' assumption of fixed population parameters is particularly untenable in the innovation management context because studies in this field are based on samples from e.g., different countries and industries. Consequently, random-effects models are most valid for the meta-analysis in innovation management.

3.2.2 Corrections applied as differentiating criteria

The methods of meta-analysis may be further distinguished according to the number of distortions corrected for. Three different methods for correcting distortions are known in literature as shown in figure 3-2.[227]

[223] Cf. Schulze (2007), pp. 91f.; Field (2005), p. 445; and Field (2003), p. 107.
[224] Field (2005), p. 445.
[225] Cf. Field (2005), p. 445 and Hunter/Schmidt (2004), p. 394.
[226] Cf. Hedges/Vevea (1998), p. 487.
[227] For a detailed description of the different methods, see Hunter/Schmidt (2004), pp. 453f.

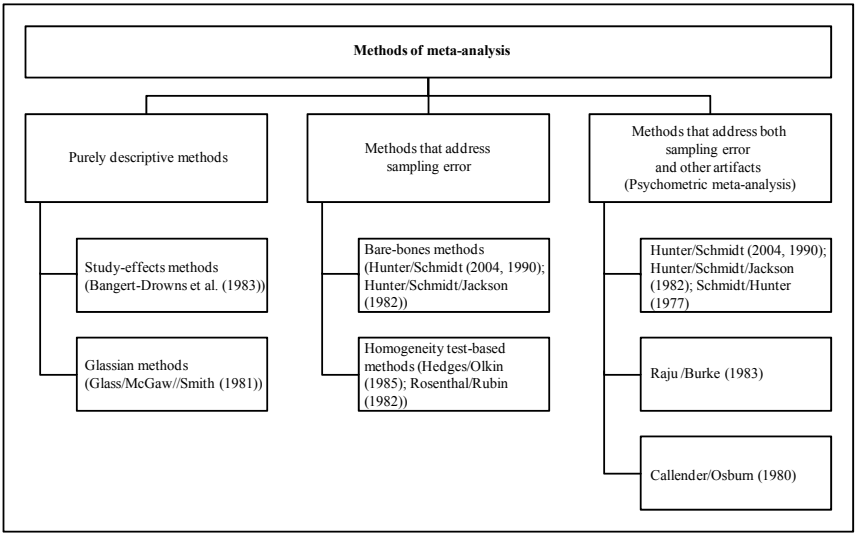

Figure 3-2: Methods of meta-analysis grouped by corrections applied[228]

The *purely descriptive approach* to correcting distortions, which approach is strongly influenced by the work of Glass et al. (1981) and Bangert-Drowns (1983), does not correct for any artifacts[229] in the individual studies, so the result is an average of the quantitative findings from the integrated single studies.[230] The *addressing the sampling error* method is driven by the work of Hedges and Olkin (1985) and Rosenthal and Rubin (1982), who developed *homogeneity test-based methods*,[231] which calculate the average sizes of effects, adjusted for sample size in homogenous groups. Other procedures with similar results are the *bare-bones methods*, developed by Hunter, Schmidt and Jackson (2004, 1990, 1982).[232] The third category of meta-analysis is the *psychometric meta-analysis*, which corrects for sampling errors and other systematic artifacts. This approach is dominated by the procedure published by Hunter and Schmidt (1990, 2004)[233], but other researchers have developed comparable procedures.[234]

[228] Adapted from Hunter/Schmidt (2004), p. 455
[229] Artifacts are any distortions of the observed effect size; for details, see sub-section 3.4.1.1.
[230] Cf. Glass et al. (1981) and Bangert-Drowns et al. (1984).
[231] Cf. Hedges/Olkin (1985) and Rosenthal/Rubin (1982).
[232] Cf. Hunter/Schmidt (2004), Hunter/Schmidt (1990b) and Hunter et al. (1982).
[233] Cf. Hunter/Schmidt (2004), Hunter/Schmidt (1990b), Hunter et al. (1982) and Hunter/Schmidt (1977). An analysis of the published meta-analysis in psychology shows the dominance of the Hunter and Schmidt approach in this research domain. Cf. Hunter/Schmidt (2004), p. 26. In the marketing and management literature most of the meta-analyses published in the last 10 years are based on the Hunter and Schmidt approach, e.g., Krasnikov/Jayachandran (2008), Song et al. (2008), Geyskens et al. (2006), Franke/Park (2006), Palmatier et al. (2006), Kirca et al. (2005), Gerwin/Barrowman (2002), Henard/Szymanski (2001), Dalton et al. (1999), Brown et al. (1998) and Dalton et al. (1998).
[234] Cf. Raju/Burke (1983) and Callender/Osburn (1980).

Reflecting these different methods with the ultimate objective of a meta-analysis defined by Rubin (1990), the most value-adding method is the psychometric meta-analysis. Rubin (1990) called for meta-analyses that would estimate the true effect of a relationship, which "would be obtained in an infinitely large, perfectly designed study or sequence of such studies." [235] Claiming this objective as being as well the objective of this dissertation, a psychometric meta-analysis needs to be chosen.

Based on the discussed differentiation possibilities of the methods of meta-analyses, the use of random-effects models within psychometric meta-analysis is the preferred approach for this dissertation. The argument for the random-effects models relates to the dissertation's objective of generalizing success factors in the field of innovation management and the complexity of the research area. The argument for the psychometric meta-analysis lies in its sophistication in correcting artifacts in individual studies. Thus, the current work will be based on the method of Hunter and Schmidt (2004, 1990), which is both commonly used and comprehensive, especially compared to the alternatives of Callender and Osburn (1980) and Raju and Burke (1983).[236]

The next two sections detail the approach of Hunter and Schmidt (2004) and the general steps of a meta-analysis, as shown in figure 3-3.

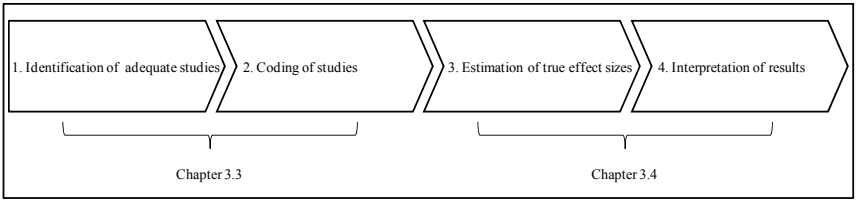

Figure 3-3: General steps of a meta-analysis

[235] Rubin (1990), p. 157
[236] In addition, Law, Schmidt and Hunter showed in a simulation analysis that all three psychometric meta-analysis methods retrieve comparable findings in the calculations; cf. Law et al. (1994).

3.3 Identification and coding of studies for the meta-analysis

The identification and coding of studies are the most critical parts in the process of meta-analysis. The development of the database of studies to be integrated is the basis of a sophisticated meta-analysis. [237] The following two sections illustrate how studies for the meta-analysis are identified, analyzed and encoded to develop a database.

3.3.1 Identification of adequate studies for inclusion

The process of finding the studies to be included in the meta-analysis encompasses three steps:[238]

1. Specification of the research problem
2. Definition of the characteristics of the studies to be included
3. Search for literature

3.3.1.1 Specification of research problem

The starting point for general integrative reviews is the specification of the research problem, so the availability of several relevant results from primary studies regarding the research problem is central to such a review.[239] The research problem should be described in a problem statement that provides a complete and straightforward, but not too detailed, picture of the object to be analyzed. Ideally, the problem statement suggests "the research literature at issue, major category of independent variables that is of interest, and the key dependent variables at issue."[240] Based on the problem statement, further details of the studies to be included can be defined.

[237] Cf. Hunter/Schmidt (2004), p. 470.
[238] Cf. Lipsey/Wilson (2001), pp. 12ff. and Cooper (1998a), pp.12ff.
[239] Cf. Fricke/Treinies (1985), p. 26.
[240] Lipsey/Wilson (2001), p. 12.

3.3.1.2 Characteristics of studies to be included

Lipsey and Wilson (2001) defined several general categories of information to be clarified before conducting a literature search for studies to be included in a meta-analysis: the form of the research findings, the distinguishing features, the research respondents, the key variables, the research methodology, the cultural and linguistic range of the research, the time frame, and the type of publication.[241]

Form of research findings. A clear specification of the form of the effect sizes is necessary, as only findings in terms of the same statistic can be integrated. In general, research findings are distinguished into four types:

- *Central tendency description.* The statistics used in this form of research finding represent the central tendency of the summarized distribution of values on the analyzed variable. They are measures like mean, median, mode, or proportion. In general, the statistics used to describe the central tendency are usable for meta-analysis "if the operationalization of the variable of interest is the same for all findings."[242]

- *Pre-post contrasts.* This type of research finding compares the central tendency of the measures of a variable of interest at two different points in time. Descriptive statistics—like the direct difference between two values, the central tendency of the difference, or gain scores—are common. In 1988, Becker developed an effect-size statistic for pre-post contrasts that allows meta-analysis to be applied to this type of finding.[243]

- *Group contrasts.* These findings are the result of the comparison across two or more groups of central tendencies of one or more variables measured. Descriptive statistics are typically means or proportions. There are appropriate effects-size statistics in this type of finding, so it is regularly used in meta-analysis.[244]

- *Association between variables*. An association between variables is measured by the covariation over respondents' answers regarding two variables. The findings are reported as, for example, correlation coefficients or indices of association derived from a cross-tabulation of the variables. Research findings in the form of association be-

[241] Cf. Lipsey/Wilson (2001), pp. 12ff.. If not otherwise identified, the following paragraphs are based on the explanations of Lipsey and Wilson.
[242] Lipsey/Wilson (2001), p. 13.
[243] Cf. Becker (1988).
[244] Cf. Rosenthal (1994c).

> tween variables are commonly used for meta-analyses, and sophisticated effect-size statistics have been developed.[245]

For each of the four types of research finding, the application of meta-analysis is straightforward using established statistics for the size of effects. However, findings stated in forms other than these may be difficult to analyze. The major form of results for which meta-analysis is not currently applicable is measures of multivariate analysis, like multiple regressions, discriminant analysis or structural equation models. Even if there were some specific cases for which those data could be converted into bivariate measures,[246] meta-analysts have not yet developed any solutions for the inability to use those findings, and "their complexity and the diversity across studies with regard to the selection of variables involved may make this impossible."[247]

Distinguishing features. In this category, a study's features are determined in order to qualify it for the meta-analysis. The content of the studies must fit with the overall research problem. For example, in meta-analyses that examine group comparisons, the distinguishing features are the nature of the groups and the comparisons at issue. When two constructs are associated, the distinguishing features criterion specifies those constructs, along with how they should be operationalized.

Research respondents (informant). Search results can also be narrowed based on a study's sample. Characteristics like the industry, region or hierarchy level can be used to define the appropriate sample for the meta-analysis since "the interests of a meta-analyst may require a very inclusive explication of pertinent characteristics of research respondents."[248]

Key variables. Examples of variables that may be appropriate for the meta-analysis are the specific outcome variables or dependent variables necessary to answer the research question or certain distinguishing variables in group comparisons. For correlation studies, covariates or control variables could be specified as necessary variables, or a particular operationalization of constructs defined in the distinguishing features of the study may be required before a study can be considered for the meta-analysis. Nevertheless, statistical information about the variables is necessary in order to specify a variable as key variable; otherwise, an appropriate calculation of the effect statistics would not be possible.

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[245] Cf. Hunter/Schmidt (2004).
[246] Cf. Peterson/Brown (2005) for the use of regression coefficients in the meta-analysis of correlations.
[247] Lipsey/Wilson (2001), p. 16.
[248] Lipsey/Wilson (2001), p. 17.

Research method. Research methods may vary in their design and methodology, so the research methods applied in the studies should be specified: Should the study design be experimental or survey based? Are studies included that used databases to retrieve information or should the studies have used a survey-based design? Methodological differences like multiple- or single-informant surveys or the use of single- or multi-item constructs are also in this category. However, the meta-analyst needs to keep in mind that restrictive criteria in this category will limit inclusion to high quality studies only but will also reduce the number and range of studies. More relaxed criteria will include more studies but may increase errors and biases in the meta-analysis.

Cultural and linguistic range. Since research is done in different countries and languages, the meta-analyst should identify any cultural or linguistic restrictions to answering the research question and justify any restrictions that are not based on it. In many cases, the practical problems of translation are used as reason to focus on studies written in one language or another. Lipsey and Wilson (2001) advised that, "if cultural or linguistic restrictiveness is not necessary for pursuit of the research question, the biases and limitations inherent in any such restriction should be considered and addressed as part of the meta-analysis."[249]

Time frame. In this category, the time frame is defined in which the studies must have been published. Specific interests and directions indicated by the research question might narrow the time frame for eligible studies, such as when only the most recent studies or studies dating from the point of a specific occurrence are of interest.

Publication type. Report types might be books, published journal articles, dissertations, conference presentations, unpublished manuscripts, and the like. In this category, the exclusion is sometimes based on practical considerations, such as using only published material, even though this limitation may lead to overestimating the size of an effect because published studies tend to report larger effects than unpublished ones.[250] Restrictions of publication types should be based on a valid justification.

Decisions regarding these categories should be made before starting the search for literature. However, the resulting statement of eligibility criteria will be subject to iterative improvements throughout the search process, particularly when certain studies that are not assessable within the defined specifications need to be considered for one reason or another. The next section continues the discussion of the literature search in greater detail.

[249] Lipsey/Wilson (2001), p. 18.
[250] Cf. Hunter/Schmidt (2004), pp. 493 ff.; Cooper (1998a), p. 75; and Begg (1994).

3.3.1.3 Search for literature

Before beginning the literature search, the meta-analyst must decide how the process of identifying eligible studies will be reported. An overview of the progress of the search process itself is necessary and the identified studies need to be displayed in a usable format. The development of a meticulous database based on a tool like Microsoft Excel® or Access® is recommended because these tools have considerable advantages over paper-based solutions.[251] Each identified study should be documented with information at least about the author, the title of the publication, the publication type (e.g., journal or book title, conference name and the like), the publication date, the retrieval source, the retrieval status, main keywords and a unique identification number that might also be used in other databases through the process of the meta-analysis. Another worksheet should cover the search progress by documenting the sources used in the search (e.g., title of journals or electronic literature databases searched), the search status in the specific source, the search approach (e.g., full scan of abstracts, search terms used and the like) and the years searched based on the specified time frame defined in the statement of eligibility.[252] Careful maintenance of a database-based system ensures that the search is organized and well structured and that it provides overall information like number of journals searched; number of studies identified, dropped and selected; and the like.[253] Nevertheless, the design set-up of the database will always be subject to adaption during the search process.

At this point, the search itself can begin. The realm of literature sources reaches from electronic databases covering journals with abstracts to full texts of articles to personal emails to authors or experts in the area of interest. The subsequent paragraphs outline the use of five typical sources: review articles, electronic databases, relevant journals, references in studies, and authors or experts.[254]

Review articles. An excellent starting point for collecting studies is the references in review articles that summarize current research on the topic of interest. Even if the single studies referenced are not discussed in detail in those reviews, the references to them suggest their eligibility for the meta-analysis. Review articles may also give indications of appropriate keywords to be used in the search in electronic databases.

Electronic databases. A number of databases are available that offer access to abstracts and full papers. These databases cover a large number of academic journals, conference publica-

[251] Cf. Lipsey/Wilson (2001), p. 23.
[252] Cf. Rosenthal (1994a), pp. 87ff.
[253] Cf. Lipsey/Wilson (2001), p. 24.
[254] Cf. Hunter/Schmidt (2004), p. 467; Lipsey/Wilson (2001), pp. 24ff.; White (1994), pp. 41ff.; and Rosenthal (1994a), pp. 87ff.

tions, books and working papers. It is important not to focus on only one single database because there is often only a minor overlap between the available databases.[255]

A central method for obtaining references is the use of keyword searches in these databases, although "there is an art to conducting effective computer keyword searches that is mastered largely through experience."[256] The most important part of this process is the preparation of the keywords used for the search. The search functions of the databases in general consider the title, the abstract and some standardized descriptors of the studies found in the database. Therefore, the keywords should cover the most common words used by the published authors in the field of interest. A helpful feature of the search functions of the databases is the use of "wildcard" symbols like * or *?*, which allow one to search for multiple variations of a single word. Other helpful search features, like a visual search or "explosion" of search terms, have been developed to improve and structure the comprehensive search of electronic databases.[257]

Although keyword-based research eases the process of identifying eligible references, it often produces a vast number of results, of which only a minor part may actually fit the research question. Separating the applicable studies from those that are not is usually a manual process executed by a knowledgeable reviewer who reads the title and abstract of the identified references. A way to reduce the number of irrelevant reports in the result list is through a discerning combination of keywords. Conjunctive and disconjunctive commands in the computer are helpful features in combining keywords.[258]

Even if the computer-based search identifies a large number of eligible results, the use of further search options is inevitable. Computer-based searches cannot be comprehensive because important studies will be missed through the vagaries of keywording, the limitations of search strategies, idiosyncratic titles and abstracts, and the limited number of digitalized journals. [259]

Relevant journals. As the number of eligible references grows, the names of journals that frequently address the topic of interest will become evident. The quality rankings of academic journals in the relevant research field will also give hints about acceptable journals. Searching in journals is usually done in the tables of contents, which are available either electronically or in hardcopy format.[260] Some journals with electronic versions also allow for keyword

[255] Cf. Glass et al. (1981), pp. 57ff.; for example, published studies are mainly in the EBSCO databases and unpublished (working) papers are mainly in the SSRN database.
[256] Lipsey/Wilson (2001), p. 26.
[257] See, for example, the "visual search" feature of the database EBSCO.
[258] Cf. Cooper (1998a), p. 50 and Reed/Baxter (1994), pp. 60ff
[259] For details, see Lipsey/Wilson (2001), pp. 25ff.; Cooper (1998a), pp.71ff.; White (1994), pp. 49ff.; or Fricke/Treinies (1985), pp. 38ff.
[260] Cf. Cooper (1998a), pp. 55f.

searches of titles and abstracts. However, a comprehensive visual scan of the tables of contents and abstracts overcomes the problems inherent in keyword searches.[261]

References in studies. Studies that have been identified as eligible for the meta-analysis are another helpful source for further references since the references in those studies are likely to be closely linked to the topic.[262] References in studies are also a good source of unpublished studies since there tends to be a good deal of informal information exchange among researchers in the same field of interest.[263]

Authors or experts in area of interest. Another opportunity for identifying useful unpublished studies is direct contact with authors or experts in the area of interest. Contacting authors of eligible studies by e-mail about work in progress and unpublished analysis or about feedback regarding the currently identified studies can be useful, although young researchers who are not yet part of formal or informal academic circles around a specific research topic may find this a not accessible avenue.[264]

After the studies relevant to the research problem have been retrieved, they must be analyzed or coded. The next section will deal with this step of the meta-analytic process.

3.3.2 Coding of studies

Coding of studies has the objective of extracting all relevant information for the meta-analysis from the identified studies in a structured, transparent and reproducible process. The following sub-sections detail the prerequisites for the coding process and the development and use of the coding form.

3.3.2.1 Prerequisites to coding

The necessity of coding effect sizes from the studies identified for use in the meta-analysis is derived from one of the main objectives of a meta-analysis: to correct and aggregate effect sizes. However, before such coding can take place, some conditions need to be clarified. For

[261] Cf. Lipsey/Wilson (2001), p. 25 and Green/Hall (1984), p. 46.
[262] Cf. Cooper (1998a), p. 56.
[263] Cf. Lipsey/Wilson (2001), p. 25 and White (1994), pp. 46f.
[264] Cf. Lipsey/Wilson (2001), p. 25; Cooper (1998a), pp.44f.; White (1994), p. 48; and Fricke/Treinies (1985), p. 36.

example, there may be a large variation in the effect sizes in the studies so, to ensure a sophisticated coding process, the meta-analyst must identify the range of possible effects, decide which are important, and determine how to deal with the variations. Effect sizes could fall into categories like constructs, measures or samples. [265] Each category, along with its idiosyncrasies, is described below. [266]

Constructs. In general, studies report more than one construct, so the meta-analyst has to choose whether only a specific number of constructs is of interest or all constructs should be coded. Overall, this decision should be based on the frequency with which the constructs are available in other studies. When a construct appears in only a small number of eligible studies, the aggregation of these effect sizes cannot be done in a meaningful way, so reporting on the construct might be without value. However, if the meta-analyst intends to aggregate across constructs of comparable content, the coding of these single constructs is necessary.

Measures. Measures or operationalizations represented in a study are assumed to index a specific construct. However, different research studies may use different measures to represent the same construct. Thus, the meta-analyst has to decide whether all measures of the relevant construct will be included in the analysis or only a specific subset of measures that meet specific criteria (e.g., only measures established over a longer publication period, like the measures for the *market orientation* construct of Narver and Slater (1990)[267]). Lipsey and Wilson (2001) noted that "the meta-analyst who decides not to code certain measures forgoes the opportunity to examine empirically whether those measures yield results different from those that are chosen for coding."[268] Another decision involves the use of different measures that index the same construct in the same study (e.g., financial performance measured individually by ROI, ROS and revenue growth). In this case, the meta-analyst chooses whether to include all measures separately, to include only one measure with the highest uniformity among the eligible studies, or to include the average of the effect sizes of all the measures.[269]

Samples. Effect sizes in empirical research studies are usually calculated across a specific sample of respondents. However, some studies also calculate effect sizes for groups of respondents with different characteristics in order to compare the results between or among them. The meta-analyst must decide whether those sub-group results could be of interest in answering the research question or could result in some additional findings (e.g., moderator analysis).

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[265] Cf. Lipsey/Wilson (2001), p. 77.
[266] The following description is based primarily on the explanations of Lipsey/Wilson (2001), pp. 77 ff.
[267] Cf. Narver/Slater (1990).
[268] Lipsey/Wilson (2001), p. 78.
[269] Cf. in detail Bijmolt/Pieters (2001) and the discussion in section 3.5.4.

These three categories represent a rough hierarchy of possible effect sizes that may be available for coding from a set of eligible studies for the meta-analysis. In preparing a suitable coding form, the meta-analyst should consider the decisions that must be made in each category. Besides recording the effect size of the key variables in the research context, the meta-analyst must decide which other study characteristics to include in the coding process. While some authors argue that other items should be included only if a theoretical justification is given, others consider this approach to be too conservative. They hold that a detailed coding of study characteristics is required for a better understanding of the results of the individual study, which understanding should help the meta-analyst to identify avenues for future research. They also argue against the claim that variations in effect size can be accounted for by a limited set of artifacts, a limitation that would also limit the number of study characteristics to be coded based on their not being substantially verified. Finally, they take the position that conjecture is part of science and that focusing only on formally justified items will reduce creativity.[270]

Stock (1994) suggested the following approach to settle the argument:[271] Meta-analysts should formulate conjectures about study characteristics and effect sizes that are, to their best knowledge, relevant to the research question. However, meta-analysts should also evaluate these conjectures based on the availability of information in study reports, on the likelihood that coders can be reliable in coding the information, and on the necessary coding time. Even if more items will be coded using this approach, the approach also restricts the items to those constrained by domain-specific knowledge. This method is in line with the Glass, McGaw and Smith (1981), who stated that "the characteristics of studies that are most important in a meta-analysis (apart from the findings, of course) can be roughly classified as either substantive or methodological."[272]

After the characteristics and effect sizes to be included in the coding process are defined, the process itself is designed for high reliability. Reliability is one of the most important attributes of the coding process because it ensures replicability of the meta-analysis results. Furthermore, the quality of results depends highly on a reliable coding process that guarantees that the original data are not over-refined;[273] to retain a high level of reliability, as much of the original data should be kept as possible. For numerical information (e.g., sample size, reliability estimates, effect sizes) the process of transferring the data into the coding form is generally less critical than that of transferring non-numerical, qualitative information (e.g., operationalization of constructs or sample characteristics).[274] In handling qualitative data, either a trans-

[270] Cf. the detailed discussion of the different viewpoints in Stock (1994), p. 126.
[271] Cf. Stock (1994), p. 126f.
[272] Glass et al. (1981), p. 77.
[273] Cf. Lipsey/Wilson (2001), p. 86 or Orwin (1994), p. 140.
[274] Cf. Stock (1994), pp. 129 ff.

formation into numerical data or the use of predefined qualitative categories is necessary. This kind of transformation may lead to coding errors, so it should be prepared carefully. The meta-analyst must define the categories up front to ensure consistency over the whole coding process. In the coding of qualitative information, the judgment of the coder is a central part of the process, so multiple trained coders are necessary to ensure reliability.[275] Especially in very large meta-analyses, the use of several coders is critical to meeting the reliability criteria. Therefore, an important part of judgment-based coding is the training of the coders;[276] the objective is to ensure that all coders are familiar with the research topic and have a common understanding of the qualitative information to be coded. After coding, agreement among the coders should be verified and disagreements should be resolved in discussions with all coders.[277]

The following sub-section describes the most common items for coding and how the documentation of coding should be done in the process of meta-analysis.

3.3.2.2 Development of an effective coding form

The items to be coded depend on the specific research field being analyzed.[278] However, a number of items that are frequently coded can be divided into three main categories:[279] *study descriptors* involve characteristics of the whole study, *coding process data* contains information about the behavior and dispositions of coders, and, *effect sizes information* is specific to the effect sizes extracted from the individual studies.[280]

The category of *study descriptors* covers information about the more substantial aspects of each study, e.g., size of the companies in the sample, cultural and organizational context, characteristics of respondents, theories applied in research, and so on. Coding of this information is necessary in order to understand variations in these aspects of the studies. Second, the category deals with methods and procedures used in a specific study, like survey design, sampling procedures, quality of measures, and the like. Because differences in study results may stem from methodological variations,[281] this information should be included in every coding form. Finally, study descriptors should include information about the study itself with

[275] Cf. Stock (1994), pp. 134 or Orwin (1994), p. 144.
[276] Cf. Lipsey/Wilson (2001), p. 88.
[277] Cf. in detail Orwin (1994), pp. 140ff.
[278] Cf. Hunter/Schmidt (2004), p. 471 and Stock (1994), p. 12.7
[279] In some coding forms, more than three categories are reported, but in this case, the original categories are just split over more sections.
[280] Cf. Hunter/Schmidt (2004), pp. 479f.; Lipsey/Wilson (2001), pp. 73ff.; and Stock (1994), pp. 127f.
[281] Cf. Hunter/Schmidt (2004), pp. 34ff.

data like the form of publication, the publication data, the title of the study, or the unique identification number. These elements, which are mainly of a descriptive nature, identify and categorize the studies in the meta-analysis.[282] In the category of *coding process data* are pieces of information like coding time, missing data, the rationale behind judgment-based coding or a confidence rating behind the most important elements.[283] Finally, the category of *effect size information* deals with the four aspects of the effect size: the nature of the effect size, including the construct measured, the operationalization of the constructs (e.g, for correlations, the independent and dependent variables), and the statistical nature of the variables (e.g, dichotomous, continuous or discrete); the time of the measurement; the sample basis on which the effect size is measured, e.g., only companies from a specific country or industry, only management respondents and so on; and statistical data about the value of the effect size and the related variance weight, e.g., sample sizes, variances, standard deviations and correlations. Reliability indicators for the variables should also be coded to support the corrections and adjustments of the effect sizes in the next step of the meta-analysis.[284]

After the items for coding are defined, a coding form should be developed. The order of elements on the form should mirror the general order of information in the studies being coded. Direct coding into a computer file has the advantage of efficiency.[285] Beside the coding form, an explanation sheet details each category of the coding form to guide the coders through the process.[286]

After all studies have been coded and the coders have reached agreement on the reliability of the data, the next step is calculation and interpretation of true effects sizes. The following section explains the calculation and interpretation of the results in the meta-analysis.

[282] Cf. Lipsey/Wilson (2001), pp. 83ff.
[283] Cf. Stock (1994), p. 128 or Orwin (1994), pp. 153ff.
[284] For details, see Lipsey/Wilson (2001), pp. 81ff.
[285] Cf. Lipsey/Wilson (2001), pp. 91ff., who describes and details the use of electronic databases in meta-analysis.
[286] Cf. Stock (1994), p. 137.

3.4 Estimation and interpretation of true effect sizes in meta-analysis

This section deals with the mathematical methods and the interpretation of aggregated effect sizes in the meta-analysis process, based on the random effects model approach of Hunter and Schmidt (2004).[287] The main imperfections of and possible corrections to empirical studies are discussed, and interpretations based on variance in the resulting estimated effect sizes are explained.

3.4.1 Correcting studies for imperfections and aggregation

The objective of a meta-analysis is the estimation of the sizes of effects in the real population. However, empirical research studies are generally biased by different errors (artifacts), like sampling sizes, measurement methods, and construct operationalization. The following subsections provide an overview of the artifacts that can influence empirical research, explain how artifacts in the individual studies are corrected, and detail how the corrected effect sizes are aggregated. The following explanations are based on correlated effect sizes because they are the most common data format available in the empirical innovation management literature.[288]

3.4.1.1 Artifacts in empirical studies

In their introduction to study artifacts, Hunter and Schmidt (2004) stated, "We refer to study imperfections as 'artifacts' to remind ourselves that errors in study results produced by study imperfections are artifactual or man-made errors and not properties of nature."[289] Table 3-2 is an overview of the artifacts identified by Hunter and Schmidt (2004). Even if all artifacts influence the results of an empirical study, only those artifacts could be corrected for which auxiliary information is available (e.g., study sample sizes, standard deviations, estimates of reliability). In most cases, this information is helpful only in correcting sampling and measurement errors and, in minor cases, for range restrictions or dichotomization.[290] Thus, the fol-

[287] Cf. Hunter/Schmidt (2004) and Hunter/Schmidt (2000).
[288] Cf. the remarks of Henard/Szymanski (2001), p. 363 and the literature analysis in section 4.1. Also compare the comments of Hunter/Schmidt (2004), p.71, who stated that correlations studies and two-group intervention studies (mainly in medical or psychological studies) are most common in general research.
[289] Cf. Hunter/Schmidt (2004), p. 33.
[290] Cf. Hunter/Schmidt (2004), p. 80 and 461; Lipsey/Wilson (2001), pp. 108f.; see also the correction applied in present meta-analyses, e.g., Song et al. (2008), who corrected for sampling and measurement errors and dichot-

lowing explanation of artifacts addresses sampling errors, measurement errors, and dichotomization only.[291]

	Study artifacts	Desciption	Impact on effect size
1.	Sampling Error	Observed effect sizes in a sample will vary randomly from the population's true effect size due to too small sample sizes.	Effect sizes will vary randomly.
2.	Error of measurement in the dependent variable	Imperfect construct reliability in the dependent/independent variable caused by random errors.	Effect sizes will be systematically lower by a factor x.
3.	Error of measurement in the independent variable		
4.	Dichotomization of a continuous dependent variable	Systematic errors resulting from to the split of a continuous variable into two groups.	Effect sizes will be systematically lower by a factor x.
5.	Dichotomization of a continuous independent variable		
6.	Range variation in the dependent variable	Range variations emerge in cases when the sample is of higher (range restriction) or lower (range enhancement) homogenity than the real population. Hence, the standard deviation in the dependent/independent variable of the sample is lower (restriction)/higher (enhancement) than that of the real population.	Effect sizes will be systematically lower (range restriction) or higher (range enhancement) by a factor x.
7.	Range variation in the independent variable		
8.	Deviation from perfect construct validity in the independent variable	Systematic measurement error in the dependent or independent variable. Variable does not measure the intended construct.	Effect sizes will be systematically lower by a factor 'x'.
9.	Deviation from perfect construct validity in the dependent variable		
10.	Reporting or transcriptional error	Data errors caused by a variety of reporting problems - like inaccuracy in coding data, errors in reading computer output, computational errors or typographical errors - influence the observed effect sizes.	Effect sizes will vary randomly.
11.	Variance resulting from extraneous factors that affect the relationship	Because of the measurement process of the specific relationship a third variable influences the effect size and is introduced into the relationship between the independent and dependent variable.	Effect sizes will be systematically lower by a factor 'x'.

Table 3-1: Study artifacts and their impact[292]

omization, or Franke/Park (2006), who corrected for sampling error only; or Henard/Szymanski (2001), who corrected for sample and measurement errors.

[291] To keep the work focused, only the three artifacts for which corrections will be done in chapter 5 will be discussed in greater detail. This limitation is based on the examination of available information about imperfections in the sample of eligible studies. For a detailed discussion of all artifacts, see Hunter/Schmidt (2004) or Rosenthal (1994c).

[292] Adapted from Hunter/Schmidt (2004), p. 35

Sampling Error (Artifact 1). This error emerges as result of person sampling, such that each time a new random sample from the same population is taken, it can be expected that the results of the analysis will vary.[293] Therefore, sampling errors have an additive and non-systematical impact on findings in empirical studies. Mathematically, if the true correlation is denoted by ρ and the observed correlation in the study is r, the sampling error e is added the true correlation: [294]

$$r = \rho + e \tag{3.1}$$

The only ways to avoid sampling error are careful selection of samples and increasing the sample size.[295] A correction in an individual correlation is not possible because of the unsystematic effect of sampling errors so, in a meta-analysis, sampling errors are corrected in the aggregation step.

Error of measurement (Artifacts 2 and 3). This error refers to imperfections that result from unreliability of the constructs used. In contrast to the errors through deviation from perfect construct validity (8 and 9), this error is an unsystematic one,[296] although the impact on the effect sizes is systematic and multiplicative. (The denotations in the formula are: real correlation of study i as r_{ci}, observed correlation in study r_i and attenuation factor a_{1i}):[297]

$$r_i = a_{1i} r_{ci}$$

The measurement error is measured by the square root of the reliability, which is less than 1. Thus, measurement errors systematically decrease the true correlation by the factor a_{1i}. When independent and dependent variables that correlate in terms of effect size have an imperfect reliability, the true correlation is even more greatly reduced:

$$r_i = a_{1i} a_{2i} r_{ci},$$

where a_{1i} represents the square root of the reliability of the independent variable and a_{2i} the square roof of the reliability of the dependent variable.[298]

Dichotomization (Artifacts 4 and 5). Splitting continuous variables into two groups is a common procedure in the social sciences; most of the studies use a median or 50-50 split.[299] However, this dichotomization of variables leads to inaccuracies in calculations based on the new

[293] Cf. Schulze (2007), p. 90.
[294] Cf. Hunter/Schmidt (2004), p. 34.
[295] Cf. Assael/Keon (1982), p. 114.
[296] Also see the discussion in section 2.2.3 and Bagozzi (1998), pp. 70ff.
[297] Cf. Hunter/Schmidt (2004), p. 34
[298] Cf. Hunter/Schmidt (2004), p. 36.
[299] Cf. Irwin/McClelland (2003), p. 366.

groups of variables analyzed in detailed studies.[300] In general, the dichotomization reduces the real correlation r_{ci} of study i by a factor a_{3i}; thus, the observed correlation r_i is:[301]

$$r_i = a_{3i} r_{ci},$$

The dichotomization factor c depends on how extreme the split of the continuous variable is. When the independent and dependent variable are dichotomized, the true effect size will be distorted by the formula[302]

$$r_i = a_{3i} a_{4i} r_{ci},$$

where a_{3i} and a_{4i} are the attenuation factors for the independent and dependent variables, respectively. In the case of a median split of a continuous variable, the attenuation factor takes the value of .80, or a 20 percent reduction in the true correlation. [303]

After the definition of the different relevant imperfection of empirical studies in innovation management in this section, the next section deals with the correction of the observed effect sizes for those selected artifacts.

3.4.1.2 Correction for selected artifacts in single studies

This sub-section addresses the mathematical and statistical corrections for the relevant artifacts in a single study. A brief overview of the most important correction formulae is given in order to keep the following paragraphs simple and focused. A detailed overview of the complex derivation of the formulae can be found in Hunter and Schmidt (2004).[304]

On a single-study level, only imperfections in measurement and errors through dichotomization of variables can be corrected.[305] The sampling error is corrected during the aggregation step by accounting for the different sample sizes of each study.

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[300] Cf. Irwin/McClelland (2003) and MacCallum et al. (2002).
[301] Cf. Hunter/Schmidt (2004), p. 36
[302] The exact formula is more complicated, but Hunter and Schmidt showed that this approximation holds in most current meta-analysis. Cf. Hunter/Schmidt (1990a), p.336.
[303] Cf. Hunter/Schmidt (2004), p. 36.
[304] Cf. Hunter/Schmidt (2004).
[305] Cf. Jensen/Mertesdorf (2006), p. 662 and Hunter/Schmidt (2004), pp. 95ff.

Measurement error. Measurement error is quantified by the reliability measures of the constructs used for the correlations analyzed. Hunter and Schmidt (2004) proposed equation (3.2) to correct for this study artifact[306]:

$$r_{ci} = \frac{r_i}{a_{1i}a_{2i}} = \frac{r_i}{\sqrt{R_{a_{1i}}R_{a_{2i}}}}, \tag{3.2}$$

where r_{ci} is the corrected real correlation of study i and $R_{a_{1i}}$ and $R_{a_{2i}}$ are the reliability coefficients of the independent and dependent variables, respectively, of the correlation analyzed. Unfortunately, in most empirical studies the reliability coefficient is measured by Cronbach's alpha,[307] which does not allow for a full correction of measurement error.[308] However, Schmidt et al. (2003) showed that, by correcting the Cronbach's alpha coefficient by subtracting .05 from the reliability estimate, the correction improves and covers most of the measurement error.[309]

Dichotomization. The size of the error resulting from dichotomization depends on how extreme the variable split is. In most empirical studies, the split is made at the median, so the correction presented here can be used only in these common situations.[310] When the variable is split at the median, the attenuation factor c will be .80, so the correction formula is:[311]

$$r_{ci} = \frac{r_i}{a_{3i}} = \frac{r_i}{.80} \tag{3.3}$$

If both variables in the correlation are dichotomized at the median, the formula changes to:

$$r_{ci} = \frac{r_i}{a_{3i}a_{4i}} = \frac{r_i}{(.80)(.80)}$$

[306] Cf. Hunter/Schmidt (2004), p. 96.
[307] Cf. Homburg/Giering (1996), p. 8.
[308] In general, a measurement error is one of three types: (a) random response error, (b) specific error, and (c) transient error. Cronbach's alpha coefficient (also denoted as the coefficient of equivalence (CE)) measures only the types (a) and (b). Cronbach also suggested a coefficient to measure all types, called the "Coefficient of equivalence and stability" (CES). However, the use of this reliability estimate is rare in the literature. For details, see Cronbach (1947) and Schmidt et al. (2003), pp. 206ff.
[309] Cf. Schmidt et al. (2003), pp. 218 ff.
[310] A more general but more complex formula can be found in Hunter/Schmidt (2004), pp. 112ff.
[311] Cf. Hunter/Schmidt (2004), pp. 112ff.

Finally, the corrected correlation -- of an individual study adjusted for all relevant artifacts n (in this dissertation, for measurement error and dichotomization only) is:[312]

$$r_{ci} = \frac{r_i}{\prod_{j=1}^{n} a_{ji}} = \frac{r_i}{A_i}, \tag{3.4}$$

where A_i is the total attenuation factor.

After the imperfections on an individual-study level are corrected, the results should be aggregated into a true population effect size. The following section discusses this integration of single-study effect sizes and details the additional calculations and statistics necessary to interpreting the results of a meta-analysis.

3.4.1.3 Aggregation of effect sizes

The aggregation of effect size is a central step in a meta-analysis. When single-study findings are averaged, the sampling error will be reduced. However, averaging values also implies a decision concerning the weight of each study. Hunter and Schmidt (2004) recommended accounting for the sample sizes of each study first, and then considering the attenuation of each study in calculating the weight ω_i of a single study:[313]

$$\omega_i = N_i A_i^2, \tag{3.5}$$

where N_i is the sample size and A_i the attenuation factor of study i.[314]

The following paragraphs address the formulae for estimating the real population effect size, the variance in corrected correlations, the sampling-error variance in the corrected correlations caused, and the variance in the estimated real population effect size. The difference between the confidence and credibility intervals is also discussed briefly.[315]

[312] Cf. Jensen/Mertesdorf (2006), p. 662.
[313] Cf. Hunter/Schmidt (2004), pp. 122 ff.
[314] The attenuation factor in the study weight is squared since the study weight factor is derived from the sampling error variance of the corrected correlation of a study; cf. Hunter/Schmidt (2004), pp. 124.
[315] All formulae are based on Hunter/Schmidt (2004), pp. 123ff.

Estimate for the real population effect size. Based on the individual weights of each study, the estimate of the real population effect sizes ρ i is calculated using the weighted average formula:

$$\rho = \frac{\sum_{i=1}^{n} \omega_i r_{ci}}{\sum_{i=1}^{n} \omega_i} \tag{3.6}$$

To estimate the variance in this estimate of the real population effect size σ_ρ^2, it is necessary to calculate the variance in the corrected correlations $\sigma_{r_c}^2$ and the sampling error variance of the corrected correlations σ_e^2 using:

$$\sigma_\rho^2 = \sigma_{r_c}^2 - \sigma_e^2,$$

where the variance of the corrected correlations $\sigma_{r_c}^2$ is given by

$$\sigma_{r_c}^2 = \frac{\sum_{i=1}^{n} \omega_i (r_{ci} - \bar{r}_c)^2}{\sum_{i=1}^{n} \omega_i} \tag{3.7}$$

The sampling error variance of the corrected correlations is calculated by:

$$\sigma_e^2 = \frac{\sum_{i=1}^{n} [\omega_i \frac{(1-\bar{r}_i^2)^2}{(N_i-1)A_i^2}]}{\sum_{i=1}^{n} \omega_i} \tag{3.8}$$

Finally, the formula for the variance of the estimated real population effect size is:

$$\sigma_\rho^2 = \sigma_{r_c}^2 - \sigma_e^2 = \frac{\sum_{i=1}^{n} \omega_i (r_{ci} - \bar{r}_c)^2}{\sum_{i=1}^{n} \omega_i} - \frac{\sum_{i=1}^{n} [\omega_i \frac{(1-\bar{r}_i^2)^2}{(N_i-1)A_i^2}]}{\sum_{i=1}^{n} \omega_i} \tag{3.9}$$

The standard deviation can be calculated by applying the square root of the variance, and the standard deviation can be used as a further descriptive measure in the interpretation of the results.

Another measure for interpreting the calculation results is the explained variance EV:

$$EV = \frac{\sigma_e^2}{\sigma_{r_c}^2} \tag{3.10}$$

Finally, the difference between the confidence and credibility intervals will be detailed which is important for the further interpretation of the effect sizes. Both intervals give borders for the estimated effect sizes for a specific percentage of a probability. However, while the borders of the confidence interval are calculated based on the standard error of the true effect size, and while the confidence interval gives the probability that the mean true effect size is in between these borders, the credibility interval is calculated based on the standard variance of the true population effect size and gives the percentage of the probability that the distribution of the true effect sizes will be between the interval borders. Because the random-effects models allow for a distribution of effect sizes, the use of credibility intervals is critical.[316] The borders of the credibility interval are calculated using the formula[317]:

$$\rho \pm \zeta \sigma_{\rho}, \tag{3.11}$$

where ζ is based on the assumption of a normal distributed population.[318] The confidence interval is calculated based on the formula:

$$\rho \pm \zeta SE_{\rho}, \tag{3.12}$$

where ζ is based on the assumption of a normal distributed population, and SE_{ρ} is the standard error of true effect size and is calculated based on the variance in the corrected correlations $\sigma_{r_c}^2$:

$$SE_{\rho} = \frac{\sqrt{\sigma_{r_c}^2}}{\sqrt{k}},$$

where k is the number of effects included into the effect size calculation.[319]

After the true effect size is estimated and the associated variances, standard deviation, variance explained, confidence and credibility intervals are calculated, the results are interpreted in the next step.

[316] Cf. Hunter/Schmidt (2004), pp. 205f.
[317] Cf. Jensen/Mertesdorf (2006), p. 663.
[318] E.g., for 95% credibility intervals $\zeta = 1.96$, for 90% credibility intervals $\zeta = 1.645$
[319] Cf. Hunter/Schmidt (2004), p. 206; Hunter/Schmidt (2000), pp. 280ff.; and Whitener (1990), pp. 316ff.

3.4.2 Interpretation of results

Since meta-analyses have the objective of estimating the most accurate effect sizes of the relationships of variables in the real population, corrections of the original effect sizes from the eligible studies are done to reduce the variance in the resulting aggregated effect size and to make it possible to generalize the results over the real population. In this context, the question about the magnitude of the effect size, the explained variance, should be answered; the meta-analyst should ensure that the results are stable, even if unavailable or unpublished studies may show different findings; and, if results are not valid for the complete population, moderator variables should be identified to split the real population into groups and allow for the possibility to generalize within these sub-groups. The following sub-sections detail these three steps for interpretation

3.4.2.1 Estimated true effect size and the explained variance in meta-analysis

The central information in the results of a meta-analysis is the estimation of the true effect size and the connected variances. Cohen (1988) used a power table (Table 3-2) to explain the magnitude of the correlation effect size.[320]

Small	Medium	Large
$r \leq .10$	$.10 < r < .50$	$r \geq .50$

Table 3-2: Cohen Power Table[321]

However, the magnitude alone is not sufficient to answer the question of the generalizability and accuracy of the estimated true effect size in the population. The accuracy of the estimated effect size is given when the null hypothesis can be rejected at a high significance level, which will be the case if the calculated confidence interval is not including zero. Only when the estimation of the effect size is accurate a precise interpretation of the findings can be made.[322]

Generalizability is tested by calculating the credibility interval. The borders of a credibility interval are the boundaries for the distribution of real effect size for a defined probability. If this interval is not including zero under a high percentage of probability, the direction of the

[320] Cohen (1988), pp. 25 ff., pp.77 ff. and pp. 284 ff.
[321] Adapted from Cohen (1988), pp. 25 ff.
[322] Cf. Whitener (1990), pp. 316ff.

effect size can be identified and the true effect size can be generalized to the population based on the direction of the effect.[323] Moreover, when the credibility interval is small and the underlying population is homogenous, the estimation can also be generalized in magnitude.[324] Several methods can be used to analyze the homogeneity of a population;[325] however, as Sacket et al. (1986) showed, Hunter and Schmidt's (2004) "75 percent rule" has shown to be have the most statistical power under all conditions, especially when the number of studies included in the meta-analysis is comparatively small (as is the case in almost all business-related analysis, compared to publications in medical or psychological science).[326]

The 75 percent rule states that, "as a rule of thumb [,. . .] if in any data set, known and correctable artifacts account for 75 percent of the variance in study correlation,[327] it is likely that the remaining 25 percent is due to uncontrolled artifacts."[328] In other words, in the case of an explained variance (EV) above 75 percent, the population is homogenous in respect to the estimated true effect size, so the effect size can be generalized in terms of direction and magnitude in this population. In contrast, in a heterogeneous population, further identification of moderators in the population is necessary to generalize the true effect size for sub-groups. (This moderator analysis will be detailed in sub-section 3.4.2.3.) Additional information about the stability of the results will provide the availability bias, which measures the influence of unpublished or unavailable studies that might impact the significance of the effect size. A detailed discussion of this impact follows.

3.4.2.2 Availability bias

The availability bias (also often referred to as sampling bias, publication bias, or selection bias) is a problematic issue for meta-analysis.[329] As McNemar (1960) pointed out, published studies generally show more highly significant effects than unpublished ones do,[330] and Lipsey and Wilson (2001) showed that the effect sizes in published studies have a larger mean effect size than unpublished ones do.[331] This difference between published and unpublished studies may bias meta-analysis towards larger effect sizes. To measure the presence of availa-

[323] Cf. Kristof-Brown et al. (2005), p. 299 and Cortina (2003), pp. 428f., Cortina also suggested having at least a 95% probability for the calculation of the credibility interval.
[324] Cf. Hunter/Schmidt (2004), p. 401.
[325] For example, the use of chi-square tests (cf. Hedges/Pigott (2001), p. 212) or the Callender-Osburn procedure (cf. Callender/Osburn (1980)).
[326] Cf. Hunter/Schmidt (2004), pp. 401ff. and Sackett et al. (1986), p. 310.
[327] The *75 percent rule* refers to the explained variance (EV) in formula 3.10.
[328] Hunter/Schmidt (2004), p. 34.
[329] Cf. Hunter/Schmidt (2004), pp. 493ff.
[330] Cf. McNemar (1960).
[331] Cf. Lipsey/Wilson (1993), pp. 1194ff.

bility bias or sampling bias, the statistical measure *fail-safe N*, was developed by Rosenthal (1979) and adapted by Orwin (1983).[332] In the original model, the *fail-safe N* gives the number of studies required to reduce the results of the meta-analysis to non-significance, based on the ρ-value summary. The main differences between the adapted model and the original model are that the adaption can be used for effect size analysis, which is more informative than XX-value summaries, and the adaption allows the researcher to introduce his or her own critical level in place of the fixed level of non-significance.[333] The current work uses Orwin's (1983) adaption to analyze effect sizes, and uses the calculated *fail-safe N* to determine the number of studies that would reduce the estimated true effect size to the .05 significance level:[334]

$$X_s = k(\frac{\rho}{\bar{r}_s} - 1), \tag{3.13}$$

where X_s is the number of studies of effect size zero needed, k is the number of effect sizes included in the estimated true effect size ρ, and $\bar{r}_s$ is the critical effect size level. The critical effect size level can be measured by the specific significance level that should be reached at least. Thus, the value of X_s suggests the tendency about the stability and reliability of the estimated effect size. The larger the number of studies needed, the more stable and reliable the results. If X_s is zero, the analyzed factors are already insignificant, according to the ρ-value criterion.[335] However, there exists no precise guideline, how to categorize the stability and reliability of the results.[336]

3.4.2.3 Moderator analysis

Moderators are factors that cause differences in the correlation between two variables.[337] If true effect sizes are influenced through moderators, these differences will be shown in the variance of the estimated true effect size and the explained variance (EV). Following the 75 per-

[332] Cf. Rosenthal (1979) and Orwin (1983). There are also other methods to identify the availability bias and approaches to correct for the availability bias; however, the most common method used in meta-analysis is the adapted *fail-safe N* calculation. For details about the other methods, see Rothstein et al. (2005).
[333] Cf. Orwin (1983), pp. 157ff.
[334] As applied by Song et al. (2008), p. 11.
[335] Cf. Song et al. (2008), p. 11; and Rothstein et al. (2005), pp. 111ff.
[336] Rosenthal's suggested ad hoc rule to set the results in perspective cannot be used because as the results between the original *fail-safe N* and the adaption of Orwin differ. Cf. Rothstein et al. (2005), pp. 118f. Some of the recent meta-analyses even leave out the availability bias because of the missing guidelines; cf. Troy et al. (2008). In the current analysis, a value of $X_s$above 20 will be assumed to be stable. (This assumption is based on the totally identified studies in this work (60) within 27 years of research in innovation management).
[337] Cf. Hunter/Schmidt (2004), p. 90.

cent rule, all corrected effect sizes with an EV less than 75 percent might be subject to moderator influence. The objective of a moderator analysis is to explain this remaining variance and thereby allow for generalization of the effect size under the influence of the specific moderators. Moderator analysis can be done with two different approaches,[338] based on the type of moderators used.

The first approach is best for moderators of a dichotomous or categorical nature. In this approach the studies are split into at least two groups, based on the moderator, and a new meta-analysis is conducted for each group. If the average of the new calculated variance of the estimated true effect size of each group is lower than the variance in the complete data set, and the new estimated effect sizes in the groups differ one from the other, the moderator is confirmed.[339] In cases where there are multiple moderators, multiple splits of sub-groups are often necessary to reach the desired level of explained variance. If this approach is applied to the moderator analysis, the meta-analyst should bear in mind that moderators are often correlated with each other. To overcome this issue, a hierarchical analysis of moderators considers moderators together in sub-groups of sub-groups. However, a hierarchical moderator analysis requires a large number of studies in order to split the studies into multiple sub-groups. Thus, in many analyses, a hierarchical moderator analysis cannot be conducted because of the small number of studies available. In this case, conclusions about the analyzed factors in the meta-analysis can be only tentative.[340] The second approach, which is best for continuous moderators, uses ordinary least squares (OLS) or weighted least squares (WLS) methods.[341] In this dissertation, the first approach will be applied because all moderators are of a categorical nature.[342]

Once a moderator is confirmed for a specific factor, the next step is to analyze the change in the effect of the factor on the dependent variable. The same criteria as were defined in section 3.4.2.1 are applied. If the results are generalizable in direction and homogenous (explained variance of more than 75 percent), the factor is also generalizable in magnitude for the specified moderator. Otherwise, the only conclusion is the confirmation of the moderator and the likelihood that other moderators may influence the relationship.

[338] Cf. Viswesvaran/Sanchez (1998), p. 79.
[339] These two criteria are mathematically dependent; when the average variance of the sub-groups is smaller than for the data as a whole, then the estimated correlation value varies between the sub-groups; for details, see Hunter/Schmidt (2004), p. 90 and Viswesvaran/Sanchez (1998), pp. 79f.
[340] Cf. Hunter/Schmidt (2004), pp. 424ff. and Viswesvaran/Sanchez (1998), p. 80.
[341] Cf. Hunter/Schmidt (2004), pp. 388ff.; see also Viswesvaran/Sanchez (1998), p. 82 for issues with OLS and WLS used in cases where the sub-group analysis should be applied.
[342] See details in section 4.2.2.5. A detailed explanation of the second approach can be found in Hedges/Olkin (1985), pp. 168ff.

After the correction of all effect size measures and interpretation indicators such as the availability bias, the meta-analyst can derive the implications of his or her findings to the research field and for practical application. However, there are still other general issues in the meta-analysis method to be discussed in the following sub-sections.

3.5 General issues in meta-analysis

In this section the focus lies on the general issues in meta-analysis that are regularly discussed in the literature.[343] First, two general data aggregation problems are detailed, followed by two mathematical data issues.

3.5.1 Garbage-in-garbage-out

The "garbage in, garbage out" issue refers to the problem of quality differences, in terms of methodology, in the studies included in the meta-analysis.[344] In general, methodologically weak studies have less significant and lower effect sizes than do studies with good methodology.[345] Therefore, some researchers have suggested excluding studies with low methodological quality from the analysis and just focusing on methodologically sophisticated studies.[346] However, exclusion of data is always accompanied by a reduction in the information to be analyzed.[347] Another–probably better–opportunity lies in correcting methodological weaknesses and weighting factors in the studies during aggregation, based on the methodological quality.[348] Methodological moderator variables could also be used to split the group of studies along the moderators in order to explain remaining variances as resulting from quality issues in the studies. This approach can lead to methodological suggestions for researchers who plan to conduct further primary analysis. This dissertation applies the correction and weighting approach proposed by Hunter and Schmidt (2004) and uses moderators to account for methodological differences among the studies.

3.5.2 Problem of "apples and oranges"

Exact replication studies are rare in research because they are usually difficult to publish. For this reason, general studies usually differ from each other in, for example, operationalization of independent and dependent variables, type of respondents interviewed, geographical regions from which the sample is drawn, and so forth. The critics of "apples and oranges" com-

[343] Cf., for example, Hunter/Schmidt (2004), pp. 189ff.; Cortina (2003); Rosenthal/DiMatteo (2001); Bijmolt/Pieters (2001); and Sharp (1997).
[344] Cf. Hunt (1997a), p. 42.
[345] Cf. Fricke/Treinies (1985), p. 171.
[346] Cf., for example, Slavin (1986).
[347] Cf. Glass et al. (1981), pp. 220ff.
[348] Cf. Hunter/Schmidt (2004), pp. 468ff.

parisons argue that aggregating the effect sizes of those studies would lead to meaningless results. However, mixing apples and oranges can be a good thing if one wants to generalize about fruit. (A mixture of apples and oranges would lead to the generalizations that fruit tends to be round and sweet, to have seeds, and so on.) In fact, studies that are exact replications of each other are actually more limited in their generalizability.[349] The key is to identify an appropriate group of studies to aggregate in order to reach a better understanding of the research question since, according to Hall et al. (1994), "combining apples and oranges to understand something about fruit may make more sense than combining fruit and humans to understand something about organic matter."[350] Moreover, a well performed meta-analysis deals with a variety of methodologies by treating this difference as a moderator variable. In the present meta-analysis, the explanation of variances is in much greater focus than is the aggregation of effect sizes alone.[351] While this meta-analytic approach will be applied here to all appropriate studies in an effort to answer the research question, this work will aggregate only those constructs that measure the same relationship and will include moderators to deal with differences in the studies under consideration.

3.5.3 Measures different to "r"

An issue that arises during aggregation of studies in a meta-analysis is the different types of measures reported in the studies. In general, only the Pearson correlation coefficient r can be used in the aggregation process of the meta-analysis. However, some studies that are eligible to answer the research question from a content perspective report other measures than the correlation coefficient. Standardized multiple regression coefficients, path coefficients of structural equation models (SEMs), canonical correlations, and test statistics are all examples of measures used in studies.[352] To include studies that use these kinds of measures in a meta-analysis, the Pearson correlation coefficient must be available. In the best case, the studies will have published correlation matrices, in addition to the other measures, or there will be a mathematical procedure to transform the reported measures into the Pearson correlation coefficient. In reality, however, many researchers do not publish the necessary correlations; therefore Rosenthal (1994b) developed statistics to transform different measures into correlation coefficients.[353]

[349] Cf. Glass et al. (1981), pp. 218ff.
[350] Hall et al. (1994), p. 20.
[351] Cf. Lipsey/Wilson (2001), pp. 8f.
[352] Cf. Hunter/Schmidt (2004), pp. 473ff.
[353] Cf. Rosenthal (1994b) or Rosenthal/DiMatteo (2001), pp. 70ff.

Still, there is no method by which to transform measures like canonical correlations and path coefficients from SEMs.[354] Regarding multiple regression coefficients, Peterson and Brown (2005) published a formula tested with a large sample of real data to transform beta-coefficients into the Pearson correlation coefficient[355]:

$$r = \beta + 0.5\lambda,$$

where $\lambda = 1$ for $\beta > 0$ and $\lambda = 0$ for $\beta < 0$.

The present meta-analysis applies the formulae from Rosenthal and from Peterson and Brown to transform respective measures into the Pearson correlation coefficient.

3.5.4 Multiple measurements of a focal effect in a single study

Many studies use multiple measures of the effect being analyzed. The issue to be considered in this context is how to include the different measures into the meta-analysis, either by using an average of the effect sizes or by using each single effect size. While Hunter and Schmidt (2004) argued from a conceptual point of view,[356] Bijmolt and Pieters (2001) conducted a Monte-Carlo simulation with the different procedures to identify the most suitable one.[357] Hunter and Schmidt supposed the use of single effect sizes only for fully replicated designs (i.e., fully independent effect sizes) and argued for averaging the correlations in all other cases. However, Bijmolt and Pieters (2001) showed that averaging multiple measures leads to less sophisticated results than does including all single measures from one study into the meta-analysis. Thus, the current meta-analysis follows the suggested approach of Bijmolt and Pieters (2001), which is also commonly used in other meta-analyses.[358]

[354] Cf. Hunter/Schmidt (2004), pp. 476ff.
[355] Cf. Peterson/Brown (2005).
[356] Cf. Hunter/Schmidt (2004), pp. 429ff.
[357] Cf. Bijmolt/Pieters (2001).
[358] Cf., for example, the meta-analysis of Heugens/Lander (2009), Krasnikov/Jayachandran (2008), Troy et al. (2008), and Henard/Szymanski (2001).

3.6 Summary of the method of meta-analysis

The objective of this chapter was to describe the method of meta-analysis and its issues. Before the method was detailed, meta-analysis was delimitated from other review concepts and the superiority of the meta-analysis procedure of Hunter and Schmidt (2004) was discussed.

In general a meta-analysis is the most powerful method for estimating true effect sizes and also allows a structured overview of extremely complex topics with conflicting findings in single studies. The selection of Hunter and Schmidt's (2004) psychometric meta-analysis approach is based on several arguments: First, psychometric approach is based on the assumptions of the random-effects model, which are closer to reality than those of the fixed-effects model. Second, a psychometric meta-analysis is more accurate in correcting for biases in the individual studies than other methods. Finally, the method is the most commonly used approach in the management research.

Usually meta-analyses do not differ in terms of their processes, but in the detailed procedure of correcting the identified effect sizes from single studies and estimating the true effect sizes in the population. Thus a meta-analysis can be divided into four general steps, as shown in figure 3-4.

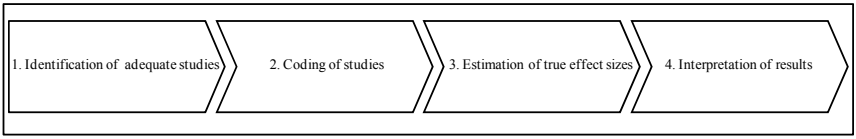

Figure 3-4: General steps in meta-analysis

1. Identification of adequate studies:
   Before starting the final identification of studies, the research problem should be specified and the characteristics of the studies to be included in the meta-analysis defined. The search for literature is based on sources that include literature reviews, electronic databases, and the tables of contents of relevant journals.

2. Coding of studies:
   Coding of studies begins with a clear guideline about the effect size to be included in the studies. The meta-analyst identifies the range of possible effects, decides which are important, and defines how to deal with the variations. The characteristics of studies to be coded are also defined. To guarantee a replicable coding process, the coders should

be trained before starting the coding process, and an electronic coding form should be developed so all relevant studies are coded in the same way.

3. Estimation of true effect sizes:
   Having identified and coded the studies for the meta-analysis, the meta-analyst applies mathematical corrections, as detailed by Hunter and Schmidt (2004), to estimate the true effect size, confidence and credibility intervals, as well as the explained variance.

4. Interpretation of results:
   The interpretation of the results is based on the magnitude of the estimated true effect; the accuracy of the results, measured by the confidence interval; the generalizability of the results in direction, shown by the credibility interval; and the generalizability of the result in magnitude by the explained variance. Availability bias is calculated as a further measure of stability. To identify possible moderators, Hunter and Schmidt's 75 percent rule is used, based in the percentage of the explained variance. When moderators are indicated, a sub-group moderator analysis is conducted on the identified sub-group of effect sizes, and the results are interpreted as outlined in the first part of this step.

Conducting a meta-analysis is also connected to other issues that can distort its results. The main topics from a content perspective are the issues of "garbage in, garbage-out" and "apples and oranges." Both topics are relevant are considered in the present analysis The mathematical problems in dealing with "measures different from "r" and "multiple measurements of a focal effect in a single study" are also be addressed in this work.

4 Identification and coding of single studies of success factors in innovation management

This chapter deals with the first two steps in the meta-analysis procedure. The identification of eligible studies is discussed first, following by the coding of the studies, which leads to the final identification of success factors denoted in single studies. These two steps lay the foundation for a sophisticated meta-analysis with helpful and forward-looking results.

4.1 Identification of adequate studies: Scanning the innovation literature

Identifying eligible studies for the meta-analysis is an essential part of the path to good results in the calculation part of the analysis. Therefore, in a first step, the characteristics of the eligible studies must be clarified in order to serve as a basis for the literature search that follows. Once studies that fit the research question have been identified, a categorization of possible success factors must be developed to guide the analysis and coding of those studies.

4.1.1 Research problem and characteristics of eligible studies

The central research question that leads the effort to identify eligible studies was defined in the introduction as "What are the true estimated effects of success factors identified in single studies that can predict successful innovation performance on a firm level?" Following this basic research question, additional characteristics of the studies to be chosen were defined.[359]

Form of research findings in studies. After a pre-study of several publications in the context of innovation management and based on the findings of former meta-analyses with similar analysis backgrounds, it became apparent that the dominant form of effect sizes used in this literature is associations between variables. Most studies use either bi- or multivariate techniques. Consequently, a meta-analysis using correlations will be applied in this dissertation.[360]

[359] The characteristics are based on the explanations in section 3.2.1.
[360] Cf., for example, De Luca/Atuahene-Gima (2007), Atuahene-Gima et al. (2005), Li/Atuahene-Gima (2001a), Tsai (2001) and the meta-analysis of Henard/Szymanski (2001) or Damanpour (1991). This hypothesis and example-driven approach was also confirmed by a later published analysis regarding research in new product development, cf. Page/Schirr (2008), p. 239.

M. Sattler, *Excellence in Innovation Management,* DOI 10.1007/978-3-8349-6158-7_4,

Distinguishing features. To ensure a focused search for eligible studies, the decision was made to examine only studies that analyzed success on a firm or program level.[361] Moreover, only associations that measure financial success with either an objective[362] or a subjective[363] construct will be included in the meta-analysis.[364] Finally, the studies should have been done in the context of innovation management. Therefore, either financial success directly refers to innovations or the independent variables are defined and operationalized in the context under study.

Research respondents (informant). No restrictions in the types of respondent were defined; however, the industry, region and hierarchical level of respondents are included as possible elements for moderating factors in the coding scheme. A restriction on types of respondents was not necessary because the definition of distinguishing features and the research method restricted the respondents.

Key variables. The definition of key variables was kept open to allow for a broad identification of possible success factors in the step of identifying studies during the literature search. However, the variables must be linked to innovation management.

Research method. To ensure comparability of the different studies included in the analysis, the focus was narrowed to studies with an empirical survey design. To avoid a too-narrow sample of studies, further methodological restrictions were not made. However, methodological differences like multiple vs. single informants or multiple vs. single items will be reported in the coding scheme to account for possible moderator factors.

Cultural and linguistic range. Since innovation management is a global phenomenon and is relevant to all companies of any size in all parts of the world, no cultural restrictions were defined. However, the region in which the survey was conducted will be reported in the coding scheme since it may have a moderating influence on the reported effect sizes. No linguistic restrictions were added.

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[361] This criterion was chosen to answer the research question, which focuses on the macro or the firm level. This choice is in contrast to studies that analyze success factors on the project level. For details, cf. Cooper/Kleinschmidt (1995), pp. 375f., Johne/Snelson (1988), p. 116, and section 2.2.

[362] Objective measures like new sales, new profit through innovations, ROI, sales growth, profit growth and so forth have been used. Cf., for example, Sandvik/Sandvik (2003), Ittner/Larcker (1997), or Pelham/Wilson (1996).

[363] Subjective measures like relative market share growth in comparison to competitors, firms' perceived new product financial performance, satisfaction with new product performance, and so forth have been used; cf., for example, Bart/Pujari (2007), Im et al. (2003), or Moorman/Rust (1999).

[364] Based on the analysis of common measures of success in new product development by Griffin/Page (1993); see also the detailed discussion of financial innovation performance in section 2.2.1.

Time frame. The publication time frame is limited to before September 2007 because the literature search was finalized at that time.

Publication type. In line with other meta-analyses in the context of innovation management, the focus of the literature search is on published and unpublished articles only.[365] Books were excluded because, in most cases, the studies imprinted in books are published in similar form as articles.

After the characteristics for eligible studies were identified (Table 4-1), the next step was to search for those studies in the literature databases and journals.

Characteristic categories	**Specification for eligible studies defined for the meta-analysis**
Form of research findings in studies	Correlations or measures transformable to correlations.
Distinguishing features	1. Financial success at the firm level. 2a. Either financial success refer directly to innovation or 2b. Success factors in the study refer to innovation management on the firm level.
Research respondents	No restrictions
Key variables	No restrictions, but variables must to be linked to innovation management.
Research method	Empirical survey design only
Cultural and linguistic range	No restrictions
Time frame	No restrictions
Publication type	Published or unpublished articles

Table 4-1: Characteristics of eligible studies for the meta-analysis

[365] Cf. the meta-analysis of Damanpour (1991), Montoya-Weiss/Calantone (1994), or Henard/Szymanski (2001).

4.1.2 The tide of identification

The literature search was conducted in three steps. The first step was the search for appropriate journals. Based on the VHB sub-ranking for innovation management from 2003[366] and based on discussions with affiliated researchers in innovation management, a list of journals was compiled covering all journals in which studies on innovation management practices and firm financial innovation performance are most likely to be published.[367] The electronic database Business Source Complete (BSC), which covers more than 1,200 business related, peer-reviewed journals, was the primary source used in the search.[368]

The three most obvious keywords, *innovat**, *product development* and *new product*, were applied sequentially in the BSC search interface for each selected journal, and the abstracts of the resulting studies were scanned for adequacy. In cases in which the journal was not covered or not completely covered by BSC, the internet page of the respective journal was used for a scan through the table of contents of each issue.[369] In a second step, a general keyword search using the same keywords as in the search on the journal level was performed on the BSC database[370] and the SSRN Electronic Library,[371] the latter which include over 200,000 abstracts of forthcoming and working papers, for relevant papers. In the third step, the references from the studies obtained from the first two steps were examined for additional eligible studies.[372]

Table 4-2 shows the results of the search procedure. In total, 75 published studies from 26 different journals fit the defined study characteristics. However, 80 percent of the identified studies were published in one of 11 journals—largely innovation management and marketing journals. Most of the studies were identified from the leading journal for innovation management, *Journal of Product Innovation Management* (*JPIM*).

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[366] For details about the VHB Jourqual 1 Ranking from 2003, see http://pbwi2www.uni-paderborn.de/WWW/VHB/VHB-Online.nsf/id/DE_Ergebnisse_von_Jourqual_1_aus_dem_Jahre_2003 (retrieved 7 April 2009).

[367] The journals on the list were: *Academy of Management Journal, Journal of the Academy of Marketing, Journal of Marketing, Journal of Marketing Research, Journal of Product Innovation Management, Management Science, Marketing Science, Journal of International Marketing, R&D Management, Organization Science, Strategic Management Journal, Journal of Small Business Management, IEEE Transactions on Engineering Management* and *Journal of Business Venturing.*

[368] Business Source Complete is the world's leading database for academic research; it exceeds all other databases in terms of business-related journals. For more details on Business Source Complete, see http://www.ebscohost.com/thisTopic.php?marketID=1&topicID=399 (retrieved7[t] April 2009).

[369] E.g., for research policy or R&D management.

[370] In the second step, all journals searched during the first search steps were excluded through the respective operators in the BSC database.

[371] The SSRN eLibrary is the leading database providing access to unpublished papers. For more details, see http://www.ssrn.com (retrieved 7 april 2009).

[372] Appendix (1) provides an overview of the structure of the databases used (Tables 8-1 and 8-2) during the literature search.

Journal	Research domain	Rating (Jourqual 1)	Number of studies identified	Percentage of total studies identified
Journal of Product Innovation Management	Innovation Management	B	22	29.3%
Journal of Marketing	Marketing	A+	12	16.0%
R&D Management	Innovation Management	B	8	10.7%
Journal of the Academy of Marketing Science	Marketing	A	4	5.3%
Academy of Management Journal	General Management	A+	2	2.7%
International Journal of Research in Marketing	Marketing	A	2	2.7%
International Journal of Technology Management	Innovation Management	C	2	2.7%
Journal of International Marketing	Marketing	A	2	2.7%
Journal of Small Business Management	Innovation Management	C	2	2.7%
Management Science	General Management	A+	2	2.7%
Research Policy	Innovation Management	B	2	2.7%
Others*			15	20.0%
Total			**75**	**100.0%**

* One study was identified in each of the following journals:
Entrepreneurship: Theory & Practice, European Journal of Marketing, IEEE Transactions on Engineering Management, Industrial Marketing Management, International Marketing Review, Journal of Business Venturing, Journal of International Business Studies, Journal of Management Studies, Journal of Marketing Management, Journal of Marketing Research, Journal of Marketing Theory & Practice, Journal of Strategic Marketing, Journal of World Business, Long Range Planning, Strategic Management Journal.

Table 4-2: Result of search for eligible studies

A complete list of all studies identified is in appendix (2).[373] The publication dates of the studies identified range from 1990-2007, a result that was not unexpected since the first seminal empirical work on success factors in innovation management on a firm level was published (by Cooper and Kleinschmidt) in 1995.[374]

After the eligible studies were identified, the next step of the meta-analysis involved coding the studies to aggregate similar effects sizes. However, before detailed coding could begin, a conceptual framework was necessary to serve as a guide in the coding process and to structure the success factors of the individual studies. This framework is developed in the next section.

4.1.3 Conceptual framework for structuring the success factors in innovation management

In innovation management, there is no theory-based model of all determinants of innovation success.[375] However, as section 2.2.2 discussed, the factors analyzed in combination with innovation performance are both broad and numerous, so a framework is needed to arrange the variables reported in the literature into an easily accessible structure that can guide the coding process of the meta-analysis. Several suggestions have been made by innovation researchers

[373] See Tables 8-3 and 8-4 in Appendix (2).
[374] Cf. Cooper/Kleinschmidt (1995).
[375] Cf. Ernst (2002), p. 2 and Hauschildt (1993), p. 320.

for categorizing the diverse success factors identified in single studies, including reviewing articles to arrange the factors in frameworks or models for a structured overview of what has been done in the field.[376] However, none of the frameworks suggested cover all factors identified by the present work. Therefore, based on a review of the proposed models, a four-category framework was developed that combines the different models into one overarching framework. Table 4-2 provides an overview of the categories identified in the reviews and their links to the four categories proposed in this dissertation: strategic attributes, innovation process characteristics, organization and culture, and environmental characteristics.

[376] For example, see the publications of Smith et al. (2008), Adams et al. (2006), Burgelman et al. (2004), Cormican/O'Sullivan (2004), Verhaeghe/Kfir (2002), Henard/Szymanski (2001), Goffin/Pfeiffer (1999), Chiesa et al. (1996), Cooper/Kleinschmidt (1995), and Montoya-Weiss/Calantone (1994).

Integrating categories	Smith et. al. (2008)	Adams at. al. (2006)	Burgelman et. al. (2004)	Cormican/ O'Sullivan (2004)	Verhaeghe/Kfir (2002)	Henard/ Szymanski (2001)	Goffin/Pfeiffer (1999)	Chiesa et. al (1996)	Cooper/ Kleinschmidt (1995)	Montoya-Weiss/ Calantone (1994)
Strategic attributes	Corporate strategy Resources	Strategy Portfolio management Inputs	Strategic management Resource availability	Strategy and leadership		Firm strategy characteristics	Innovation strategy Portfolio management	Resource provision	NPD strategy	Strategic factors
Innovation process characteristics	Innovation process Technology Knowledge management	Knowledge management Project management Commer-cialization	Understanding of relevant technological developments and competitor strategies	Planning and selection Communication and collaboration Structure and performance	Idea generation Technology acquisition Networking Development Commer-cialization	Firm process characteristics	Creativity and human resources Project management	System and tools	NPD process	Development process factors
Organization and Culture	Management style Leadership Employees Organizational structure	Organization and culture	Structural and cultural context of the organization	Culture and climate				Leadership	Organizational culture Management commitment	Organizational factors
Environmental characteristics						Marketplace characteristics				Market environment factors

Table 4-3: Innovation management models and integrating categories[377]

[377] Adapted from Adams et al. (2006), p. 25

The four categories were discussed with innovation researchers to ensure the categories' appropriateness and completeness. A first definition of all four categories was developed to help the coders to arrange the identified constructs into the correct category. A very narrow description of the categories was avoided to allow a broad number of factors to be included. This categorization should serve only as a rough guideline for the coding process and should be reasonable and easily accessible from an educative and practical point of view, so the objective was not to offer a final framework for determinants of innovation success.[378]

Strategic attributes. This category includes all factors that describe to what degree the firm's organization is aligned with the strategic objective to be innovative.

Innovation process characteristics. This category contains all variables that are directly connected with the innovation process.

Organization and culture. The elements captured in this category are all associated with the organizational set-up and the cultural and behavioral characteristics of the firm.

Environmental characteristics. The factors in this category describe the characteristics of the market in which the firm acts but on which it has no direct influence.

The categorization framework was integrated into the coding scheme in order to analyze each eligible study in detail. The next section describes the process of analysis and the outcome.

[378] This approach is in line with the approach of other meta-analysis that developed a framework to guide the coding process and structure the analysis, e.g., cf. Song et al. (2008); Henard/Szymanski (2001); or Palmatier et al. (2006).

4.2 Coding of studies: Identification of success factors in single studies

The following sections deal with the process of coding the identified studies. First, the coding scheme and the coding approach are described and the results are shown in an overview. The subsequent section details the hypothesized effect of the success factors from the single studies on financial innovation performance.

4.2.1 Coding scheme and approach for identification of success factors

In addition to the framework for the classification of success factors, a coding scheme was built to ensure an accurate and structured coding procedure.[379] This coding scheme did not include any predefined constructs as independent variables because the objective of the work was to report all factors that may influence the success of innovation management.[380] Apart from the constructs and effect sizes also contextual and methodological study characteristics were included.[381] Thereby, the focus was on information that may explain differences in the studies and that could serve as moderators in the further aggregation of effect sizes. Consequently, information about the methodology used to set up the survey and about the execution of the survey was coded. The context of each study was also part of the coding scheme.

The coding scheme was structured in seven parts:[382]

1. General study and coding information - The general information about the study, like the title of the study, authors or publication, and about the coding process, like the name of the coder or the reason the paper was rejected from the meta-analysis.

2. Study context parameters- All data about the context in which the study was carried out, e.g., information about the industry, region, and size of the companies in the sample, or type of innovation.

3. Theoretical backgrounds of study - The theories used by the studies' authors to derive the hypotheses to be analyzed in the study.

[379] The coding scheme was discussed with adjacent researchers to ensure complete coverage of the important data for the meta-analysis and to adjust for practicability.
[380] Cf. Hunter/Schmidt (2004), p. 470, and see the discussion in section 3.3.2.1.
[381] In line with the suggestion of Glass et al. (1981), p. 77.
[382] The complete coding scheme is shown in Table 8-5 in Appendix (3).

4. Survey design information - information on how the authors set up the survey design used and how the reliability and validity of the used constructs was tested.

5. Survey execution information - All data about how the survey was conducted, e.g., level of analysis object, management level of respondent, sample size.

6. General information about effect sizes - general information about the effect sizes that is valid for all effect sizes in the study, e.g., type of effect size and missing information about the effect size.

7. Specific information about effect size - specific information about each effect size reported, e.g., all data about the dependent and independent variable, like definition of constructs used and values for mean, standard deviation, reliability measures, and effect size. This part is filled in several times by the coder, depending on the number of effect sizes in the study.

Differences in the coding scheme from the suggested categories defined in the previous chapters[383] are related primarily to the practical need to ease the transfer of the data into the electronic database later. In terms of content, all three suggested information categories—study descriptor, coding process and information about effect size—are included in the scheme.

After finalization of the coding scheme, the coding process was started. All articles were read and analyzed in detail, and the information relevant to coding was copied directly into the coding scheme. Since the coding scheme included only numerical or directly quoted information from the respective journals, no coders other than the author were needed;[384] in this step, no judgments by the coder were made because all scales reported in the primary studies were copied directly. This procedure was chosen to guarantee that dissimilar effects would not be combined inappropriately and that conceptually similar variables[385] would not be left as separated in the following judgment-based coding. [386]
Subsequent to the first coding step, which included identifying missing information, the authors of the respective studies were contacted via e-mail to help fill in the missing information. In most cases, the correlation matrix or relevant parts of it were not published in the articles;[387] missing information is a common problem for meta-analysts that often leads to the exclusion of otherwise eligible studies from the meta-analysis.[388] After responses were re-

[383] See section 3.3.2.2.
[384] Cf. Stock (1994), p. 129.
[385] Authors of single studies often use slightly different denotations for variables, but they refer to the same constructs.
[386] In line with the approach taken by Henard/Szymanski (2001), p. 363.
[387] Cf., for example, De Brentani/Kleinschmidt (2004), Nicholson et al. (1990), or Gemuenden et al. (1992).
[388] Cf. Hunter/Schmidt (2004), p. 473.

ceived from the authors contacted, 18 studies had to be excluded, primarily because the authors said they could not find the data because it was too old. Others mentioned confidentially, and a few did not respond even after a reminder e-mail was sent. Six studies were excluded because their authors published more than one article using the same sample and similar constructs,[389] although two such studies were retained, even though the same sample was used twice, because different constructs have been reported.[390]

Four additional coders with innovation backgrounds were used to code the judgment-based aggregation of effect sizes. These coders were trained, as suggested by Lipsey and Wilson,[391] through an explanation of the framework categories and an elucidation of the constructs identified by the author in the first step of the coding process. Each of the four coders analyzed the different constructs and suggested which variables should be aggregated because of conceptual similarity and to which framework categories the variables belonged. After analyzing the suggested aggregations and framework categories, an inter-coder agreement of 98 percent was reached; then the remaining discrepancies were resolved via discussions.[392]

After coding, 23 success factors and six methodological and context-specific moderators were placed in the framework categories, as shown in Table 4-4. The factors stemmed from 45 studies, with 47 samples and 277 effect sizes. They represent more than 11,000 individual observations with study sample sizes ranging from 48 to 1,360.[393] The inclusion rate of 60 percent of the identified studies is in line with other meta-analyses in management and marketing research.[394]

The next section defines all 23 factors and explains the hypotheses concerning their effects on innovation performance.

[389] For details see Table 8-4 in Appendix (2).
[390] The studies of Bart/Pujari (2007) and Bart (2002).
[391] Cf. Lipsey/Wilson (2001), p. 88.
[392] See also the similar process undertaken by Geyskens et al. (2006), who also split coding into two steps: numerical coding first and judgment-based coding second.
[393] Another six studies have been excluded because the reported effect sizes were unique or were reported fewer than 3 times (e.g., the constructs *proficiency in portfolio management* or *use of new-to-the firm products*). This choice is in line with the approach taken by Song et al. (2008), p. 13. All details about the studies included and effect sizes can be found in Table 8-4 in Appendix (2).
[394] Cf. Troy et al. (2008), p. 134; Song et al. (2008), p. 10; or Henard/Szymanski (2001), p. 363. The number of studies included exceeds the number of studies included in other work in the area of marketing research; cf. Troy et al. (2008), p. 134.

Success factors from single studies	
Strategic attributes	
F1	Explicit innovation strategy
F2	New-to-the-market products
F3	Provision of resources
Innovation process characteristics	
F4	Formal product development process
F5	Proficiency in product development process
F6	Reduced cycle time
F7	Customer input
F8	Competitor intelligence
F9	Cross-functional coordination
F10	Explicit knowledge management
F11	External networks
F12	Available knowledge in workforce
Organization and culture	
F13	Market orientation
F14	Innovation orientation
F15	Learning orientation
F16	Absorptive capacity
F17	Top management support
F18	Formalization
F19	Decentralization
F20	Firm size
Environmental characteristics	
F21	Market dynamism
F22	Technological uncertainty
F23	Competitive intensity

Moderators	
Context specific moderators	
M1	Innovation focus
M2	Region
Methodological moderators	
M3	Level of management
M4	Single informant bias
M5	Data type of performance construct
M6	Items used to measure performance construct

Table 4-4: Overview of success factors from single studies and moderators

4.2.2 Hypothesis on the impact of the success factors identified from single studies

This section describes the effect of each success factor identified among the individual studies. The descriptions are based primarily on primary studies and other publications that deal with a specific factor and have been discussed with the coders before being aggregated into the constructs from the eligible studies.[395] The section does not include a detailed discussion of a specific theory-based background that guides the relationship between the specific factors and the performance construct because, as Song et al. explained in their meta-analysis (2008), there are only two types of meta-analytic studies, each of which can be distinguished by its general analysis focus. The first kind of meta-analytic study focuses on a relationship between two variables or the change in a single variable across different respondent groups. The se-

[395]Thus, the description will be kept short and will reflect only the main effect hypothesized by the respective articles. For details, see the references in the description of each factor.

cond one examines a large number of variables related to one focal construct, like *financial innovation performance*. The former type is strongly guided by one or two theories, but the second integrates all of the existing research on that specific construct and is "largely atheoretical because the research it combines rests on heterogeneous theoretical backgrounds."[396]

The aim of the present meta-analysis is to understand the influence of all success factors that relate to financial innovation performance. As a result, the identified studies do not share one central innovation theory background; instead, they use different theoretical streams[397] or practical experience[398] to argue for the effect of several factors on that construct. Hence, the present meta-analysis is of the second type described by Song et al. and has no central theory explaining the inclusion of different factors.[399]

The structure of this section follows the categories of the framework and closes with the moderators in the final sub-section.

4.2.2.1 Strategic attributes

Three *strategic attributes* were identified during the coding process. In the following, the factors *explicit innovation strategy*, *new-to-the-market products*, and *provision of resources* are detailed.

Explicit innovation strategy. A firm's innovation strategy defines the role of innovation management in the company's overall strategy.[400] Cooper (1993) defined the innovation strategy or product innovation charter as the "master plan," which is "an overarching construct that influences every stage of the new-product process."[401] In this context, the focus areas for new products and markets are defined, the organizational setup for implementation is formalized,[402] and goals for the overall company and new products are specified.[403] Furthermore, having an explicit innovation strategy allows management to plan how to dedicate resources to specific innovation projects.[404] An explicit innovation strategy incorporated in the firm

[396] Song et al. (2008), p. 9.
[397] For example, cf. Belderbos et al. (2004), who based the factors on the organization theory; or Kleinschmidt et al. (2007), who used the resource-based view as underlying theory.
[398] Cf. Ittner/Larcker (1997) or Langerak/Hultink (2005).
[399] This approach is in line with all other meta-analyses in an adjacent innovation context; cf. Pattikawa et al. (2006), Henard/Szymanski (2001), or Montoya-Weiss/Calantone (1994).
[400] Cf. Bart/Pujari (2007), p. 5; Li/Atuahene-Gima (2001b), p. 1124; Hegarty/Hoffman (1990), p. 187.
[401] Cooper (1993), p. 287.
[402] Cf. Ettlie et al. (1984), p. 684.
[403] Cf. Bobrow (1994), p. E10.
[404] Cf. Gupta/Wilemon (1990), p. 285.

strategy should have an overall positive influence on financial innovation performance.[405] As shown in Table 4-5, 23 effect sizes and a total sample size of 3,018 respondents were used in the meta-analysis. The effect sizes range from .01 to .47, which documents the conflicting results and supports the need for a meta-analysis.

Success factor	Direction of hypothesized effect on financial innovation performance	Range of effect sizes in identified studies		Number of effect sizes identified	Total sample size
		min.	max.		
Explicit innovation strategy	+	.01	.47	23	3,018

Table 4-5: Effect details - Explicit innovation strategy

New-to-the-market products. New-to-the-market products are innovations that are totally new to the market and industry, so this construct refers to the degree of that newness. Some authors also refer to this kind of innovation as new-to-the-world[406] or radical products.[407] In comparison, new-to-the-firm products or incremental products are innovations that are new in the product portfolio of the firm but that already exist in the industry and market. These products are often improvements of existing products in the firm or imitations of products that are in the market.[408] A positive influence on financial innovation performance is expected from new-to-the-market products. As shown in Table 4-6, five effect sizes and a total sample size of 1,445 respondents are used in the meta-analysis. The effect sizes range from .03 to .24, documenting the conflicting results and supporting the need for a meta-analysis.

Success factor	Direction of hypothesized effect on financial innovation performance	Range of effect sizes in identified studies		Number of effect sizes identified	Total sample size
		min.	max.		
New-to-the-market products	+	.03	.24	5	1,445

Table 4-6: Effect details - New-to-the-market products

Provision of resources. Resources are assets or inputs that are owned, controlled, and accessed by the firm[409] and that enable the firm to develop new products in an efficient and effective process.[410] Resources might be tangible—like employees, funds, or machinery—or

[405] Cf. Yam et al. (2004), p. 1135; Bart (2002), p. 25; or Pelham/Wilson (1996), pp. 29ff.
[406] Cf. Olson et al. (1995), p. 52.
[407] Cf. De Brentani (2001), pp. 170f. or Atuahene-Gima (1995), p. 279.
[408] Cf. Sandvik/Sandvik (2003), p. 357 or Danneels/Kleinschmidt (2001), pp. 358f.; in this meta-analysis, only the innovation category *new-to-the-market* was included because there were not enough studies available using the *new-to-the-firm* construct linked to financial innovation performance.
[409] Cf. Helfat/Peteraf (2003), p. 348.
[410] Cf. Hunt (1997b), p. 60.

intangible—like an organizational resource that is based on experience and developed over time.[411] In the resource-based view, the provision of sufficient resources to critical problems and tasks is an essential capability of the senior management of a firm.[412] Consequently, the effect of resource provision on innovation performance has been identified by several studies as positive.[413] As shown in Table 4-7, five effect sizes and a total sample size of 1,196 respondents are used in the meta-analysis. The effect sizes range from .20 to .41, which indicates the possible size of the effect of this success factor.

Success factor	Direction of hypothesized effect on financial innovation performance	Range of effect sizes in identified studies		Number of effect sizes identified	Total sample size
		min.	max.		
Provision of resources	+	.20	.41	5	1,196

Table 4-7: Effect details - Provision of resources

4.2.2.2 Innovation process characteristics

The *innovation process* is characterized by input and organizational elements. The factors of *formal product development process, proficiency in product development process, reduced cycle time, customer input, competitor intelligence, cross-functional coordination, explicit knowledge management, external networks*, and *available knowledge in workforce* are described in the following paragraphs.

Formal product development process. A formal product development process, which is mostly a stage-gate-like system, refers to a conceptual and operational model for moving product development from idea to launch. The use of this formal system helps firms improve the efficiency and effectiveness of innovation management.[414] Several studies have hypothesized and demonstrated the positive effect of such a formal process on innovation financial performance.[415] As shown in Table 4-8, four effect sizes and a total sample size of 871 respondents are used in the meta-analysis. The effect sizes range from .12 to .42, which indicates the possible size of the effect of this success factor.

[411] Cf. Wernerfelt (1984), p.173.
[412] Cf. Helfat/Peteraf (2003), p. 348.
[413] Cf. Swink (2000), p. 211 or Cooper/Kleinschmidt (1995), p. 389.
[414] Cf. Cooper/Kleinschmidt (1991), p. 137; see also figure 2-2 in section 2.1.1.2 for details.
[415] Cf. Kleinschmidt et al. (2007), p. 425; Bonner et al. (2002), p. 237; and Cooper/Kleinschmidt (1995), p. 377.

Success factor	Direction of hypothesized effect on financial innovation performance	Range of effect sizes in identified studies		Number of effect sizes identified	Total sample size
		min.	max.		
Formal product development process	+	.12	.42	4	871

Table 4-8: Effect details - Formal product development process

Proficiency in product development process. In addition to the availability of a formal product development process, mastery in the use of these process activities is another factor critical to innovation management.[416] The activities in the product development process range from a first idea to development to commercialization and launch.[417] Proficiency in the product development process is expected to have a positive influence on financial innovation performance. As shown in Table 4-9, 13 effect sizes and a total sample size of 1,103 respondents are used in the meta-analysis. The effect sizes range from .23 to .55, indicating the importance of this factor.

Success factor	Direction of hypothesized effect on financial innovation performance	Range of effect sizes in identified studies		Number of effect sizes identified	Total sample size
		min.	max.		
Proficiency in product development process	+	.23	.55	14	1,491

Table 4-9: Effect details - Proficiency in product development process

Reduced cycle time. Cycle time refers to the time required to move an innovation from idea to launch.[418] Several activities, such as use of IT tools and reduction in the number of parts and components to reduce the cycle time have been identified by different authors.[419] In general, a positive effect of a reduction of the cycle time on performance is expected, but some studies also measured a negative effect, as shown in Table 4-10. A total of twelve effect sizes and a total sample size of 2,315 are used in the meta-analysis. The effect sizes range from -.09 to .44, documenting the conflicting results and supporting the need for the meta-analysis.

[416] Cf. Im et al. (2003), p. 92; Song/Parry (1997), p. 66; and Calantone et al. (1995), p. 215.
[417] Cf. Cooper (2008), p. 215.
[418] Cf. Ittner/Larcker (1997), p. 15 or Calantone et al. (1995), p. 216.
[419] Cf. Langerak/Hultink (2005), p. 30 or Calantone et al. (2003), p. 95.

Success factor	Direction of hypothesized effect on financial innovation performance	Range of effect sizes in identified studies		Number of effect sizes identified	Total sample size
		min.	max.		
Reduced Cycle Time	+	-.09	.44	12	2,316

Table 4-10: Effect details - Reduced Cycle Time

Customer input. This factor refers to the inclusion of customer experiences and preferences in the product development process.[420] A common practice is the involvement of specific lead users into the process.[421] This firm capability, often described as responsiveness to the expressed and unexpressed needs of current and potential customers, is expected to have a positive effect on innovation performance.[422] However, as shown in Table 4-11, the sizes of the effects from the identified studies range from -.24 to .50, indicating that the empirical studies could not always demonstrate the positive hypothesis and supporting the need for the meta-analysis. In total 20 effect sizes and a sample size of 4,657 respondents are used in the meta-analysis.

Success factor	Direction of hypothesized effect on financial innovation performance	Range of effect sizes in identified studies		Number of effect sizes identified	Total sample size
		min.	max.		
Customer input	+	-.24	.50	20	4,657

Table 4-11: Effect details - Customer input

Competitor intelligence. Competitor intelligence is the firm's ability to integrate information about competitors' goals, strategies, offerings, resources, and capabilities into product development activities.[423] Firms place high priority on a detailed assessment of existing and potential competitors.[424] A positive influence is expected from this factor on financial innovation performance.[425] However, as shown in Table 4-12, the effect sizes from the identified studies range from -.22 to .38 and, like the studies on customer input, these studies could not always support a positive hypothesis regarding the impact of customer input. This issue also supports the need for a meta-analysis. In total, ten effect sizes and 1,448 respondents are used in the meta-analysis.

[420] Cf. Belderbos et al. (2004), p. 1489; or Voss/Voss (2000), p. 67
[421] Cf. Langerak/Hultink (2005), p. 31
[422] Cf. Deshpandé et al. (1993), pp. 27 f. and Narver/Slater (1990), p. 21.
[423] Cf. Voss/Voss (2000), p. 67 or Narver/Slater (1990), pp. 21f.
[424] Cf. Olson et al. (1995), p. 52.
[425] Cf. Slater et al. (2007), p. 8 or Voss/Voss (2000), p. 70.

Success factor	Direction of hypothesized effect on financial innovation performance	Range of effect sizes in identified studies		Number of effect sizes identified	Total sample size
		min.	max.		
Competitor intelligence	+	-.22	.38	10	1,448

Table 4-12: Effect details - Competitor intelligence

Cross-functional coordination. Cross-functional coordination refers to the coordinated utilization of company functions like marketing, research and development, and manufacturing in the innovation process.[426] Cross-functional participation on development teams, in particular, has been seen as improving the efficiency and effectiveness of the development process.[427] Other studies also expected a positive influence on innovation financial performance.[428] As shown in Table 4-13, 20 effect sizes ranging from .08 to .47 and a total sample size of 3,016 respondents are used in the meta-analysis.

Success factor	Direction of hypothesized effect on financial innovation performance	Range of effect sizes in identified studies		Number of effect sizes identified	Total sample size
		min.	max.		
Cross-functional coordination	+	.08	.47	20	3,016

Table 4-13: Effect details - Cross-functional coordination

Explicit knowledge management. Several authors have reported on the importance of integrating knowledge into the new product development process.[429] However, such integration efforts must be managed actively, which management is described by the factor *explicit innovation management*. The consolidation of existing knowledge with newly created or externally accessed knowledge is the central task of knowledge management. Existing knowledge from past innovations needs to be transferred into new product developments, but new knowledge needs to be created as well. [430] Indeed, this effort is a central capability in the innovation process[431]. Thus, the effect of explicit knowledge management is hypothesized to be positive. As shown in Table 4-14, four effect sizes and a total sample size of 600 respondents are used in the meta-analysis. The effect sizes range from .31 to .49, emphasizing the importance of this factor.

[426] Cf. Song/Jinhong (2000), p. 64 and Narver/Slater (1990), p. 22.
[427] Cf. Ittner/Larcker (1997), p.14.
[428] Cf. Voss/Voss (2000), p. 71; Griffin/Hauser (1996), p. 193; or Cooper/Kleinschmidt (1995), p. 377.
[429] Cf. Danneels (2002), pp. 1103f. and Dougherty (1992b), p. 78.
[430] Cf. Marsh/Stock (2006), p. 424.
[431] Cf. Marsh/Stock (2006), p. 423.

Success factor	Direction of hypothesized effect on financial innovation performance	Range of effect sizes in identified studies		Number of effect sizes identified	Total sample size
		min.	max.		
Explicit knowledge management	+	.31	.49	4	600

Table 4-14: Effect details - Explicit knowledge management

External networks. External networks or co-operative arrangements are important to firms' ability to gain access to external knowledge about resources and capabilities,[432] but sharing risks and costs in an uncertain development environment also fosters external networks.[433] Partners in those external networks are competitors, universities, suppliers and so forth.[434] The effect of external networks on financial innovation performance is expected to be positive,[435] but this hypothesized effect was not always found by the identified studies, as shown in Table 4-15. The effect sizes range from -.11 to .26, which supports the need for a meta-analysis. In total, eleven effect sizes and a sample size of 5,770 respondents are included in the meta-analysis.

Success factor	Direction of hypothesized effect on financial innovation performance	Range of effect sizes in identified studies		Number of effect sizes identified	Total sample size
		min.	max.		
External networks	+	-.11	.26	11	5,770

Table 4-15: Effect details - External networks

Available knowledge in workforce. This factor refers to the innovation experience of the members of the product development teams. The ability of the employees to conceptualize, formulate, develop, and commercialize a new product is essential in this context.[436] This factor is expected to have a positive influence on financial innovation performance. As shown in Table 4-16, five effect sizes and a total sample size of 762 respondents are used in the meta-analysis. The effect sizes range from .20 to .53, emphasizing the importance of this factor.

[432] Cf. Wirtz et al. (2007), p. 301.
[433] Cf. Belderbos et al. (2004), p. 1479.
[434] Cf. Chang (2003), p. 428.
[435] Cf. Belderbos et al. (2004), p. 1480 and Li/Atuahene-Gima (2001b), p. 1126.
[436] Cf. Im et al. (2003) p. 85; and Cooper/Kleinschmidt (1995), p. 377.

Success factor	Direction of hypothesized effect on financial innovation performance	Range of effect sizes in identified studies		Number of effect sizes identified	Total sample size
		min.	max.		
Available knowledge in workforce	+	.20	.53	5	762

Table 4-16: Effect details - Available knowledge in workforce

4.2.2.3 Organization and culture

The category of *organization and culture* is comprised of all factors related to structure and behavior: *market orientation, innovation orientation, learning orientation, absorptive capacity, top management support, formalization, decentralization*, and *firm size*.

Market orientation. Market orientation is "the set of cross-functional processes and activities directed at creating and satisfying customers through continuous needs assessment."[437] Market orientation is often seen as a "value-based strategic philosophy manifesting itself in behaviors designed to keep the firm close to the customer."[438] In the context of innovation management, market orientation helps the firm keep the development process focused on the needs of current and potential customers by having superior information-gathering and information-processing capabilities, by being more involved in close and effective cross-functional cooperation, and by being more sophisticated in dealing with uncertainty in the marketplace.[439] Consequently, the hypothesized effect of market orientation on financial innovation performance is positive. However, the hypothesized effect was not always found in the identified studies, as shown in Table 4-17; the effect sizes range from -.07 to .72, which supports the need for the meta-analysis. A total of 46 effect sizes and a sample size of 9,924 respondents are included in the meta-analysis.

Success factor	Direction of hypothesized effect on financial innovation performance	Range of effect sizes in identified studies		Number of effect sizes identified	Total sample size
		min.	max.		
Market orientation	+	-.07	.72	46	9,924

Table 4-17: Effect details - Market orientation

[437] Deshpandé/Farley (1998), p. 213. This definition is in line with the works of Kohli/Jaworski (1990) and Narver/Slater (1990).
[438] Baker/Sinkula (2005), p. 484; see also the statements of Han et al. (1998), p. 31.
[439] Cf. Wei/Morgan (2004), p. 378.

Innovation orientation. Innovation orientation refers to the degree to which the culture of a firm is open to innovation by allowing new ideas and pursuing them proactively.[440] Innovation orientation fosters a spirit of creativity and experimentation in developing and introducing new processes and products.[441] Consequently, the effect of innovation orientation on financial innovation performance has been shown to be positive in several studies.[442] As shown in Table 4-18, 13 effect sizes and a total sample size of 2,697 respondents are used in the meta-analysis. The effect sizes range from .20 to .52, emphasizing the importance of this factor.

Success factor	Direction of hypothesized effect on financial innovation performance	Range of effect sizes in identified studies		Number of effect sizes identified	Total sample size
		min.	max.		
Innovation orientation	+	.20	.52	13	2,697

Table 4-18: Effect details - Innovation orientation

Learning orientation. An organization with a learning orientation emphasizes the importance of developing new skills, enjoying learning, being curious about new ways to enhance performance, having a preference for challenging work, and reflecting critically on the assumptions of the organization.[443] Thus, a learning orientation is "the manifestation of the organization's propensity to learn and adapt accordingly."[444] In product development, a culture of learning orientation affects organizational members' mindsets by encouraging and even requiring them to "think outside the box."[445] Consequently, the effect of learning orientation on financial innovation performance is expected to be positive.[446] However, as documented in Table 4-19, the range of identified effect sizes in the eligible studies is broad, varying from -.01 to .50. In total, twelve effect sizes and a sample size of 4,005 respondents are used in the meta-analysis.

Success factor	Direction of hypothesized effect on financial innovation performance	Range of effect sizes in identified studies		Number of effect sizes identified	Total sample size
		min.	max.		
Learning orientation	+	-.01	.50	12	4,005

Table 4-19: Effect details - Learning orientation

[440] Cf. Olson et al. (2005), p. 52; Hurley/Hult (1998), p. 44; and O'Reilly/Rao (1997), p. 60.
[441] Cf. Lumpkin/Dess (2001), p. 431.
[442] Cf. Cooper/Kleinschmidt (1995), p. 377.
[443] Cf. Atuahene-Gima et al. (2005), p. 469.
[444] Mavondo et al. (2005), p. 1237.
[445] Cf. Baker/Sinkula (1999), p. 413.
[446] Cf. Slater/Narver (1995), p. 66.

Absorptive capacity. This factor refers to the ability of the firm to value, assimilate, and apply new knowledge in new product development activities.[447] The extent to which a firm invests in R&D is the measure for its level of absorptive capacity.[448] The relationship between absorptive capacity and financial innovation performance is expected to be positive.[449] As shown in Table 4-20, four effect sizes and a total sample size of 274 respondents are used in the meta-analysis. The identified effect sizes range from .24 to .40.

Success factor	Direction of hypothesized effect on financial innovation performance	Range of effect sizes in identified studies		Number of effect sizes identified	Total sample size
		min.	max.		
Absorptive capacity	+	.24	.40	4	274

Table 4-20: Effect details - Absorptive capacity

Top management support. The commitment of a firm to its strategic efforts, like innovation management, can be measured by the level of top management support. The characteristics of top management support include visioning to guide the new product development, championing innovation efforts during critical phases, participating directly in day-to-innovation activities or indirectly as project reviewers, sponsoring high-risk ventures, and interacting with strategic customers.[450] The effect of top management support on financial innovation performance is expected to be positive.[451] As shown in Table 4-21, six effect sizes and a total sample size of 1,321 respondents are used in the meta-analysis. The identified effect sizes range from .16 to .33.

Success factor	Direction of hypothesized effect on financial innovation performance	Range of effect sizes in identified studies		Number of effect sizes identified	Total sample size
		min.	max.		
Top management support	+	.16	.33	6	1,321

Table 4-21: Effect details - Top management support

Formalization. This structural factor of an organization measures the degree to which "activities and relationships are governed by rules, procedures and contracts,"[452] the instruments that

[447] Cf. Tsai (2001), p. 998 and Cohen/Levinthal (1990), pp. 128f.
[448] Cf. Cohen/Levinthal (1990), pp. 138ff.
[449] Cf. Tsai (2001), p. 998.
[450] Cf. Kleinschmidt et al. (2007), pp. 423ff.
[451] Cf. Cooper/Kleinschmidt (1995), p. 377.
[452] Ruekert et al. (1985), p. 15.

provide employees with behaviors and routines to deal with problems appropriately.[453] While formalization can lead to increased efficiency in performance,[454] some authors have expected a negative influence in performance, especially in complex environments with high uncertainty, as is the case in new product development.[455] Thus, the expected effect of formalization on financial innovation performance is negative. However, as shown in Table 4-22, the values of the identified effect sizes range from neutral (.01) to positive (.16). This ambiguous range of effects sizes can be addressed only by a meta-analysis. The total sample size for this factor is 364 respondents.

Success factor	Direction of hypothesized effect on financial innovation performance	Range of effect sizes in identified studies		Number of effect sizes identified	Total sample size
		min.	max.		
Formalization	-	.01	.16	3	364

Table 4-22: Effect details - Formalization

Decentralization. The spread of authority into the organization is measured by the factor of decentralization. Organizations whose top managers hold close authority are centralized, while organizations whose authority is delegated to middle and lower managers is more decentralized.[456] While centralized organizations may have advantages resulting from clear responsibilities and communication lines, in uncertain and complex environments like those related to innovation management, decentralized organizations should be more effective.[457] Thus, the expected effect of decentralization on financial innovation performance is positive. As shown in Table 4-23, four effect sizes and a total sample size of 597 respondents are used in the meta-analysis. The identified effect sizes range from .11 to .31.

Success factor	Direction of hypothesized effect on financial innovation performance	Range of effect sizes in identified studies		Number of effect sizes identified	Total sample size
		min.	max.		
Decentralization	+	.11	.31	4	597

Table 4-23: Effect details - Decentralization

Firm size. Firm size affects the structure and processes of organizations and may lead to positive or negative performance results. Researchers have also differed in their expectations

[453] Cf. Olson et al. (2005), p. 51.
[454] Cf. Pelham/Wilson (1996), p. 30 and Ruekert et al. (1985), p. 18.
[455] Cf. Olson et al. (2005), p. 51.
[456] Cf. Olson et al. (2005), p. 51.
[457] Cf. Pelham/Wilson (1996), p. 30 and Ruekert et al. (1985), p. 18.

about the effect of firm size on financial innovation performance: while some have argued that size affects innovation positively because of greater access to resources and capabilities like marketing skills or product development experience, others have seen serious disadvantages for large firms resulting from formalized and standardized behaviors that interfere with flexibility and change.[458] Thus, the effect of firm size on innovation performance will be hypothesized as ambiguous. The identified effect sizes, as shown in Table 4-24, mirror this expectation with an effect size ranging from -.34 to .48. This conflicting range of effects sizes can be resolved by meta-analysis, which will be conducted with a total sample size of 3,023 respondents.

Success factor	Direction of hypothesized effect on financial innovation performance	Range of effect sizes in identified studies		Number of effect sizes identified	Total sample size
		min.	max.		
Firm size	+/-	-.34	.48	16	3,023

Table 4-24: Effect details - Firm size

4.2.2.4 Environmental characteristics

Environmental characteristics are attributes of the market a company wants to enter or in which it currently acts.[459] Since these characteristics cannot be influenced directly, most studies have used them as moderator variables.[460] As explained in section 3.3.1, meta-analysis allows inclusion only of factors with direct relationships; however, while companies may not be able to influence these factors directly, there is little doubt that the factors can influence companies directly. Since these factors have a direct influence on financial innovation performance in the form of opportunities or threats for innovative companies, they will be included in the analysis. Three factors—*market dynamism, technological uncertainty, and competitive intensity*—will be addressed in the meta-analysis.

Market dynamism. The construct of market dynamism reflects the speed of changes in the composition of customers and their needs and preferences and in competitor activities in the market place.[461] High market dynamism results in uncertainty, which affects the configurations and characteristics of the innovation process and the organization of the firm,[462] and thereby financial innovation performance. In general, one might assume that high market un-

[458] Cf. for details Damanpour (1996), p. 695
[459] Cf. Kohli/Jaworski (1990), p. 14.
[460] Cf., for example, De Luca/Atuahene-Gima (2007), Calantone et al. (2003), or Li/Atuahene-Gima (2001b).
[461] Cf. Kohli/Jaworski (1990), p. 14.
[462] Cf. Song/Montoya-Weiss (2001), p. 61.

certainty results in the need for additional effort by companies and reduces financial innovation performance. However, uncertainty could also be considered an opportunity for growth and outperformance of competitors if a firm acts well (e.g., through innovations).[463] Thus, the effect of market dynamism on financial innovation performance is hypothesized as ambiguous. As shown in Table 4-25, the effect size of the included studies ranges from -.09 to .25, indicating the value of a meta-analysis for clarification.

Success factor	Direction of hypothesized effect on financial innovation performance	Range of effect sizes in identified studies		Number of effect sizes identified	Total sample size
		min.	max.		
Market dynamism	+/-	-.09	.25	14	2,619

Table 4-25: Effect details - Market dynamism

Technological uncertainty. This factor describes the degree of change or instability in the technological environment in a market or industry. As defined by Kolhi and Jaworski, technology "refers to the entire process of transforming inputs to outputs and the delivery of those outputs to the customer."[464] Similar to market dynamism, technology uncertainty affects the innovation management in a firm[465] and, thus, financial innovation performance. The direction is hypothesized as ambiguous for the same reasons as were given for market dynamism.[466] As shown in Table 4-26, the effect size of the included studies ranges from -.09 to .25, indicating the need for a meta-analysis to clarify the effect of this factor.

Success factor	Direction of hypothesized effect on financial innovation performance	Range of effect sizes in identified studies		Number of effect sizes identified	Total sample size
		min.	max.		
Technological uncertainty	+/-	-.02	.23	10	2,118

Table 4-26: Effect details - Technological uncertainty

Competitive intensity. This factor measures the competitiveness of the environment in which the firm acts.[467] Since intense competition is characterized by "severe price wars, heavy advertising, diverse product alternatives, and added services,"[468] it is expected to have a nega-

[463] Cf. Voss/Voss (2000), p. 70; Pelham/Wilson (1996), p. 28; and Porter (1979), pp. 138ff.
[464] Kohli/Jaworski (1990), p. 14.
[465] Cf. Song/Montoya-Weiss (2001), p. 62.
[466] Cf. Voss/Voss (2000), p. 70.
[467] Cf. Tsai (2001), p. 1000.
[468] Zhou et al. (2005), p. 47 and Porter (1998), pp. 5ff.

tive influence on financial innovation performance.[469] As shown in Table 4-25, 16 effect sizes and a total sample size of 2,425 respondents are used in the meta-analysis. The effect sizes range from -.47 to .07.

Success factor	Direction of hypothesized effect on financial innovation performance	Range of effect sizes in identified studies		Number of effect sizes identified	Total sample size
		min.	max.		
Competitive intensity	-	-.47	.07	16	2,425

Table 4-27: Effect details - Competitive intensity

4.2.2.5 Moderators

Variations among studies can be caused by artifacts or by aspects of the studies that differ from study to study, also called moderators in the context of meta-analysis.[470] In general, either context-specific moderators, like the origin of the respondents or the type of product analyzed, or methodological moderators, like survey design or type of measures, are used in meta-analysis.[471] In the meta-analysis conducted in this dissertation, the two context-specific moderators,[472] *innovation focus* and *region*, and the four methodological moderators, *level of management*, *single-informant bias*, *data type of performance construct* and *items used to measure performance construct* will be tested.[473] The expectation is that these moderators will divide the identified effect sizes for each factor into sub-groups that will differ from each other in respect to the estimated true effect size. If this assumption is confirmed, the moderator will be accepted for the analyzed factor.[474]

For all moderator specifications described in the following paragraphs, the number of effect sizes is reported in tables. Depending on the heterogeneity level of each success factor in the complete data set, a moderator analysis will be conducted for the factor when at least three

[469] Cf. Slater/Narver (1994), p. 51.
[470] Cf. Hunter/Schmidt (2004), p. 33 and section 3.4.2.3.
[471] Cf. Hall et al. (1994), pp. 24ff.
[472] Actually, the industry used for the survey sample should also have been tested as a context-specific moderator, but a classification into sub-groups was impossible because of a missing general industry classification applied in the eligible studies. The denotation of "manufacturing industry" is, in particular, too broad to split into meaningful sub-groups.
[473] In selection of the moderators, the meta-analyst depends on the available information in the studies included in the meta-analysis. Thus, the moderators presented here are those for which sufficient information was reported.
[474] Cf. the theory on moderators in section 3.4.2.3.

effect sizes or two different studies on the moderator are available for at least two subgroups.[475]

Context-specific moderator - Innovation focus. Several studies have distinguished the objects of the innovation process. Some focused on services or physical products only, others on both. Cooper and Brentani (1991) demonstrated that services and products have three major differences: services are intangible, services' production and consumption phases are simultaneous, and services show an extremely high variability.[476] These differences between services and products might influence the correlations between the success factors and financial innovation performance, so innovation focus may serve as a moderator variable. The specifications of the moderator included are a focus on product, service, or both. As documented in Table 4-28, a total of 154 product-specific effect sizes, 15 service-specific effect sizes and 108 effect sizes without a differentiation between products and services have been extracted from the eligible studies. For twelve factors, enough data is available to conduct a moderator analysis: explicit innovation strategy, customer input, competitor intelligence, cross-functional coordination, external networks, market orientation, innovation orientation, learning orientation, firm size, market dynamism, technological uncertainty, and competitive intensity.

[475] Cf. the approach of Song et al. (2008), p. 14 and section 5.1.3 for the results of the moderator analysis.
[476] Cf. Cooper/de Brentani (1991), p. 77.

Moderator: Innovation focus				
Success factor		**Number of effects for moderator specification**		
		Product	Service	Both
Firm strategic attributes	Explicit innovation strategy[1]	12	3	8
	New-to-the-market products	3	2*	0
	Provision of resources	4	0	1
	Subtotal	**19**	**5**	**9**
Innovation process characteristics	Formal product development process	3	0	1
	Proficiency in product development process	13	0	1
	Reduced cycle time	12	0	0
	Customer input[1]	10	3	7
	Competitor intelligence[1]	2	3	5
	Cross-functional coordination[1]	11	3	6
	Explicit knowledge management	4	0	0
	External networks[1]	7	0	4
	Available knowledge in workforce	5	0	0
	Subtotal	**67**	**9**	**24**
Firm Organization and Culture	Market orientation[1]	21	1	24
	Innovation orientation[1]	4	0	9
	Learning orientation[1]	2	0	10
	Absorptive capacity	4	0	0
	Top management support	5	0	1
	Formalization	0	0	3
	Decentralization	1	0	3
	Firm size[1]	9	0	7
	Subtotal	**46**	**1**	**57**
Environmental characteristics	Market dynamism[1]	8	0	6
	Technological uncertainty[1]	7	0	3
	Competitive intensity[1]	7	0	9
	Subtotal	**22**	**0**	**18**
Total		**154**	**15**	**108**

[1] Enough data available for moderator analysis

* No moderator analysis conducted beecause the defined criteria were not met

Table 4-28: Moderator details - Innovation focus

Context-specific moderator - Region. Several studies have mentioned that the regional background of the respondents influences the magnitude and statistical significance of certain effects on financial innovation performance.[477] Elenkov and Manev (2005), for example, found that the effect of top management support on innovation differs between different cultures (based on Hofstede's cultural-value dimensions[478]).[479] Consequently, the moderator *region* will be taken into consideration in the analysis. The different moderator specifications used are[480]: (1) Africa, (2) Asia, (3) Europe, (4) North America and (5) worldwide.[481] In total, six

[477] Cf. Hauser et al. (2006), pp. 689 or Parry/Song (1994), p. 16.
[478] Cf. Hofstede (1980), pp. 65ff.
[479] Cf. Elenkov/Manev (2005), pp. 392ff.
[480] No information about the region was available for the remaining 13 effect sizes.

measures for Africa, 36 for Asia, 23 for Europe, 155 for North America and 44 for worldwide have been identified. For twelve factors, enough data is available for a moderator analysis, as shown in Table 4-29: explicit innovation strategy, proficiency in product development, reduced cycle time, customer input, cross-functional coordination, external networks, market orientation, innovation orientation, firm size, market dynamism, technological uncertainty and competitive intensity.

Moderator: Region						
Success factor		**Number of effects for moderator specification**				
		Africa	Asia	Europe	North America	Worldwide
Firm strategic attributes	Explicit innovation strategy[1]	0	2	1	14	6
	New-to-the-market products	0	1	2*	2*	0
	Provision of resources	0	1	0	1	3
	Subtotal	**0**	**4**	**3**	**17**	**9**
Innovation process characteristics	Formal product development process	0	1	0	0	3
	Proficiency in product development process[1]	0	4	0	9	1
	Reduced cycle time[1]	0	0	0	4	4
	Customer input[1]	0	0	2	12	4
	Competitor intelligence	0	0	0	10	0
	Cross-functional coordination[1]	0	3	2*	8	5
	Explicit knowledge management	0	1	0	3	0
	External networks[1]	0	1	5	0	4
	Available knowledge in workforce	0	2	0	0	2*
	Subtotal	**0**	**12**	**9**	**46**	**23**
Firm Organization and Culture	Market orientation[1]	2*	9	4	31	0
	Innovation orientation[1]	2*	2	1	6	2
	Learning orientation	2*	1	1	7	0
	Absorptive capacity	0	0	0	1	3
	Top management support	0	0	2*	1	3
	Formalization	0	0	0	3	0
	Decentralization	0	0	0	3	0
	Firm size[1]	0	2	1	11	2
	Subtotal	**6**	**14**	**9**	**63**	**10**
Environmental characteristics	Market dynamism[1]	0	3	1	10	0
	Technological uncertainty[1]	0	2	1	7	0
	Competitive intensity[1]	0	1	0	12	2
	Subtotal	**0**	**6**	**2**	**29**	**2**
Total		**6**	**36**	**23**	**155**	**44**

[1] Enough data available for moderator analysis

* No moderator analysis conducted beecause the defined criteria were not met

Table 4-29: Moderator details - Region

Methodological moderator - Level of management. Senior managers or project managers may provide different information regarding the same object. This effect is caused mainly by the respondents' hierarchical level in the company. While project managers are much more involved in the day-to-day activities and may assess the process details more accurately, the

[481] Originally South America and Australia were also used; however, no studies were found that used these regions.

senior managers will answer the questions with a more global view.[482] Consequently, the respondents' level of management may be a reason for variations in effect sizes and, therefore, may be used as moderator in the present meta-analysis. Table 4-30 documents the effect sizes identified for each moderator specification and success factor. In total, 160 effect sizes for senior managers, 39 for project managers and 55 for mixed levels have been extracted.[483] For nine factors, enough data is available for a moderator analysis: explicit innovation strategy, proficiency in product development, reduced cycle time, customer input, cross-functional coordination, external networks, market orientation, market dynamism, and technological uncertainty.

Moderator: Level of management				
Success factor		**Number of effects for moderator specification**		
		Senior Manager	Project Manager	Mixed
Firm strategic attributes	Explicit innovation strategy[1]	13	4	6
	New-to-the-market products	4	0	1
	Provision of resources	3	1	1
	Subtotal	**20**	**5**	**8**
Innovation process characteristics	Formal product development process	3	1	0
	Proficiency in product development process[1]	5	9	0
	Reduced cycle time[1]	3	4	5
	Customer input[1]	10	4	6
	Competitor intelligence	8	0	2*
	Cross-functional coordination[1]	9	6	4
	Explicit knowledge management	1	0	0
	External networks[1]	2	4	2
	Available knowledge in workforce	2*	2	1
	Subtotal	**43**	**30**	**20**
Firm Organization and Culture	Market orientation[1]	28	2	15
	Innovation orientation	8	1	2*
	Learning orientation	10	0	2*
	Absorptive capacity	3	0	0
	Top management support	4	1	0
	Formalization	3	0	0
	Decentralization	3	0	1
	Firm size	9	0	2*
	Subtotal	**68**	**4**	**22**
Environmental characteristics	Market dynamism[1]	11	0	2
	Technological uncertainty[1]	7	0	2
	Competitive intensity	11	0	1
	Subtotal	**29**	**0**	**5**
Total		**160**	**39**	**55**

[1] Enough data available for moderator analysis

* No moderator analysis conducted beecause the defined criteria were not met

Table 4-30: Moderator details - Level of management

[482] Cf. Montoya-Weiss/Calantone (1994), p. 414.

[483] No information about the level of management surveyed was available for the remaining 23 effect sizes.

Methodological moderator – Single-informant bias. Using single informants in empirical survey studies may lead to effect sizes that are distorted because of the highly subjective views held by the single informant. Ernst analyzed the effect of this bias in a detailed study in the context of innovation management and suggested using multiple informants to avoid these distortions. [484] Thus, the single-informant bias will be used as a moderator that may influence the variance in the effect sizes. Table 4-31 shows the details of the effect sizes identified for each moderator specification and success factor. Overall, 212 effect sizes have single-informant bias and 60 do not.[485] For eleven factors, enough data to conduct a moderator analysis is available: explicit innovation strategy, reduced cycle time, customer input, cross-functional coordination, external networks, market orientation, innovation orientation, absorptive capacity, firm size, market dynamism, and competitive intensity.

Moderator: Single-informant bias			
Success factor		**Number of effects for moderator specification**	
		Yes	No
Firm strategic attributes	Explicit innovation strategy[1]	18	5
	New-to-the-market products	4	1
	Provision of resources	4	1
	Subtotal	**26**	**7**
Innovation process characteristics	Formal product development process	4	0
	Proficiency in product development process	14	0
	Reduced cycle time[1]	8	4
	Customer input[1]	16	4
	Competitor intelligence	10	0
	Cross-functional coordination[1]	15	5
	Explicit knowledge management	3	0
	External networks[1]	7	4
	Available knowledge in workforce	5	0
	Subtotal	**82**	**17**
Firm Organization and Culture	Market orientation[1]	34	12
	Innovation orientation[1]	8	5
	Learning orientation	10	2*
	Absorptive capacity[1]	2	2
	Top management support	6	0
	Formalization	3	0
	Decentralization	4	0
	Firm size[1]	11	5
	Subtotal	**78**	**26**
Environmental characteristics	Market dynamism[1]	10	4
	Technological uncertainty	6	0
	Competitive intensity[1]	10	6
	Subtotal	**26**	**10**
Total		**212**	**60**

[1] Enough data available for moderator analysis

* No moderator analysis conducted beecause the defined criteria were not met

Table 4-31: Moderator details - Single informant bias

[484] Cf. for details Ernst (2001), p.87ff. and the discussion in section 2.2.3.

[485] No information about the single-informant bias was available for the remaining 5 effect sizes.

Methodological moderator - Data type for performance construct. Financial innovation performance is assessed either through objective data from company reports (e.g., market shares, sales, or profit growth) or by subjective data from the surveyed respondents (e.g., perception of innovation success versus competitor or realization of financial objectives). Whereas objective information is generally considered to be accurate and without biases, subjective data tends to have more errors because of the human inclination to overstate or understate the true performance (e.g., inflating performance to look good, omitting information on how well the company really performs to hide information from competitors, and so on).[486] Thus, the data type for performance construct will be a moderator in this meta-analysis. In total, as shown in Table 4-32, 74 effect sizes with objective performance measures and 203 with subject performance measures have been identified. For twelve factors, enough data is available in case a moderator analysis is necessary: explicit innovation strategy, proficiency in product development, reduced cycle time, customer input, cross-functional coordination, external networks, innovation orientation, absorptive capacity, top management support, firm size, and competitive intensity.

[486] Cf. Ford et al. (1990), pp. 434ff.

Moderator: Data type for performance construct			
Success factor		**Number of effects for moderator specification**	
		Objective	Subjective
Firm strategic attributes	Explicit innovation strategy[1]	7	16
	New-to-the-market products	2*	3
	Provision of resources	1	4
	Subtotal	**10**	**23**
Innovation process characteristics	Formal product development process	2	2*
	Proficiency in product development process[1]	10	4
	Reduced cycle time[1]	6	6
	Customer input[1]	7	13
	Competitor intelligence	2*	8
	Cross-functional coordination[1]	7	13
	Explicit knowledge management	0	4
	External networks[1]	8	3
	Available knowledge in workforce	0	5
	Subtotal	**42**	**58**
Firm Organization and Culture	Market orientation	1	45
	Innovation orientation[1]	3	10
	Learning orientation	1	11
	Absorptive capacity[1]	2	2
	Top management support[1]	3	3
	Formalization	0	3
	Decentralization	0	4
	Firm size[1]	5	11
	Subtotal	**15**	**89**
Environmental characteristics	Market dynamism	0	14
	Technological uncertainty	0	10
	Competitive intensity[1]	7	9
	Subtotal	**7**	**33**
Total		**74**	**203**

[1] Enough data available for moderator analysis

* No moderator analysis conducted beecause the defined criteria were not met

Table 4-32: Moderator details - Data type for performance measure

Methodological moderator - Items used to measure performance construct. Constructs in the identified studies are measured either by a single item or by multiple items. Differences in the number of items used to measure performance influence the reliability of the performance construct. The reliability of single-item constructs is especially unclear, so the literature has suggested using multi-item scales, which allow for a well documented assessment of reliability and which, in general, capture a broader domain of the performance construct.[487] Thus, the data type for the performance construct may influence the variance in the estimated effect sizes and serve as a moderator in the analysis. Table 4-31 documents the identified effect sizes for the different moderator specifications; for multi-item constructs, 195 effect sizes have been identified, and 83 effect sizes for single-item constructs have been identified. For eleven

[487] Cf. Churchill (1979), pp. 65ff.; see also the suggested performance measure for financial innovation performance by Griffin/Page (1996).

factors, enough data is available to conduct a moderator analysis: explicit innovation strategy, proficiency in product development process, reduced cycle time, customer input, competitor intelligence, cross-functional coordination, external networks, innovation orientation, absorptive capacity, firm size, and competitive intensity.

Moderator: Items used to measure performance construct			
Success factor		**Number of effects for moderator specification**	
		Multi-item	Single-item
Firm strategic attributes	Explicit innovation strategy[1]	8	15
	New-to-the-market products	4	1
	Provision of resources	5	0
	Subtotal	**17**	**16**
Innovation process characteristics	Formal product development process	3	1
	Proficiency in product development process[1]	5	9
	Reduced cycle time[1]	5	7
	Customer input[1]	12	8
	Competitor intelligence[1]	7	3
	Cross-functional coordination[1]	11	9
	Explicit knowledge management	4	0
	External networks[1]	3	8
	Available knowledge in workforce	5	0
	Subtotal	**55**	**45**
Firm Organization and Culture	Market orientation	44	2*
	Innovation orientation[1]	11	2
	Learning orientation	11	1
	Absorptive capacity[1]	2	2
	Top management support	4	2*
	Formalization	3	0
	Decentralization	4	0
	Firm size[1]	11	5
	Subtotal	**90**	**14**
Environmental characteristics	Market dynamism	14	0
	Technological uncertainty	10	0
	Competitive intensity[1]	9	7
	Subtotal	**33**	**7**
Total		**195**	**82**

[1] Enough data available for moderator analysis

* No moderator analysis conducted beecause the defined criteria were not met

Table 4-33: Moderator details - Items used to measure performance construct

4.3 Overview of the success factors identified from single studies

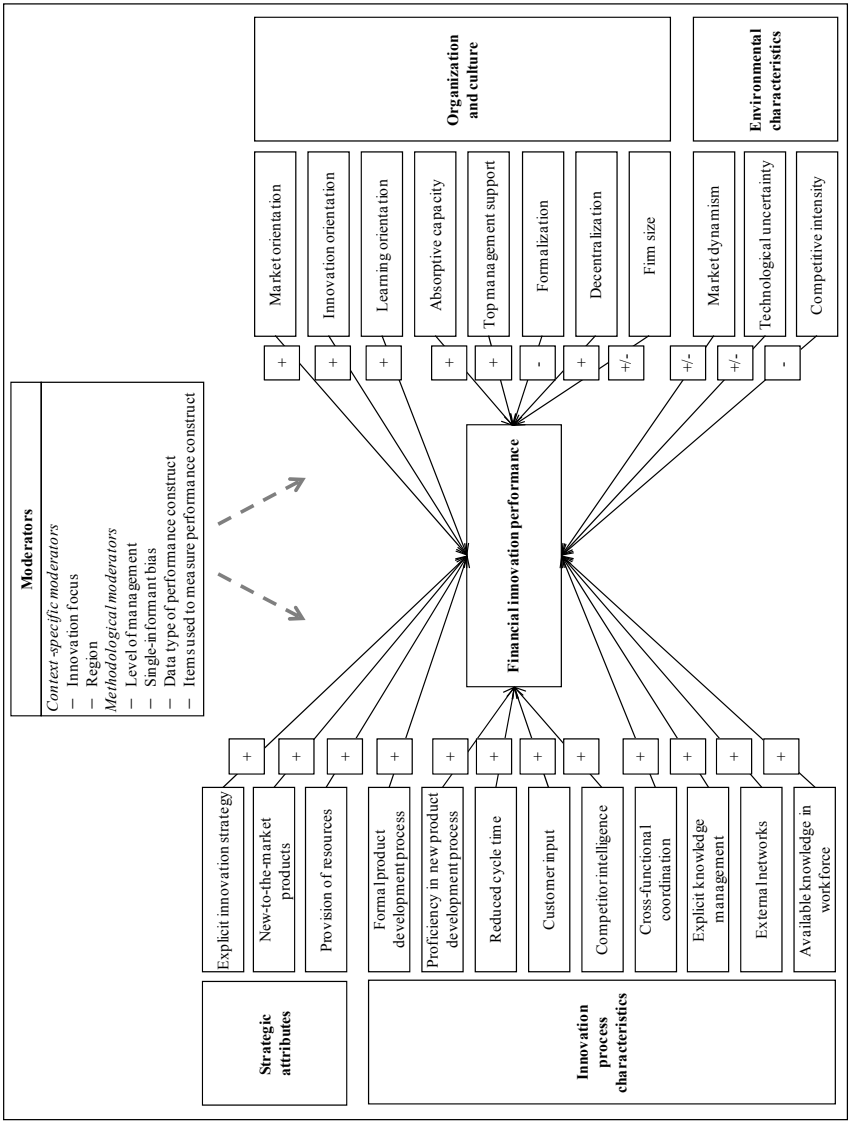

Figure 4-1: Overview of identified factors and hypothesized impact in financial innovation performance

5 Application of meta-analysis mathematical procedure on identified effect sizes of success factors

While the previous chapter dealt with the identification of the success factors from the eligible studies, this chapter applies the mathematical and statistical procedures and the interpretation approach of the meta-analysis explained in section 3.4. The first section of this chapter reports on the necessary input factors for the calculations, and the results of the complete data set and the moderator analysis. In the second section, the results are integrated into a categorization scheme on which the discussion and interpretation of the results in chapter 6 are based.

5.1 Results of the correction and integration of primary study findings

This section reports the results of the meta-analysis. First, the approach for correction and integration is briefly documented, then the results of the analysis of the complete data set are detailed and, finally, the moderator analysis is discussed. To ease reading of the results in the two results sections, the main results are highlighted in tables and figures at the end of each chapter. An overview integrating all results is presented at the end of the chapter.

5.1.1 The correction and integration approach applied

Before the concrete correction and integration of the data could begin, the data set had to be analyzed for the available artifacts, the missing data points needed to be identified and, if necessary, the available effect sizes had be transformed into correlation coefficients. The first step revealed that enough information from the eligible studies was available to correct for sampling error, measurement error, and dichotomization. Unfortunately, the correction method for range restriction, which is also often a distortion factor, could not be applied because not enough data are available.[488] In addition, not enough information was provided in the eligible studies to conduct a correction of the remaining possible artifacts.[489] Thus, the meta-analysis corrects for errors through sampling, measurement, and dichotomization alone.

[488] The random-selection approach most researchers have used for the survey sample may restrict the range of the dependent variable to companies that perform very well in innovation management because companies with poor performance in innovation management are less likely to answer the questionnaire and because they may have already disappeared from the marketplace. Cf. Henard/Szymanski (2001), p. 374. However, no data is available in support of this theory, so no correction could be performed.

[489] Information about the validity of the variables is not given in the studies, and the influence through external factors could not be validated through eligible information. However, this approach is in line with other meta-

M. Sattler, *Excellence in Innovation Management,* DOI 10.1007/978-3-8349-6158-7_5,

In the second step, the missing information in the data set was filled in. Reliability coefficients, in particular, were not available in all articles, and the request for those data from the authors did not solve the problem. Thus, the averaging approach suggested by Hunter and Schmidt (2004)[490] was applied, as has been done in several other meta-analyses in the management and marketing research context.[491] The averaged data for the success factors and the performance variable are detailed in Appendix (4).[492]

In the final step, the data for two studies were transformed from regression coefficients to correlations using the approach of Peterson and Brown (2005).[493] All other studies reported the data in the required data format or the authors sent the correlation matrix after the e-mail request.[494]

After completion of the analysis, the data set contained all information required to start the corrections and integration, for which the meta-analysis software of Schmidt and Lee (2004) were primarily used.[495] However, the correction for dichotomization, the calculation of the 95 percent credibility and confidence intervals, and the availability bias were done manually. The adjustment of the effect sizes for dichotomization, which split the data at the median, was applied to effect sizes from one study only.[496] For all calculations, the formulas reported in section 3.4.1 were used. Following the calculation with the complete data set, the homogeneity of the results was analyzed using the 75 percent rule for the explained variance (EV) in order to identify the success factors for the moderator analysis. The detailed results are illustrated in the next two sections.

5.1.2 Complete data set analysis

This section discusses the results of the meta-analysis done with the complete data set. The overall results for each factor are presented in Table 5-1, which documents the *Total N*, referring to the total sample size used to calculate the results; *k*, the number of effect sizes included in the analysis of the relationship; ρ, referring to the estimated true effect size for the population; the 95 percent credibility interval for the true effect sizes population, which provides information about the generalizability of the estimated effect size; the 95 percent confidence

analyses conducted in the economic research field, e.g., Troy et al. (2008), Song et al. (2006), or Kirca et al. (2005).

[490] Cf. Hunter/Schmidt (2004), p. 121.
[491] Cf. Kirca et al. (2005), p. 27.
[492] See Table 8-6 in Appendix (4).
[493] For transformation details, cf. Peterson/Brown (2005) or section 3.5.3.
[494] See section 4.2.1.
[495] Cf. Schmidt/Le (2004).
[496] Cf. Belderbos et al. (2004), p. 1489. For the correction, formula (3.3) in section 3.4.1 was used.

interval, which indicates the accuracy of the findings; the observed variance of the individually corrected correlations r_c[497]; the variance of the estimated true effect size in the population; the explained variance[498]; and the availability bias X_s[499] which measures the number of zero value studies necessary to reduce the effect size below the .05 significance level of the factor.[500]

[497] r_c is the variance of the correlations corrected for measurement error and dichotomization, not for sampling error, cf. Hunter/Schmidt (2004), p. 524
[498] The explained variance is calculated based on formula (3.10) in section 3.4.1.
[499] Critical level of X_s is defined as 20, see chapter 3.4.2.2
[500] For a detailed description of the results and their interpretation, see section 3.4.2.

Table 5-1: Detailed results of meta-analysis on the complete data set

Identified factors	Total N	k	ρ	95% credibility interval	95% confidence interval	Variance of corrected correlations r_c	Variance of ρ	Explained variance (in %)[a]	Availability bias X_s
Strategic attributes [SA]									
1 Explicit innovation strategy	3,018	23	0.25	(0.07, 0.43)	(0.19, 0.31)	0.020	0.009	57	169
2 New-to-the-market products	1,445	5	0.15	(0.05, 0.24)	(0.08, 0.22)	0.007	0.002	65	12
3 Provision of internal resources	1,196	5	0.39	(0.32, 0.45)	(0.32, 0.45)	0.006	0.001	80	36
Innovation process characteristics [IPC]									
4 Formal product development process	871	4	0.25	(0.10, 0.40)	(0.15, 0.36)	0.011	0.006	48	14
5 Proficiency in product development process	1,491	14	0.41		(0.36, 0.46)	0.009	0.000	100	121
6 Reduced cycle time	2,316	12	0.27	(-0.15, 0.69)	(0.14, 0.40)	0.057	0.047	17	83
7 Customer input	4,657	20	0.25	(-0.19, 0.68)	(0.14, 0.35)	0.055	0.049	12	185
8 Competitor intelligence	1,448	10	0.23	(-0.05, 0.51)	(0.12, 0.34)	0.031	0.021	32	43
9 Cross-functional coordination	3,016	20	0.29	(-0.04, 0.62)	(0.20, 0.38)	0.039	0.029	26	173
10 Explicit knowledge management	600	4	0.51		(0.45, 0.58)	0.005	0.000	100	27
11 External networks	5,770	11	0.17	(0.01, 0.33)	(0.11, 0.23)	0.010	0.007	32	75
12 Available knowledge in workforce	762	5	0.44	(0.18, 0.71)	(0.30, 0.59)	0.027	0.019	31	32
Organization and Culture [O&C]									
13 Market orientation	9,924	46	0.36	(0.14, 0.59)	(0.32, 0.40)	0.019	0.014	29	969
14 Innovation orientation	2,697	13	0.38	(0.19, 0.57)	(0.31, 0.44)	0.015	0.010	38	142
15 Learning orientation	4,005	12	0.39	(0.07, 0.70)	(0.29, 0.48)	0.030	0.026	12	167
16 Absorptive capacity	274	4	0.42		(0.35, 0.48)	0.004	0.000	100	13
17 Top management support	1,321	6	0.32		(0.26, 0.38)	0.006	0.000	100	37
18 Formalization	364	3	0.08		(-0.02, 0.18)	0.007	0.000	100	0
19 Decentralization	597	4	0.26	(0.05, 0.48)	(0.11, 0.41)	0.023	0.012	47	12
20 Firm size	3,023	16	0.03	(0.02, 0.05)	(-0.03, 0.09)	0.016	0.009	46	1
Environmental characteristics [EC]									
21 Market dynamism	2,619	14	0.10	(-0.07, 0.26)	(0.03, 0.17)	0.016	0.007	57	29
22 Technological uncertainty	2,118	10	0.18		(0.13, 0.22)	0.006	0.000	100	39
23 Competitive intensity	2,425	16	-0.15	(-0.46, 0.16)	(-0.24, -0.05)	0.036	0.025	31	55

[a] Explained variance lower than 75% indicated that the factor may be influenced by moderators.

In the following sections, the results of each factor and the necessary steps to prepare the interpretation are detailed.[501]

5.1.2.1 Results on strategic attributes

Explicit innovation strategy. This factor had a positive medium correlation effect size of .25 with financial innovation performance. Since the credibility (.07, .43) level and the confidential intervals (.19, .31) do not include zero, the direction of the effect is accurate and generalizable in the population. The results appear very stable, with 169 null-result studies necessary to reduce the effect size below the .05 significance level.[502] Although these results confirm the hypothesized positive effect of the factor on innovation performance, the explained variance below 75 percent documents the heterogeneity of the results and, thus, indicates the availability of moderators that influence the final true effect size. Therefore, before interpretation, the next step is to conduct a moderator analysis.

New-to-the-market products. This factor's true correlation coefficient in the population is estimated with a medium magnitude of .15. The credibility interval is within positive borders (.05, .24) and the confidence interval (.08, .22) is positive, indicating a generalizable direction and an accurate and significant effect size. However, the comparatively small number (twelve) of null-result studies necessary to reduce the effect size below the significance level of .05 leaves some doubt about the stability of this effect size. Nevertheless, this result may be used as an indication of the true effect size, so the hypothesized positive effect size is confirmed with restrictions. The value of the explained variance (65 percent), which is below the 75 percent level, necessitates a moderator analysis for a complete interpretation of the influence of this factor.

Provision of internal resources. The estimated true effect size for this factor is calculated as .39 and is also within positive credibility (.32, .45) and confidence interval borders (.32, .45). Thus, the effect size direction is generalizable and significant. In addition, the 36 null-result studies necessary for the reduction of the effect size below the .05 significance level suggest the stability of the effect size. Since the high explained variance of 80 percent indicates the homogeneity of the population, no further moderator analysis is necessary for interpretation.

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[501] Correlation coefficients cannot determine any causality between two variables, i.e., financial innovation performance could also lead to the specified success factors. However, the focus of the studies included in this meta-analysis is clearly on the impact of the success factors on financial innovation performance, not the other way around. Therefore, causality in the opposite direction is improbable. This note applies to the following chapters of this dissertation, including all interpretations of the results.

[502] In line with the approach taken by Song et al. (2008), p. 11, who also used .05 as a critical level.

In short, the hypothesized positive effect size of this factor on financial innovation performance is confirmed and the effect is generalizable and accurate in direction and magnitude.

5.1.2.2 Results on innovation process characteristics

Formal product development process. This factor shows an estimated true correlation with a medium magnitude of .25. The effect size is significant and its direction generalizable, as indicated by the credibility (.10, .40) and the confidence interval (.15, .36), which do not include zero. However, with only 14 null-result studies necessary to reduce the effect size below the .05 significance level, the results are slightly instable. The heterogeneity of the population, shown by the low explained variance of 48 percent, suggests that a moderator analysis should be conducted for a complete interpretation of the results. Thus, the hypothesized positive effect size could be confirmed by this analysis only with restrictions.

Proficiency in product development process. The estimated true effect size for this factor is calculated with a medium magnitude of .41. The missing credibility interval that is due to a non-existent variance in the true effect size, along with the positive confidence interval (.36, .46), indicates a significant and accurate true effect size with a generalizable direction. The very low availability bias of 121 null-result studies needed to reduce the effect size below the .05 significance level shows the stability of the results. Since the estimated effect size has no variance, the explained variance yields 100 percent and a moderator analysis for interpretation is unnecessary. Hence, the hypothesized positive effect size is confirmed and the effect size is generalizable and accurate in direction and magnitude.

Reduced cycle time. The estimated true correlation for this factor has a medium magnitude of .27. While the effect size is accurate and significant with a confidence interval of (.14, .36), the credibility interval around the distribution of the true effect sizes includes the zero value (-.15, .69), which does not allow for generalization of the effect direction and magnitude. The availability bias of 83 null-result studies needed to reduce the effect size below the .05 significance level is low but is also without meaning as long as the effect size is not generalizable. Although the hypothesized positive effect size could not be confirmed with this first analysis, the very low explained variance (17 percent) hints at moderators that need to be analyzed in the next step and that may reveal new results about the true effect size.

Customer input. The estimated true effect size for this factor has a medium magnitude of .25, but the effect direction and magnitude is not generalizable in the complete population because the credibility interval (-.19, .68) contains the zero value. However, the positive confidence

interval (.14, .35) suggests that the results are significant and accurate. The availability bias, with 185 null-result studies needed to reduce the effect size below the .05 significance level, is very low. Finally, the low percentage of explained variance (12 percent) indicates the presence of moderators. Thus, even if the hypothesized positive effect size of this factor on financial innovation performance could not be confirmed through this analysis, the moderator analysis may come up with different findings.

Competitor intelligence. This factor's true effect size is estimated with a medium magnitude of .23. Based on the confidence interval (.12, .34), the findings are significant and accurate. However, the credibility interval around the true effect size distribution includes the zero value (-.05, .51), so the effect size is not generalizable in the population. The 43 null-result studies necessary to reduce the effect size below a critical level supports the stability of the results. Nevertheless, the hypothesized positive effect size is not confirmed in this analysis. However, the low percentage of explained variance (32 percent) indicates that moderators may be the reason for the heterogeneity of the result, so they will be analyzed in the next steps.

Cross-functional coordination. The correlation coefficient between cross-functional coordination and financial innovation performance has an estimated true effect size with a medium magnitude of .29. This result is accurate and significant, as shown by the positive confidence interval (.20, .38), but the effect size is not generalizable because of the zero value in the credibility interval (-.04, .62). The availability bias is very low with 173 null-result studies necessary to reduce the effect size below the .05 significance level, which supports the stability of the results. Nevertheless, because of the credibility interval, the hypothesized positive effect size could not be confirmed. The low percentage of the explained variance (26 percent) necessitates a moderator analysis, which may result in better insights.

Explicit knowledge management. For this factor, the analysis reports a large magnitude of .51 as the estimated true effect size, which is generalizable in direction and significant because there in no variance in the result and because of the positive confidence interval (.45, .58). In addition, the relatively low availability bias, with 27 null-result studies necessary to reduce the effect size below the critical value, indicates that this result is a stable estimate. Since the estimated effect size has no variance, the explained variance yields 100 percent—in other words, is completely homogenous—and a moderator analysis for interpretation is unnecessary. In short, the hypothesized positive effect size of this factor on financial innovation performance can be confirmed and the effect size can be generalized in direction and magnitude.

External networks. An estimated true effect size with a medium magnitude of .17 is calculated for the factor of external networks. The effect size direction is generalizable and the effect is

significant, as indicated by the credibility (.01, .33) and confidence intervals (.11, .23), both of which have positive borders. In addition, the considerable number of 75 null-result studies necessary for the reduction of the effect size below a .05 significance level suggests the stability of the effect size and allows the hypothesized positive effect size to be confirmed. However, the very low explained variance (32 percent) hints at moderators that influence the magnitude of the correlation coefficient and should be analyzed in the next step.

Available knowledge in workforce. The estimated true effect size for this factor has a medium magnitude of .44 and is accurate and generalizable in direction, since the credibility interval (.18, .71) does not contain the zero value, and the confidence interval (.30, .59) is positive. In addition, the low availability bias of 32 further null-result studies to reduce the effect size below the critical significance level of .05 indicates a stable result. Thus, the hypothesized positive effect of this factor on financial innovation performance is confirmed, but the final value of the explained variance of 31 percent suggests that moderators might be the reason for the high remaining variance in the estimated true effect size and need to be identified in a next step.

5.1.2.3 Results on organization and culture

Market orientation. This factor's true effect size is estimated with a medium magnitude of .36. The effect size direction is generalizable and significant, as indicated by the credibility (.14, .59) and confidence intervals (.32, .40), both of which have positive borders. In addition, the very large number of 969 null-result studies necessary for the reduction of the effect size below a .05 significance level indicates the stability of the effect size. Therefore, the hypothesized positive effect size is confirmed. However, because of the low percentage of explained variance (29 percent), a further moderator analysis needs to be conducted in the next step; doing so may result in better insights about the real magnitude of the factor in the context of the moderators.

Innovation orientation. The correlation coefficient between innovation orientation and financial innovation performance has an estimated true effect size with a medium magnitude of .38. The credibility interval within positive borders (.36, .40) and the positive confidence interval (.31, .44) indicate a significant effect size with a generalizable direction. The low availability bias of 142 further null-result studies to reduce the effect size below the critical significance level of .05 indicates stable results. Thus, the hypothesized positive correlation coefficient can be confirmed, although the low percentage of explained variance (38 percent) indi-

cates that moderators may be the reason for the remaining variance and should be analyzed in the next steps.

Learning orientation. This factor has an estimated true effect size with a medium magnitude of .39. The effect size is significant and generalizable in direction, as indicated by the credibility (.07, .70) and confidence intervals (.29, .48), both of which have positive borders. With a very high number of 167 null-result studies necessary to reduce the effect size below the .05 significance level, the results appear to be very stable. Although these results confirm the positive effect of this factor on innovation performance, at twelve percent, the calculated value of the explained variance suggests the presence of moderators that may influence the final true estimated magnitude of the effect size and be the reason for the high remaining variance in the estimated true effect size. Consequently, the moderators need to be identified in a next step.

Absorptive capacity. The estimated true effect size for this factor has a medium magnitude of .42 and is generalizable in direction because there is no variation in the effect size. The positive confidence interval (.35, .48) confirms the accuracy and significance of the results, but the results may become insignificant–below the .05 significance level–with another 14 null result studies, so they are slightly instable. Nevertheless, this result may be an indication of the real true effect size, so confirmation of the hypothesized positive effect size is reached only with restrictions using this analysis. In addition, the estimated true effect size is homogenous, so the explained variance yields 100 percent, and a moderator analysis for interpretation is unnecessary.

Top management support. For this factor, the analysis reports a medium magnitude of .32 as the estimated true correlation coefficient between the factor and financial innovation performance. This coefficient is generalizable in direction and significant because of the missing credibility intervals and the positive confidence interval (.26, .38). In addition, the low availability bias of 37 further null-result studies shows the stability of the results. Finally, since the estimated effect size has no variance, the explained variance yields 100 percent, and a further moderator analysis will not be conducted. In short, the hypothesized positive effect size of this factor on financial innovation performance could be confirmed and is generalizable in direction and magnitude.

Formalization. This factor's true effect size is estimated with a small magnitude of .08. Although the non-existent credibility interval indicates the generalizability of the direction, the confidence interval reports a non-significant and inaccurate finding (-.02, .18). In addition, the availability bias indicates a very instable result.[503] With the extremely homogenous result

[503] If the factors have no effect on financial performance, the availability bias must be extremely large (X_s is close to zero) because the null hypothesis cannot be rejected and the confidence interval includes the zero value.

(explained variance of 100 percent), the conclusion can be drawn that the factor has no effect on financial innovation performance.

Decentralization. The correlation coefficient between decentralization and financial innovation performance has an estimated true effect size with a positive medium magnitude of .26. The effect size is significant and generalizable in direction, as indicated by the credibility interval (.05, .48), which has positive borders only, and the positive confidence interval of (.11, .41). However, the 12 null-result studies necessary to reduce the effect size below a significance level of .05 leaves some doubt about the stability of this effect size. Nevertheless, the results can serve as an indication for the true effect size, and the hypothesized positive effect size can be confirmed only with some restrictions. Furthermore, the value of the explained variance (47 percent), which is below the 75 percent level, necessitates a moderator analysis to determine the real influence of this factor.

Firm Size. This factor has an estimated true effect size with a small magnitude of .03. The effect size is generalizable in direction because of the positive credibility interval (.02, .05). However, the result is not significant, as indicated by the confidence interval (-.03, .09), which includes the zero value. In addition, with only one null-result study necessary to reduce the effect size below the .05 significance level, the results are very unstable. Therefore, the two hypotheses about the effect of this factor on financial innovation performance cannot be confirmed, and a null effect on financial innovation performance is expected.[504] The final value of the explained variance of 46 percent suggests that moderators might be the reason for the high remaining variance in the estimated true effect size. Identifying these moderators in the next step could reveal better insights about the real magnitude of the estimated true effect size.

5.1.2.4 Results on environmental characteristics

Market dynamism. The estimated true effect size for this factor has a small magnitude of .10 and is accurate and significant, as indicated by the positive confidence interval (.03, .17). The result of the test for availability bias is low, with 29 null-result studies necessary to reach the .05 significance level, indicating a stable result. However, because the zero value is included in the credibility interval (-.07, .26), the effect size is not generalizable. Therefore, neither the hypothesis of a negative effect, nor that of a positive effect of this factor on financial innova-

[504] Argumentation is based on the confidence interval and the large availability bias, as for the factor *formalization*.

tion performance can be confirmed. However, because of the low percentage of explained variance (57 percent), a further moderator analysis may lead to further insights.

Technological uncertainty. The estimated true effect size for this factor is calculated with a medium magnitude of .18. The missing credibility intervals resulting from the lack of variance in the true effect size, and the positive confidence interval (.13, .22) indicate a significant and accurate true effect size that is generalizable in direction. In addition, a low availability bias of 39 additional null-result studies suggests the stability of the results. Moreover, since there is no variance in the estimated effect size, the explained variance yields 100 percent, and a moderator analysis for interpretation would be redundant. In short, the hypothesis of a positive effect size of this factor on financial innovation performance can be confirmed and the hypothesis of negative influence is rejected. The calculated effect is generalizable with a positive direction and magnitude.

Competitive intensity. The correlation coefficient between competitive intensity and financial innovation performance has an estimated true effect size with a negative medium magnitude of -.15. The effect size is not generalizable, as indicated by the credibility interval (-.46, .16), which includes the zero value. Although the results are significant and accurate, as indicated by the negative confidence interval (-.24, -.05), and the availability bias is quite low with 55 further null-result studies necessary to reduce the effect size below the critical level, the overall findings do not confirm the hypothesized positive effect size. However, the low percentage of explained variance (31 percent) indicates that moderators may be the reason for the remaining variance in the estimated correlation effect, so they will be analyzed in the next step.

5.1.2.5 Summary of results of complete data set analysis.

This section provides a structured overview of the current results and defines the next steps in beginning the interpretation of and reflection about the results of the meta-analysis. As shown in Table 5-2, the hypotheses of the direction of the effect sizes can be confirmed for ten factors. For another four, the direction of the effect size can be confirmed with restrictions because of large availability biases. For one effect size with unclear direction, the positive influence on financial innovation performance is confirmed. For the remaining eight factors, the hypotheses are not confirmed in the complete data set analysis.

Among the 15 factors with confirmed hypotheses, the magnitude of the effect is also confirmed for six. One of them has a large impact on financial innovation performance, and the remaining five have a medium effect. For the other nine factors with confirmed direction and

for seven of the eight factors without hypothesis confirmation, a moderator analysis is necessary to gain additional insights in the magnitude and the direction of the impact of those factors. The remaining factor, formalization, is not analyzed further, as the complete data set analysis reveals a homogenous null effect on financial innovation performance.

Identified factors	Hypothesized effect direction on financial innovation performance	Estimated effect size accurate and significant	Direction of effect generalizable	Hypothesize on direction confirmed	Estimated magnitude of effect size	Magnitude generalizable in population	Moderator influence expected	Stability of results
Strategic attributes [SA]								
1 Explicit innovation strategy	+	Yes	Yes	Yes	Medium	No	Yes	Given
2 New-to-the-market products	+	Yes	Yes	Yes	Medium	No	Yes	Only as indication
3 Provision of internal resources	+	Yes	Yes	Yes	Medium	Yes	No	Given
Innovation process characteristics [IPC]								
4 Formal product development process	+	Yes	Yes	Yes	Medium	No	Yes	Only as indication
5 Proficiency in product development process	+	Yes	Yes	Yes	Medium	Yes	No	Given
6 Reduced cycle time	+	Yes	No	No	Medium	No	Yes	Given
7 Customer input	+	Yes	No	No	Medium	No	Yes	Given
8 Competitor intelligence	+	Yes	No	No	Medium	No	Yes	Given
9 Cross-functional coordination	+	Yes	No	No	Medium	No	Yes	Given
10 Explicit knowledge management	+	Yes	Yes	Yes	Large	Yes	No	Given
11 External networks	+	Yes	Yes	Yes	Medium	No	Yes	Given
12 Available knowledge in workforce	+	Yes	Yes	Yes	Medium	No	Yes	Given
Organization and Culture [O&C]								
13 Market orientation	+	Yes	Yes	Yes	Medium	No	Yes	Given
14 Innovation orientation	+	Yes	Yes	Yes	Medium	No	Yes	Given
15 Learning orientation	+	Yes	Yes	Yes	Medium	No	Yes	Given
16 Absorptive capacity	+	Yes	Yes	Yes	Medium	Yes	No	Only as indication
17 Top management support	+	Yes	Yes	Yes	Medium	Yes	No	Given
18 Formalization	-	No	Yes	No	Small	Yes	No	Given
19 Decentralization	+	Yes	Yes	Yes	Medium	No	Yes	Only as indication
20 Firm Size	+/-	No	Yes	No	Small	No	Yes	Given
Environmental characteristics [EC]								
21 Market dynamism	+/-	Yes	No	No	Small	No	Yes	Given
22 Technological uncertainty	+/-	Yes	Yes	Yes, positive hypothesis confirmed	Medium	Yes	No	Given
23 Competitive intensity	-	Yes	No	No	Medium	No	Yes	Given

Table 5-2: Summary of results and next steps of the complete data set analysis

Table 5-3 ranks the top 10 factors with confirmed—and, thus, generalizable—direction by the estimated true effect size. Six of the top ten factors are from the category Organization and Culture (75 percent of all factors of the category), one is from the category Strategic Attributes (33 percent of all factors in the category) and three are from the category Innovation Process Characteristics (33 percent of all factors in the category).

Factor category	Factor	Estimated effect size
IPC	Explicit knowledge management	0.51
IPC	Available knowledge in workforce	0.44*
O&C	Absorptive capacity	0.42
IPC	Proficiency in new product development process	0.41
SA	Provision of internal resources	0.39
O&C	Learning orientation	0.39*
O&C	Innovation orientation	0.38*
O&C	Market orientation	0.36*
O&C	Top management support	0.32
O&C	Decentralization	0.26*

* Magnitude may vary through the influence of moderators.

Table 5-3: Top 10 of factors with generalizable direction

In the next step, the results of the complete data set analysis are detailed for twelve of the 16 factors influenced by moderators, as shown in Table 5-2. For the other four factors (new-to-the-market products, formal product development process, available knowledge in workforce, and decentralization), not enough data are available to split the effect sizes into at least two sub-groups, and being able to do so is necessary to conduct a moderator analysis.[505] The results of all factors not included in the moderator analysis are integrated directly into the categorization scheme developed in section 5.2. This scheme will serve as basis for the interpretation and reflection of all findings in chapter 6.

5.1.3 Subgroup analysis to identify moderator influence

The sub-group approach is used in the moderator analysis, and the six moderators – *innovation focus*, *region*, *level of management*, *single-informant bias*, *data type of performance construct* and *items used to measure performance construct* – are used to build the sub-groups.[506] For each sub-group, a meta-analysis is conducted and the results are reported in the sections below.[507] A moderator is confirmed when the average variance of the effect sizes extracted in the sub-groups is smaller than the variance estimated for the complete data set.[508] The analysis is limited to a simple moderator analysis because the number of effect sizes available is

[505] See also the detailed overview of available data for each moderator in section 4.2.2.5.
[506] The moderators are described in section 4.2.2.5.
[507] Only results for the analyzable sub-groups are documented. Some sub-groups were not analyzed, because of a limited number of available data points.
[508] Cf. Hunter/Schmidt (2004), p. 90 and section 3.4.2.3.

insufficient for the hierarchical moderator analysis.[509] Therefore, when several moderators are valid for one factor, the results can be defined only as tentative.[510]

5.1.3.1 Context specific moderator - Innovation focus

The context-specific moderator *innovation focus* was introduced based on possible variations in the effect sizes when the innovation focus (product, service, both) among the included studies included in the complete data set analysis differ. The moderator is confirmed for seven of the eleven factors, as shown in Table 5-4, and is not confirmed for the factors *external networks*, *learning orientation*, *firm size*, and *market dynamism*.[511] In the following paragraphs, the results for the seven factors for which the moderator is confirmed are detailed.

Explicit innovation strategy. Innovation focus influences the results for this factor because the average variance for the effect size from the different sub-groups (.0045) is smaller than that from the total data set analysis (.0086), so the moderator is confirmed. For *products*, the estimated true coefficient is of medium magnitude (.24), and for *services*, the estimated factor has a coefficient of only .08. When the extracted effect sizes are taken from studies that did not focus on only one of the two moderator specifications, the effect size reaches its maximum magnitude of .34 (medium magnitude). Although the effect size for the focus on *services* is generalizable in direction and magnitude, it can serve only as an indication of the true effect size estimates because of the very high availability bias. For the two other specifications (*product and both)*, the effect sizes are significant and also show only a small availability bias. However, the remaining variances for these two sub-groups (43 percent for product and 28 percent for both) still indicate the further availability of moderators or artifacts not corrected for. Thus, a final generalizable effect size magnitude for those two specifications could not be found.

Customer input. The relationship of this factor with financial innovation performance has a positive direction with a medium magnitude for *product* and for *both* (.15 and .35, respectively) and is negative with a medium magnitude for *services* (-.20). The effect size is significant and stable only when *both* - service and product innovations - are observed in one sample. For *service* innovation, the effect sizes are significant, but the high availability bias indicates a very instable result. In addition, the small percentage of explained variance for the moderator specifications *product* and *both* suggests that other moderators are artifacts that cause the het-

[509] Cf. Viswesvaran/Sanchez (1998), p. 80.
[510] See section 3.4.2.3.
[511] The average variance of each of the sub-groups is larger than that of the complete data set.

erogeneity between the single effect sizes. From this moderator analysis, the positive hypothesized direction of the relationship could only be completely confirmed when *both* innovations are in focus, but the magnitude was not generalizable. In contrast, for *service* innovations, a negative relationship between customer input and financial innovation performance is confirmed, and generalization of the effect size is possible. Nevertheless, the results are quite unstable and, for *product* innovations, neither the direction nor the magnitude is generalizable.

Competitor intelligence. When *both* innovations are observed together, the largest effect size (.33) was estimated (medium magnitude), which is significant, generalizable in direction and magnitude, and stable, with 24 further null-effect studies needed to reach critical effect size. Furthermore, the correlation coefficient in *product* innovations is of medium magnitude (.20) and significant and generalizable in direction and magnitude. However, the effect size for *service* innovations is not stable because of a very high availability bias. Regarding the *service* specification of the moderator, the effect size is of small magnitude and negative direction (-.06), but it cannot be generalized because the credibility interval includes the zero value. In addition, the effect size for *service* innovations also has a low explained variance, which may indicate further moderators or artifacts.

Cross-functional. The effect size shows the highest magnitude (.35) for the samples in which *both* – product and service innovations – are analyzed together. The effect size is also significant, is generalizable in direction and has a low availability bias, with 30 further null-effect sizes necessary to reach critical significance. The effect size in the *service* sub-group with a medium magnitude (.19) appears to be significant and homogenous, so it is generalizable in direction and magnitude, and the high availability bias indicates a low stability and reliability. For the moderator specification *product*, the medium effect size (.28) is not generalizable since the credibility interval contains the zero value, even if the availability bias is low.

Market orientation. The average variance of the effect sizes in the sub-groups (.0081) for this factor is lower than the variance for the total set, so the moderator is confirmed. Both analyzable moderator specifications have medium effect size estimates (.36 for *product* and .39 for *both*) and are significant and reliable, so the hypothesized direction of the effect is confirmed. However, the results are still heterogeneous and indicate the effect of further moderators or other artifacts already corrected for.

Innovation orientation. The results are comparable to those of market orientation, with medium effect sizes (.33 for *product* and .40 for *both*), and are significant as well as reliable. For this factor, only in studies in which *both* innovations are surveyed together does the sample stay heterogeneous (30 percent explained variance). Thus, the results are generalizable in di-

rection for both moderator specifications, but only generalizable in magnitude for the *product* sub-group.

Competitive intensity. For both analyzable moderator specifications, the effect sizes are of negative direction and have a medium magnitude (-.13 for *product* and -.17 for *both*). They are also accurate and significant, and the availability biases for the estimates indicate stable results. However, the credibility interval, which includes the zero value, does not allow for generalization in direction and magnitude of the effect sizes in either sub-group.

Moderator: Innovation focus												
Identified factors		**Moderator specification**	**k**	**Total N**	**ρ**	**95% credibility interval**	**95% confidence interval**	**Variance of r_e**	**Variance of ρ**	**Explained variance (in %)[a]**	**Availability bias X_0**	**Moderator confirmed[b]**
Firm strategic attributes	Explicit innovation strategy	**Overall**	**23**	**3018**	**0.25**	**(0.07, 0.43)**	**(0.19, 0.31)**	**0.0199**	**0.0086**	**57%**	**169**	Yes
		Product	12	2108	0.24	(0.09, 0.40)	(0.17, 0.31)	0.0148	0.0064	57%	69	
		Service	3	303	0.08		(0.05, 0.11)	0.0007	0.0000	100%	0	
		Both	8	607	0.34	(0.18, 0.51)	(0.23, 0.45)	0.0253	0.0070	72%	33	
Innovation process characteristics	Customer input	**Overall**	**20**	**4657**	**0.25**	**(-0.19, 0.68)**	**(0.14, 0.35)**	**0.0553**	**0.0489**	**12%**	**185**	Yes
		Product	10	1842	0.15	(-0.33, 0.63)	(-0.01, 0.32)	0.0693	0.0600	13%	30	
		Service	3	303	-0.20		(-0.31, -0.09)	0.0092	0.0000	100%	3	
		Both	7	2512	0.35	(0.15, 0.55)	(0.27, 0.44)	0.0138	0.0103	26%	68	
	Competitor intelligence	**Overall**	**10**	**1448**	**0.23**	**(-0.05, 0.51)**	**(0.12, 0.34)**	**0.0309**	**0.0209**	**32%**	**43**	Yes
		Product	2	320	0.20		(0.18, 0.23)	0.0003	0.0000	100%	2	
		Service	3	303	-0.06	(-0.32, 0.20)	(-0.28, 0.15)	0.0362	0.0175	52%	-1	
		Both	5	825	0.33		(0.25, 0.40)	0.0072	0.0000	100%	24	
	Cross-functional coordination	**Overall**	**20**	**3016**	**0.29**	**(-0.04, 0.62)**	**(0.20, 0.38)**	**0.0390**	**0.0290**	**26%**	**173**	Yes
		Product	11	1936	0.28	(-0.12, 0.68)	(0.15, 0.41)	0.0499	0.0409	18%	72	
		Service	3	303	0.19		(0.12, 0.27)	0.0042	0.0000	100%	3	
		Both	6	777	0.35	(0.15, 0.55)	(0.23, 0.47)	0.0211	0.0105	50%	30	
	External networks	**Overall**	**11**	**5770**	**0.17**	**(0.01, 0.33)**	**(0.11, 0.23)**	**0.0099**	**0.0067**	**32%**	**75**	No
		Product	7	1363	0.13	(-0.17, 0.42)	(-0.01, 0.26)	0.0323	0.0228	29%	13	
		Both	4	4407	0.18	(0.11, 0.26)	(0.13, 0.24)	0.0030	0.0015	48%	25	
Firm Organization and Culture	Market orientation	**Overall**	**46**	**9924**	**0.36**	**(0.14, 0.59)**	**(0.32,0.40)**	**0.0191**	**0.0135**	**29%**	**969**	Yes
		Product	21	4543	0.36	(0.17, 0.55)	(0.31, 0.41)	0.0145	0.0092	37%	290	
		Both	24	5083	0.39	(0.23, 0.56)	(0.35, 0.44)	0.0127	0.0070	45%	383	
	Innovation orientation	**Overall**	**13**	**2697**	**0.38**	**(0.19, 0.57)**	**(0.31, 0.44)**	**0.0155**	**0.0096**	**38%**	**142**	Yes
		Product	4	865	0.33		(0.27, 0.40)	0.0041	0.0000	100%	20	
		Both	9	1832	0.40	(0.17, 0.62)	(0.30, 0.49)	0.0194	0.0136	30%	84	
	Learning orientation	**Overall**	**12**	**4005**	**0.39**	**(0.07, 0.70)**	**(0.29, 0.48)**	**0.0300**	**0.0263**	**12%**	**167**	No
		Product	2	385	0.37	(0.03, 0.71)	(0.11, 0.63)	0.0357	0.0298	17%	7	
		Both	10	3620	0.39	(0.07, 0.70)	(0.28, 0.50)	0.0293	0.0259	12%	132	
	Firm size	**Overall**	**16**	**3023**	**0.03**	**(0.02, 0.05)**	**(-0.03, 0.09)**	**0.0159**	**0.0086**	**46%**	**1**	No
		Product	9	929	0.08	(-0.19, 0.35)	(-0.04, 0.20)	0.0323	0.0187	42%	4	
		Both	7	2094	0.01	(-0.09, 0.12)	(-0.05, 0.08)	0.0074	0.0028	62%	0	
Environmental characteristics	Market dynamism	**Overall**	**14**	**2619**	**0.10**	**(-0.07, 0.26)**	**(0.03, 0.17)**	**0.0164**	**0.0070**	**57%**	**29**	No
		Product	8	1622	0.13	(-0.11, 0.37)	(0.02, 0.23)	0.0237	0.0151	36%	17	
		Both	6	997	0.06		(0.02, 0.09)	0.0016	0.0000	100%	0	
	Competitive intensity	**Overall**	**16**	**2425**	**-0.15**	**(-0.46, 0.16)**	**(-0.24, -0.05)**	**0.0363**	**0.0251**	**31%**	**55**	Yes
		Product	8	1546	-0.13	(-0.41, 0.14)	(-0.25, -0.02)	0.0287	0.0194	32%	17	
		Both	9	1039	-0.17	(-0.49, 0.15)	(-0.30, -0.04)	0.0404	0.0268	34%	21	

[a] Explained variance lower than 75% indicated that the factor may be influenced by further moderators.

[b] Moderator is confirmed when the average variance of ρ in the subgroups is lower than for the complete data set.

Table 5-4: Results for moderator: Innovation focus

5.1.3.2 Context specific moderator - Region

The context-specific moderator *region* groups the effect sizes into the subsets *Africa*, *Asia*, *Europe*, *North America* and *Worldwide*.[512] As shown in Table 5-5, the moderator is confirmed for six factors and rejected for the four factors *explicit innovation strategy*, *market orientation*, *firm size* and *market dynamism*. The following paragraphs describe the results for the factors with the confirmed moderator.

Reduced cycle time. For this factor, the sub-groups *North America* and *Worldwide* have been analyzed. In both subsets, the effect sizes have a medium magnitude (.11 for *Worldwide* and .43 for *North America*) and are significant and homogenous. Thus, they are generalizable in direction and magnitude, but the availability bias for *Worldwide* is large (only three further effect sizes are needed to reach critical significance), indicating that the result can be used only as an indication. In contrast, the availability bias for *North America* is low, with another 22 effect sizes necessary to reduce the magnitude below the critical level.

Customer input. The moderator is confirmed with the specifications *Europe, North America* and *Worldwide* (average variance of .0193). The effect sizes show a medium positive magnitude for *Europe* and *North America* (.29 and .28, respectively), but the effect size for *Worldwide* is negative and has a small magnitude (-.09). Only the effect sizes for *Europe* and *Worldwide* are significant and generalizable in direction; however, because of the large availability bias for *Worldwide*, this effect size is not reliable. The availability bias for *Europe* is also large (twelve further effect sizes necessary to reduce the results below the critical level), so it can be used only as an indication for the true effect size, even if the sub-group is homogenous and allows for generalization in magnitude. Finally, the results for *Europe* and *North America* are heterogeneous and suggest further moderators or artifacts not corrected for.

Cross-functional coordination. All estimated effect sizes of the analyzed sub-groups show either a medium (.45 for *Asia* and .32 for *North America*) or small influence (.10 for *Worldwide*) and are significant and generalizable in direction. Nevertheless, the high availability bias (X_S= 4) for *Worldwide* documents the instability of the result for this sub-group, even if the subset is homogenous and so the magnitude of the estimated effect size is valid for the complete subgroup population. For *Asia*, the availability shows a smaller instability, while the results for *North America* appear to be stable. However, both the *Asia* and *North America* sub-groups are heterogeneous, so no generalization of the calculated magnitudes is possible.

[512] Because of the small number of effect sizes from this region, no sub-group could be built for the sub-group *Africa*.

External networks. The estimated effect size for *Europe* is of medium magnitude (.19), significant, generalizable in direction, and reliable. However, for *Worldwide*, the small negative effect size (-.03) is generalizable in direction, but the confidence interval suggests a non-significant and inaccurate finding. In addition, with a negative availability bias result, no effect on financial innovation performance is expected from the *Worldwide* sub-group.

Innovation orientation. The average variance of the effect sizes in the sub-groups (.0047) is lower than the variance for the total set for this factor, so the moderator is confirmed. The moderator specification *Asia* has a large estimated effect size (.68), which is significant and homogenous and, thus, generalizable in direction and magnitude. However, the availability bias is quite large, so the result can serve only as an indication. The same is true for the estimate for the specification *Worldwide*, but for this subset the effect has only a medium magnitude. For *North America* the correlation coefficient is estimated at .39 (medium magnitude). This effect size is significant and stable and confirms the hypothesized direction. The remaining variance for this effect size indicates further moderators or other artifacts already corrected for.

Competitive intensity. The moderator is confirmed for this factor (average variance of .0099). The effect size estimates for the moderator specification *Worldwide*, with a large negative magnitude (-.53), are significant, homogenous, and generalizable in direction and magnitude. However, the calculated values are reliable only to a limited reliable degree because of the large availability bias. For *North America* the effect sizes are neither significant nor homogeneous, but they are reliable.

Moderator: Region												
Identified factors		Moderator specification	k	Total N	ρ	95% credibility interval	95% confidence interval	Variance of r_c	Variance of ρ	Explained variance (in %)[b]	Availability bias X_6	Moderator confirmed[c]
Firm strategic attributes	Explicit innovation strategy	**Overall**	**23**	**3018**	**0.25**	**(0.07, 0.43)**	**(0.19, 0.31)**	**0.0199**	**0.0086**	**57%**	**169**	No
		Asia	2	397	0.37	(0.05, 0.69)	(0.12, 0.62)	0.0323	0.0261	19%	7	
		North America	14	1405	0.24	(0.05, 0.44)	(0.16, 0.33)	0.0244	0.0099	60%	64	
		Worldwide	6	1006	0.22		(0.19, 0.26)	0.0021	0.0000	100%	20	
Innovation process characteristics	Reduced cycle time	**Overall**	**12**	**2316**	**0.27**	**(-0.15, 0.69)**	**(0.14, 0.40)**	**0.0565**	**0.0467**	**17%**	**83**	Yes
		North America	4	648	0.43		(0.38, 0.48)	0.0026	0.0000	100%	22	
		Worldwide	4	736	0.11		(0.08, 0.15)	0.0014	0.0000	100%	3	
	Customer input	**Overall**	**20**	**4657**	**0.25**	**(-0.19, 0.68)**	**(0.14, 0.35)**	**0.0553**	**0.0489**	**12%**	**185**	Yes
		Europe	2	1687	0.29	(0.17, 0.41)	(0.19, 0.39)	0.0052	0.0036	30%	12	
		North America	12	1768	0.28	(-0.18, 0.74)	(0.14, 0.42)	0.0633	0.0542	14%	74	
		Worldwide	4	736	-0.09		(-0.14, -0.04)	0.0024	0.0000	100%	2	
	Cross-functional coordination	**Overall**	**20**	**3016**	**0.29**	**(-0.04, 0.62)**	**(0.20, 0.38)**	**0.0390**	**0.0290**	**26%**	**173**	Yes
		Asia	3	622	0.45	(0.22, 0.67)	(0.29, 0.60)	0.0185	0.0134	28%	17	
		North America	8	876	0.32	(0.11, 0.53)	(0.21, 0.43)	0.0239	0.0118	51%	38	
		Worldwide	5	871	0.10	(0.05, 0.15)	(0.01, 0.19)	0.0111	0.0007	93%	4	
	External networks	**Overall**	**11**	**5770**	**0.17**	**(0.01, 0.33)**	**(0.11, 0.23)**	**0.0099**	**0.0067**	**32%**	**75**	Yes
		Europe	5	4617	0.19	(0.11, 0.26)	(0.14, 0.24)	0.0032	0.0015	54%	33	
		Worldwide	4	736	-0.03		(-0.12, 0.07)	0.0092	0.0000	100%	-2	
Firm Organization and Culture	Market orientation	**Overall**	**46**	**9924**	**0.36**	**(0.14, 0.59)**	**(0.32,0.40)**	**0.0191**	**0.0135**	**29%**	**969**	No
		Asia	9	1699	0.43	(0.28, 0.58)	(0.36, 0.50)	0.0114	0.0059	48%	88	
		Europe	4	724	0.20	(-0.19, 0.6)	(-0.01, 0.42)	0.0484	0.0409	16%	9	
		North America	30	6344	0.36	(0.17, 0.55)	(0.32, 0.41)	0.0151	0.0092	39%	495	
	Innovation orientation	**Overall**	**13**	**2697**	**0.38**	**(0.19, 0.57)**	**(0.31, 0.44)**	**0.0155**	**0.0096**	**38%**	**142**	Yes
		Asia	2	85	0.68		(0.66, 0.70)	0.0001	0.0000	100%	6	
		North America	6	1169	0.39	(0.16, 0.62)	(0.27, 0.50)	0.0207	0.0141	32%	42	
		Worldwide	2	523	0.42		(0.33, 0.51)	0.0040	0.0000	100%	10	
	Firm size	**Overall**	**16**	**3023**	**0.03**	**(0.02, 0.05)**	**(-0.03, 0.09)**	**0.0159**	**0.0086**	**46%**	**1**	No
		Asia	2	294	-0.01		(-0.07, 0.05)	0.0019	0.0000	100%	0	
		North America	10	1105	0.09	(-0.18, 0.36)	(-0.02, 0.20)	0.0322	0.0194	40%	8	
		Worldwide	2	60	0.00	(-0.46, 0.45)	(-0.44, 0.43)	0.0995	0.0538	46%	-2	
Environmental characteristics	Market dynamism	**Overall**	**14**	**2619**	**0.10**	**(-0.07, 0.26)**	**(0.03, 0.17)**	**0.0164**	**0.0070**	**57%**	**29**	No
		Asia	3	839	0.11	(-0.06, 0.29)	(-0.02, 0.25)	0.0135	0.0078	42%	3	
		North America	10	1654	0.10	(-0.07, 0.27)	(-0.08, 0.28)	0.0866	0.0075	60%	14	
	Competitive intensity	**Overall**	**16**	**2425**	**-0.15**	**(-0.46, 0.16)**	**(-0.24, -0.05)**	**0.0363**	**0.0251**	**31%**	**55**	Yes
		North America	12	1869	-0.16	(-0.44, 0.11)	(-0.26, -0.06)	0.0311	0.0198	36%	40	
		Worldwide	2	60	-0.53		(-0.58, -0.48)	0.0014	0.0000	100%	3	

[a] Explained variance lower than 75% indicated that the factor may be influenced by further moderators.

[b] Moderator is confirmed when the average variance of ρ in the subgroups is lower than for the complete data set.

Table 5-5: Results for moderator: Region

5.1.3.3 Methodological moderator - Level of management

For the methodological moderator *level of management*, the effect sizes have been divided into the subsets *senior manager*, *project manager*, and *mixed*. The moderator was confirmed for six factors and was rejected only for the factor *external networks* since the average variance (.0082) exceeds the variance of the total data set (.0067). The results for the factors for which the moderator was confirmed are reported in the next paragraphs and are also shown in Table 5-6.

Explicit innovation strategy. The relationship between this factor and financial innovation performance is moderated by the level of management surveyed. All estimated effect sizes of

the sub-groups show a medium influence (.22 for *senior managers*, .20 for *project managers* and .42 for *mixed*) and are significant and, thus, generalizable in direction. The results are also homogenous and can be generalized in magnitude for the respective populations, except for the effect sizes from samples in which *senior managers* were surveyed. Finally, the results for the moderator specification *project manager* are unstable because of a large availability bias (X_s= 9). For all other specifications, the sub-group results are stable and reliable.

Reduced cycle time. For the *senior manager* and *project manager* sub-groups, the results are homogenous and show a medium effect size (.44 for *senior managers* and .11 for *project managers*), which is also significant. Thus, both results in the sub-groups are generalizable in direction and magnitude. However, for both sub-groups, the availability bias is high, so the results can serve only as first indications of the true effect size. The estimated effect size in the *mixed* sub-group is .35, but it is neither significant nor homogenous.

Customer input. The effect sizes for the *senior manager* and *mixed* groups show a medium magnitude (.25 for *senior managers* and .34 for *mixed*). Both results are stable and reliable in terms of the available bias, but only the effect size for the *mixed* group is significant, so it is generalizable in direction. The effect size for the *project manager* sub-group has a small negative influence on the dependent variable (-.09), which is confirmed in direction and magnitude for the respective population. However, because of the large availability bias, the result can serve only as a first indication.

Cross-functional coordination. The moderator is confirmed for this factor (average variance .0085). In all three specifications, the factor shows a medium (.28 for *senior managers* and .13 for *project managers*) or large (.51 for *mixed*) influence on financial innovation performance. The three estimates are also significant and generalizable in direction for all subsets. For the *project manager* sub-group, the data are homogenous in comparison to the other two groups, so the magnitude is even valid for the respective sub-group population. However, the reliability of the result for this factor is low (nine further null-effect sizes necessary to reduce the current findings below the critical level). The other two findings appear to be stable and reliable.

Market orientation. All three sub-groups show significant results for this factor, but all effect sizes are of medium magnitude (.36 for *senior managers*, .41 for *project managers* and .40 for *mixed*) and generalizable in direction. The results for the *project manager* sub-group are homogenous, and the effect size magnitude can be generalized; however, because of the large availability bias, the result can serve only as a first indication. In contrast, the other sub-groups show reliable results, although the high remaining variance does not allow for a mag-

nitude generalization and suggests that there are further moderators or artifacts currently not corrected for.

Market dynamism. The sub-groups' average variance for this factor is smaller (.0043) than the variance of the complete data set (.0070), so the moderator is confirmed. Only two subsets could be built for this factor; the estimated effect sizes are .11 for the *senior manager* group and .15 for the *mixed* group. The *mixed* sub-group has a credibility interval without the zero value and is also homogenous, so the effect size is generalizable in direction and magnitude. Although the result for the *mixed* group appears to be significant and accurate, the large availability bias means the results can be only preliminary. For the *senior manager* group, the effect size is not significant, but further moderators or other artifacts not corrected for are indicated by the low explained variance.

Moderator: Level of management												
Identified factors		Moderator specification	k	Total N	ρ	95% credibility interval	95% confidence interval	Variance of r_c	Variance of ρ	Explained variance (in %)[b]	Availability bias X_a	Moderator confirmed[a]
Firm strategic attributes	Explicit innovation strategy	**Overall**	**23**	**3018**	**0.25**	**(0.07, 0.43)**	**(0.19, 0.31)**	**0.0199**	**0.0086**	**57%**	**169**	Yes
		Senior Manager	13	1811	0.22	(0.00, 0.44)	(0.14, 0.30)	0.0221	0.0115	48%	61	
		Project Manager	4	736	0.20		(0.17, 0.23)	0.0011	0.0000	100%	9	
		Mixed	6	471	0.42		(0.37, 0.46)	0.0031	0.0000	100%	27	
Innovation process characteristics	Reduced cycle time	**Overall**	**12**	**2316**	**0.27**	**(-0.15, 0.69)**	**(0.14, 0.40)**	**0.0565**	**0.0467**	**17%**	**83**	Yes
		Senior Manager	3	195	0.44		(0.32, 0.55)	0.0107	0.0000	100%	8	
		Project Manager	4	736	0.11		(0.08, 0.15)	0.0014	0.0000	100%	3	
		Mixed	5	1385	0.35	(-0.15, 0.86)	(0.12, 0.59)	0.0735	0.0661	10%	35	
	Customer input	**Overall**	**20**	**4657**	**0.25**	**(-0.19, 0.68)**	**(0.14, 0.35)**	**0.0553**	**0.0489**	**12%**	**185**	Yes
		Senior Manager	10	1512	0.25	(-0.23, 0.73)	(0.09, 0.41)	0.0686	0.0595	13%	50	
		Project Manager	4	736	-0.09		(-0.14, -0.04)	0.0024	0.0000	100%	2	
		Mixed	6	2409	0.34	(0.10, 0.58)	(0.23, 0.45)	0.0187	0.0151	19%	56	
	Cross-functional coordination	**Overall**	**20**	**3016**	**0.29**	**(-0.04, 0.62)**	**(0.20, 0.38)**	**0.0390**	**0.0290**	**26%**	**173**	Yes
		Senior Manager	9	965	0.28	(0.05, 0.51)	(0.17, 0.38)	0.0273	0.0139	49%	38	
		Project Manager	6	995	0.13	(0.02, 0.24)	(0.04, 0.22)	0.0135	0.0032	76%	9	
		Mixed	4	852	0.51	(0.33, 0.69)	(0.39, 0.62)	0.0140	0.0083	41%	32	
	External networks	**Overall**	**11**	**5770**	**0.17**	**(0.01, 0.33)**	**(0.11, 0.23)**	**0.0099**	**0.0067**	**32%**	**75**	No
		Senior Manager	6	1130	0.09	(-0.14, 0.31)	(-0.03, 0.21)	0.0223	0.0131	41%	5	
		Project Manager	4	736	-0.03		(-0.12, 0.07)	0.0092	0.0000	100%	-2	
		Mixed	2	560	0.22	(0.00, 0.43)	(0.03, 0.40)	0.0174	0.0116	34%	4	
Firm Organization and Culture	Market orientation	**Overall**	**46**	**9924**	**0.36**	**(0.14, 0.59)**	**(0.32,0.40)**	**0.0191**	**0.0135**	**29%**	**969**	Yes
		Senior Manager	28	6502	0.36	(0.11, 0.60)	(0.30, 0.41)	0.0213	0.0159	25%	462	
		Project Manager	2	259	0.41		(0.36, 0.45)	0.0009	0.0000	100%	6	
		Mixed	15	2710	0.40	(0.25, 0.56)	(0.36, 0.44)	0.0064	0.0064	50%	177	
Environmental characteristics	Market dynamism	**Overall**	**14**	**2619**	**0.10**	**(-0.07, 0.26)**	**(0.03, 0.17)**	**0.0164**	**0.0070**	**57%**	**29**	Yes
		Senior Manager	11	1677	0.11	(-0.06, 0.27)	(0.03, 0.19)	0.0192	0.0072	62%	19	
		Mixed	2	489	0.15	(0.08, 0.22)	(0.04, 0.27)	0.0069	0.0013	81%	2	

[a] Explained variance lower than 75% indicated that the factor may be influenced by further moderators.

[b] Moderator is confirmed when the average variance of ρ in the subgroups is lower than for the complete data set.

Table 5-6: Results for moderator: Level of management

5.1.3.4 Methodological moderator – Single-informant bias

The methodological moderator *single-informant bias* groups the effect sizes into the subsets *yes* and *no*.[513] As shown in Table 5-7, the moderator is confirmed for eight factors and rejected for two: *cross-functional coordination* and *firm size*. The following paragraphs provide details about the results for the factors with the confirmed moderator.

Explicit innovation strategy. For both specifications, the effect size for this factor is medium (.26 for *yes*, .21 for *no*) and significant, so it is generalizable in direction. Although the result for the *no* moderator specification is homogenous and allows for generalization of the effect size magnitude, the findings are not very reliable because of the large availability bias, so they can serve only as a first indication. This finding is in contrast to the findings for the *yes* sub-group, which are reliable. Nevertheless, the result for the *yes* sub-group still has a large proportion of unexplained variance, which might be due to further moderators or other artifacts than have been corrected for.

Reduced cycle time. The moderator was confirmed for this factor because the average variance of the effect size in the sub-groups (.0275) is lower than the variance in the complete data set. The two sub-groups both show a medium effect on financial innovation performance (.37 for *yes* and .11 for *no*), but the effect for the *yes* sub-group is not significant and heterogeneous. On the other hand, the effect for the *no* group is significant and homogenous and so is generalizable in direction and magnitude; however, because of the large availability bias, the findings can be used only as a first indication.

Customer input. The results for this factor are almost the same as for *reduced cycle time*, except for the magnitude of the effect sizes, which are medium for the *yes* sub-group (.31) and small and of negative direction for the *no* sub-group (-.09). The results in the *no* sub-group are generalizable in magnitude, but because of the large availability bias, the findings can be used only as a first indication.

External networks. The moderator analysis for this factor confirms the moderator with an average variance of .0012. The effect when there is a single-informant bias is calculated with a medium magnitude of .19, which is significant, generalizable in direction, and reliable. However, the remaining variance suggests the presence of further moderators or artifacts not corrected for. For the moderator specification *no*, the effect size is small (-.03) and generalizable with a negative direction and magnitude, but the confidence interval suggests a non-significant and inaccurate result. Considering the large availability bias, the effect of this fac-

[513] "Yes" for effect sizes with single-informant bias, and "no" for those without.

tor on financial innovation performance in the *no* sub-group is expected to be null. This result is in contrast to the confirmed positive hypothesized relationship direction of the factor in the complete data set analysis.

Market orientation. The calculated effect sizes and variances for the sub-groups of this factor confirm the influence of the single-informant bias moderator. In both subsets the factors show significant results that are generalizable in direction and have a medium influence on financial innovation performance (.34 for *yes* and .44 for *no*). The results are reliable and stable based on the availability bias, but the explained variance indicates the influence of further moderators or artifacts not corrected for.

Innovation orientation. The results for this factor are identical to those of *market orientation*, with the sole exception of the concrete magnitude of the effect sizes (.40 for *yes* and .33 for *no*).

Market dynamism. This environmental factor shows that the sub-groups impact financial innovation performance differently. While the credibility interval for both sub-groups indicates that the effect sizes are generalizable in direction and magnitude (a small magnitude of .04 for *yes* and a medium magnitude of .24 for *no*), the confidence interval for the *yes* sub-group reports a non-significant and inaccurate result. Thus, only the generalization of the results for *no* is valid, although only as indication because of the large availability bias. The finding for *yes* indicates no influence of the factor on financial innovation performance.

Competitive intensity. The moderator is confirmed for this factor, but neither estimated effect size is significant. For the *yes* group, there is a small negative effect size (-.08), and there is a medium negative effect size of -.17 for the *no* group. In addition, because of the large availability bias, the stability of the results is disputable. In addition, the results are heterogeneous since the remaining variance is still above 25 percent.

Moderator: Single informant bias												
Identified factors	Moderator specification		k	Total N	ρ	95% credibility interval	95% confidence interval	Variance of r_c	Variance of ρ	Explained variance (in %)[b]	Availability bias X_6	Moderator confirmed[a]
Firm strategic attributes	Explicit innovation strategy	**Overall**	**23**	**3018**	**0.25**	**(0.07, 0.43)**	**(0.19, 0.31)**	**0.0199**	**0.0086**	**57%**	**169**	Yes
		Yes	18	2241	0.26	(0.04, 0.48)	(0.19, 0.33)	0.0246	0.0130	47%	117	
		No	5	777	0.21		(0.16, 0.27)	0.0037	0.0000	100%	13	
Innovation process characteristics	Reduced cycle time	**Overall**	**12**	**2316**	**0.27**	**(-0.15, 0.69)**	**(0.14, 0.40)**	**0.0565**	**0.0467**	**17%**	**83**	Yes
		Yes	8	1580	0.37	(-0.09, 0.83)	(0.19, 0.54)	0.0648	0.0549	15%	63	
		No	4	736	0.11		(0.08, 0.15)	0.0014	0.0000	100%	3	
	Customer input	**Overall**	**20**	**4657**	**0.25**	**(-0.19, 0.68)**	**(0.14, 0.35)**	**0.0553**	**0.0489**	**12%**	**185**	Yes
		Yes	16	3921	0.31	(-0.06, 0.68)	(0.21, 0.41)	0.0414	0.0356	14%	170	
		No	4	736	-0.09		(-0.14, -0.04)	0.0024	0.0000	100%	2	
	Cross-functional coordination	**Overall**	**20**	**3016**	**0.29**	**(-0.04, 0.62)**	**(0.20, 0.38)**	**0.0390**	**0.0290**	**26%**	**173**	No
		Yes	15	1917	0.31	(0.08, 0.54)	(0.23, 0.39)	0.0254	0.0140	45%	108	
		No	5	1099	0.26	(-0.20, 0.72)	(0.04, 0.48)	0.0618	0.0546	12%	21	
	External networks	**Overall**	**11**	**5770**	**0.17**	**(0.01, 0.33)**	**(0.11, 0.23)**	**0.0099**	**0.0067**	**32%**	**75**	Yes
		Yes	7	5034	0.19	(0.10, 0.29)	(0.14, 0.24)	0.0047	0.0024	48%	51	
		No	4	736	-0.03		(-0.12, 0.07)	0.0092	0.0000	100%	-2	
Firm Organization and Culture	Market orientation	**Overall**	**46**	**9924**	**0.36**	**(0.14, 0.59)**	**(0.32,0.40)**	**0.0191**	**0.0135**	**29%**	**969**	Yes
		Yes	34	7819	0.34	(0.13, 0.56)	(0.30, 0.39)	0.0173	0.0119	31%	594	
		No	12	2105	0.44	(0.22, 0.66)	(0.36, 0.52)	0.0187	0.0125	33%	135	
	Innovation orientation	**Overall**	**13**	**2697**	**0.38**	**(0.19, 0.57)**	**(0.31, 0.44)**	**0.0155**	**0.0096**	**38%**	**142**	Yes
		Yes	8	1843	0.40	(0.22, 0.58)	(0.32, 0.48)	0.0135	0.0083	39%	75	
		No	5	854	0.33	(0.15, 0.51)	(0.06, 0.59)	0.0928	0.0086	47%	24	
	Firm size	**Overall**	**16**	**3023**	**0.03**	**(0.02, 0.05)**	**(-0.03, 0.09)**	**0.0159**	**0.0086**	**46%**	**1**	No
		Yes	11	2642	0.01	(-0.1, 0.12)	(-0.05, 0.06)	0.0086	0.0029	66%	0	
		No	5	381	0.22	(-0.02, 0.47)	(0.06, 0.39)	0.0360	0.0160	56%	8	
Environmental characteristics	Market dynamism	**Overall**	**14**	**2619**	**0.10**	**(-0.07, 0.26)**	**(0.03, 0.17)**	**0.0164**	**0.0070**	**57%**	**29**	Yes
		Yes	10	1935	0.04	(0.01, 0.07)	(-0.02, 0.10)	0.0097	0.0002	98%	1	
		No	4	684	0.24		(0.18, 0.31)	0.0043	0.0000	100%	11	
	Competitive intensity	**Overall**	**16**	**2425**	**-0.15**	**(-0.46, 0.16)**	**(-0.24, -0.05)**	**0.0363**	**0.0251**	**31%**	**55**	Yes
		Yes	10	1932	-0.08	(-0.27, 0.10)	(-0.28, 0.11)	0.0964	0.0093	48%	12	
		No	6	1302	-0.17	(-0.49, 0.15)	(-0.32, -0.02)	0.0356	0.0274	23%	16	

[a] Explained variance lower than 75% indicated that the factor may be influenced by further moderators.

[b] Moderator is confirmed when the average variance of ρ in the subgroups is lower than for the complete data set.

Table 5-7: Results for moderator: Single Informant Bias

5.1.3.5 Methodological moderator - Data type of performance construct

With the third methodological moderator, the effect sizes are divided into one group in which the performance construct is measured with *subjective* data and another group in which the construct is measured with *objective* data. As shown in Table 5-8, the moderator is confirmed in seven of the eight factors in this analysis, but it is rejected for the remaining one, *external networks*. The following paragraphs detail the results for each factor for which the moderator was confirmed.

Explicit innovation management. For this factor, the size of the correlation coefficient with financial innovation performance depends on the moderator. When *subjective* data are used, the effect size has a medium magnitude (.30) that is significant, generalizable in direction, and reliable. Since the sub-group is heterogeneous, further moderators or artifacts not corrected

for may influence the observed relationship. In the second sub-group, which uses *objective* data, the effect size has a medium magnitude (.16), is significant, and can be generalized in magnitude. However, the calculated availability bias indicates that this result is only preliminary.

Reduced cycle time. Both sub-groups show a medium impact on the dependent variable (.32 for the *subjective* group and .19 for the *objective* group) for this factor. However, the estimated effect sizes are not significant since both credibility intervals include the zero value. While both sub-groups are heterogeneous, the availability bias for the *subjective* data sub-group is low and that for the *objective* data sub-group is large.

Customer input. For this factor, the moderator is confirmed with an average variance of the subsets of .0439. The estimated effect sizes are of medium magnitude (.33 for *subjective;* .18 for *objective*), but neither result is either significant or homogenous. The availability bias is low, which indicates stable results.

Cross-functional coordination. While the estimated effect sizes on financial innovation performance are of medium magnitude for both sub-groups (.37 for *subjective* and .11 for *objective*), significant, and generalizable in direction, the results are reliable only for the *subjective* data sub-group in terms of the availability bias, but this sub-group's remaining variance indicates the presence of further moderator influence. In contrast, the results for the *objective* data are homogenous and, thus, generalizable in direction, but the large availability bias limits the findings to a first indication.

Innovation orientation. The average variance of the estimates in the innovation orientation sub-groups (.0057) confirms the moderator. In both sub-groups, the effect sizes have a medium magnitude (.36 for *subjective* and .45 for *objective*), are significant and are, thus, generalizable in direction. However, even if the results for the *objective* data group are generalizable in direction, the availability bias indicates that they are unstable. In contrast, while the *subjective* data group is heterogeneous, it shows reliable results.

Firm size. Both sub-groups show a small or zero impact on the dependent variable (.07 for *subjective* and .00 for *objective*), and both results are not significant since both credibility intervals include the zero value. In addition, both sub-groups are heterogeneous, and the availability bias for each sub-group is large.

Competitive intensity. The moderator is confirmed for this factor (average variance of .0249), but neither moderator specification is significant because of their negative medium magnitude

(-.14 for *subjective* and -.16 for *objective*). Furthermore, the availability bias is high, and both sub-groups still show a high remaining variance.

Moderator: Data type for performance construct													
Identified factors		Moderator specification	k	Total N	ρ	95% credibility interval	95% confidence interval	Variance of r_c	Variance of ρ	Explained variance (in %)[b]	Availability bias X_a	Moderator confirmed[c]
Firm strategic attributes	Explicit innovation strategy	**Overall**	**23**	**3018**	**0.25**	**(0.07, 0.43)**	**(0.19, 0.31)**	**0.0199**	**0.0086**	**57%**	**169**	
		Subjective	16	1841	0.30	(0.08, 0.51)	(0.22, 0.37)	0.0242	0.0121	50%	108	Yes
		Objective	7	1177	0.16		(0.13, 0.19)	0.0013	0.0000	100%	16	
Innovation process characteristics	Reduced cycle time	**Overall**	**12**	**2316**	**0.27**	**(-0.15, 0.69)**	**(0.14, 0.40)**	**0.0565**	**0.0467**	**17%**	**83**	
		Subjective	6	1569	0.32	(-0.16, 0.80)	(0.11, 0.53)	0.0681	0.0605	11%	40	Yes
		Objective	6	747	0.19	(-0.02, 0.40)	(0.06, 0.32)	0.0256	0.0119	53%	13	
	Customer input	**Overall**	**20**	**4657**	**0.25**	**(-0.19, 0.68)**	**(0.14, 0.35)**	**0.0553**	**0.0489**	**12%**	**185**	
		Subjective	13	2216	0.33	(-0.13, 0.79)	(0.19, 0.47)	0.0634	0.0549	13%	110	Yes
		Objective	7	2441	0.18	(-0.18, 0.53)	(0.03, 0.32)	0.0372	0.0329	12%	30	
	Cross-functional coordination	**Overall**	**20**	**3016**	**0.29**	**(-0.04, 0.62)**	**(0.20, 0.38)**	**0.0390**	**0.0290**	**26%**	**173**	
		Subjective	13	2052	0.37	(0.07, 0.66)	(0.27, 0.46)	0.0317	0.0229	28%	119	Yes
		Objective	7	964	0.11		(0.04, 0.19)	0.0107	0.0000	100%	8	
	External networks	**Overall**	**11**	**5770**	**0.17**	**(0.01, 0.33)**	**(0.11, 0.23)**	**0.0099**	**0.0067**	**32%**	**75**	
		Subjective	3	601	0.22	(0.02, 0.43)	(0.06, 0.38)	0.0198	0.0107	46%	7	No
		Objective	8	5169	0.16	(0.01, 0.32)	(0.10, 0.23)	0.0086	0.0060	29%	49	
Firm Organization and Culture	Innovation orientation	**Overall**	**13**	**2697**	**0.38**	**(0.19, 0.57)**	**(0.31, 0.44)**	**0.0155**	**0.0096**	**38%**	**142**	
		Subjective	10	2183	0.36	(0.15, 0.57)	(0.28, 0.44)	0.0173	0.0114	34%	92	Yes
		Objective	3	514	0.45		(0.39, 0.50)	0.0022	0.0000	100%	15	
	Firm size	**Overall**	**16**	**3023**	**0.03**	**(0.02, 0.05)**	**(-0.03, 0.09)**	**0.0159**	**0.0086**	**46%**	**1**	
		Subjective	11	1557	0.07	(-0.11, 0.25)	(-0.11, 0.25)	0.0921	0.0085	53%	7	Yes
		Objective	5	1466	0.00	(-0.16, 0.15)	(-0.10, 0.09)	0.0110	0.0062	43%	0	
Environmental characteristics	Competitive intensity	**Overall**	**16**	**2425**	**-0.15**	**(-0.46, 0.16)**	**(-0.24, -0.05)**	**0.0363**	**0.0251**	**31%**	**55**	
		Subjective	9	1273	-0.14	(-0.46, 0.19)	(-0.27, -0.01)	0.0395	0.0274	31%	18	Yes
		Objective	7	1152	-0.16	(-0.45, 0.14)	(-0.29, -0.02)	0.0326	0.0225	31%	16	

[a] Explained variance lower than 75% indicated that the factor may be influenced by further moderators.

[b] Moderator is confirmed when the average variance of ρ in the subgroups is lower than for the complete data set.

Table 5-8: Results for moderator: Data type of performance construct

5.1.3.6 Methodological moderator - Items used to measure performance construct

The final methodological moderator, *items used to measure performance construct*, splits the effect size between two sub-groups: effects with a *single-item* performance construct and effects with a *multi-item* performance construct. As shown in Table 5-9, this moderator is confirmed for eight of the nine factors analyzed. Only for the *explicit innovation strategy* was the moderator rejected. The following paragraphs describe the results for each factor with the confirmed moderator.

Reduced cycle time. The calculated true effect size estimates for this factor both have a medium magnitude (.18 for *single-item* and .35 for *multi-item*); however, only the result for the *single-item* sub-group is significant and generalizable in direction, but this sub-group is still heterogeneous, and the availability bias leaves some doubt about the stability of the result. For the *multi-item* sub-group, the effect size is not significant since the credibility intervals in-

clude the zero value, and the low explained variance suggests the presence of further moderators.

Customer input. In the *single-item* sub-group for this factor, an effect size of medium magnitude (.15) is estimated, which is not significant and not generalizable, and the remaining variance also show it is a heterogeneous sub-group. For the *multi-item* sub-group, the estimated effect size is also of medium magnitude (.36), which is significant and generalizable in direction. However the remaining variance indicates that further moderators influence the relationship. Both sub-groups show reliable results.

Competitive intelligence. The average variance of the sub-groups in the moderator analysis confirms the moderator for this factor. Only for the *multi-item* sub-group is the result significant, showing a medium influence (.029) on financial innovation performance. The *multi-item* sub-group appears to be homogenous, so the direction and magnitude of the effect size is generalizable. For the other sub-group, the resulting small effect size estimate (.06) is not significant, generalizable, reliable or homogenous.

Cross-functional coordination. This factor has a positive medium impact on financial innovation performance but, as confirmed with the moderator analysis, the concrete effect magnitude depends on the moderator (.11 for *single-item* and .41 for *multi-item*). Both effects are significant and generalizable in direction. However, only the *single-item* sub-group is homogenous, so only its magnitude can be generalized. Nevertheless, the *single-item* results are somewhat instable, while the availability bias for the *multi-item* group is low.

External networks. Both sub-groups for this factor show a medium impact (.16 for *single-item* and .21 for *multi-item*) on the dependent variable and are significant and generalizable in direction. In addition, both sub-groups are homogenous, which indicates further moderators. Only for the *single-item* results is the availability bias small; the bias for the *multi-item* sub-group lends doubt to the reliability of the calculated effect size.

Innovation orientation. For this factor, the results for the two sub-groups are nearly identical to those of *external networks*. The two sub-groups show a medium influence (.43 for *single-item* and .37 for *multi-item*) and are significant and generalizable in direction. However, the *multi-item* subset is heterogeneous in comparison to the single-item subset which is completely homogenous. In addition, the result of *multi-item* group is more reliable than that of the *single-item* group.

Firm size. For this factor, both sub-groups show a small or zero impact on the dependent variable (.07 for *single-item* and .00 for *multi-item*). In addition, neither result is significant, since

both credibility intervals include the zero value. Both sub-groups are heterogeneous, and the availability bias for each sub-group is large.

Competitive intensity. Neither moderator specification for this factor is significant or generalizable because of their negative medium magnitude (-.14 for *single-item* and -.16 for *multi-item*). Furthermore, the availability bias is high, and both sub-groups show a high remaining variance.

Moderator: Items used to measure performance construct												
Identified factors		Moderator specification	k	Total N	ρ	95% credibility interval	95% confidence interval	Variance of r_c	Variance of ρ	Explained variance (in %)[b]	Availability bias X_a	Moderator confirmed[c]
Firm strategic attributes	Explicit innovation strategy	**Overall**	**23**	**3018**	**0.25**	**(0.07, 0.43)**	**(0.19, 0.31)**	**0.0199**	**0.0086**	**57%**	**169**	No
		Single-Item	15	1933	0.23	(0.12, 0.34)	(0.17, 0.29)	0.0151	0.0029	80%	77	
		Multi-Item	8	1085	0.27	(0.02, 0.52)	(0.16, 0.38)	0.0267	0.0166	38%	35	
Innovation process characteristics	Reduced cycle time	**Overall**	**12**	**2316**	**0.27**	**(-0.15, 0.69)**	**(0.14, 0.40)**	**0.0565**	**0.0467**	**17%**	**83**	Yes
		Single-Item	7	931	0.18	(0.01, 0.36)	(0.07, 0.29)	0.0208	0.0080	62%	16	
		Multi-Item	5	1385	0.35	(-0.15, 0.86)	(0.12, 0.59)	0.0735	0.0661	10%	35	
	Customer input	**Overall**	**20**	**4657**	**0.25**	**(-0.19, 0.68)**	**(0.14, 0.35)**	**0.0553**	**0.0489**	**12%**	**185**	Yes
		Single-Item	8	2399	0.15	(-0.27, 0.56)	(-0.01, 0.30)	0.0502	0.0450	10%	27	
		Multi-Item	12	3458	0.36	(0.11, 0.61)	(0.28, 0.44)	0.0209	0.0163	22%	141	
	Competitor intelligence	**Overall**	**10**	**1448**	**0.23**	**(-0.05, 0.51)**	**(0.12, 0.34)**	**0.0309**	**0.0209**	**32%**	**43**	Yes
		Single-Item	3	303	-0.06	(-0.32, 0.20)	(-0.28, 0.15)	0.0362	0.0175	52%	-1	
		Multi-Item	7	1145	0.29	(0.25, 0.33)	(0.22, 0.36)	0.0084	0.0005	95%	35	
	Cross-functional coordination	**Overall**	**20**	**3016**	**0.29**	**(-0.04, 0.62)**	**(0.20, 0.38)**	**0.0390**	**0.0290**	**26%**	**173**	Yes
		Single-Item	9	1249	0.11		(0.06, 0.17)	0.0083	0.0000	100%	13	
		Multi-Item	11	1767	0.41	(0.15, 0.66)	(0.31, 0.50)	0.0253	0.0171	32%	103	
	External networks	**Overall**	**11**	**5770**	**0.17**	**(0.01, 0.33)**	**(0.11, 0.23)**	**0.0099**	**0.0067**	**32%**	**75**	Yes
		Single-Item	8	5026	0.16	(0.00, 0.32)	(0.10, 0.23)	0.0092	0.0065	29%	48	
		Multi-Item	3	744	0.21	(0.06, 0.36)	(0.08, 0.33)	0.0122	0.0061	50%	7	
Firm Organization and Culture	Innovation orientation	**Overall**	**13**	**2697**	**0.38**	**(0.19, 0.57)**	**(0.31, 0.44)**	**0.0155**	**0.0096**	**38%**	**142**	Yes
		Single-Item	2	126	0.43		(0.30, 0.56)	0.0093	0.0000	100%	4	
		Multi-Item	11	2571	0.37	(0.17, 0.57)	(0.30, 0.45)	0.0156	0.0104	34%	116	
	Firm size	**Overall**	**16**	**3023**	**0.03**	**(0.02, 0.05)**	**(-0.03, 0.09)**	**0.0159**	**0.0086**	**46%**	**1**	Yes
		Single-Item	5	1466	0.00	(-0.16, 0.15)	(-0.10, 0.09)	0.0110	0.0085	43%	0	
		Multi-Item	11	1557	0.07	(-0.11, 0.25)	(-0.11, 0.25)	0.0921	0.0062	53%	7	
Environmental characteristics	Competitive intensity	**Overall**	**16**	**2425**	**-0.15**	**(-0.46, 0.16)**	**(-0.24, -0.05)**	**0.0363**	**0.0251**	**31%**	**55**	Yes
		Single-Item	7	1152	-0.16	(-0.45, 0.14)	(-0.29, -0.02)	0.0326	0.0274	31%	16	
		Multi-Item	9	1273	-0.14	(-0.46, 0.19)	(-0.27, -0.01)	0.0395	0.0225	31%	18	

[a] Explained variance lower than 75% indicated that the factor may be influenced by further moderators.

[b] Moderator is confirmed when the average variance of ρ in the subgroups is lower than for the complete data set.

Table 5-9: Results for moderator: Items used to measure performance construct

5.1.3.7 Summary of results of the moderator analysis

The moderator analysis revealed that all six moderators influence the relationships between the identified factors for the moderator analysis[514] and financial innovation performance. For

[514] For the factors *new-to-the-market products*, *formal product development process*, *available knowledge in workforce* and *decentralization*, a moderator analysis could not be conducted because of the low number of available studies.

the factor *customer input*, all six moderators are confirmed. However, as shown in Table 5-10, for the factors *competitor intelligence*, *firm size* and *market dynamism*, only two of the moderators influence the relationship, and for *learning orientation*, none of the moderators could be confirmed. Besides the confirmation of the moderators, the analysis also provides further details on the results in the complete data analysis. The following paragraphs describe these further findings.

Explicit innovation strategy. For this factor, the hypothesized effect direction is confirmed in the complete data analysis and also for all moderators. A precise magnitude could be confirmed for the following moderator specifications:

- Innovation focus – Service (.08)
- Level of management – Project Manager (.20)
- Level of management – Mixed (.42)
- Single-informant bias – No (.21)
- Data type for performance construct – Objective (.16)

Reduced cycle time. For this factor, the hypothesized direction, which was not confirmed in the complete data set analysis, was confirmed in six of eleven moderator sub-groups. However, the large availability bias behind those six confirmations still leaves room for doubt about the real direction of the effect. A precise magnitude has been confirmed for the following moderator specifications:

- Region – North America (.43)
- Region – Worldwide (.11)
- Level of management – Senior Manager (.44)
- Level of management – Project Manager (.11)
- Single-informant bias – No (.11)

Customer input. The hypothesized positive effect of this factor on innovation financial performance was not confirmed in the complete data set analysis and could be confirmed in only four of fifteen moderator groups. Four other groups confirmed a negative effect of this factor. When the estimate is in the negative direction, the precise magnitude is confirmed. However, because of the availability bias, the results can be no more than an indication:

- Innovation focus – Service (-.20)
- Region – Worldwide (-.09)
- Level of management – Project Manager (-.09)
- Single-informant bias – No (-.09)

Competitor intelligence. For this factor, the hypothesized positive correlation coefficient with financial innovation performance is not confirmed in the complete data set analysis. In the moderator analysis, the direction is confirmed in three of the five sub-groups, two of which also show reliable results regarding the availability bias. For the three groups with confirmed direction, the magnitude is also generalizable:

- Innovation focus – Product (.20)
- Innovation focus – Both (.33)
- Items used to measure performance construct – Multi-Item (.29)

Cross-functional coordination. The hypothesized positive direction of the effect size is not confirmed for this factor in the complete data set analysis. However, twelve of thirteen moderator sub-groups confirm a positive direction, which gives a very strong indication of the direction of the true effect size. For five of the sub-groups, the estimated effect size magnitude could be generalized, but only with limitations because of the availability bias for all of the sub-groups:

- Innovation focus – Service (.19)
- Region – Worldwide (.10)
- Level of management – Project Manager (.13)
- Data type for performance construct – Objective (.11)
- Items used to measure performance construct – Single-Item (.11)

External networks. The hypothesized positive effect of this factor on financial innovation performance is confirmed in the complete data set analysis and also in four of six sub-groups of the moderator analysis. However, the two other sub-groups confirmed a null influence on the dependent variable[515]:

- Region – Worldwide (non-significant influence)
- Single-informant bias – No (non-significant influence)

Market orientation. All seven moderator sub-groups for this factor support the complete data analysis's confirmation of the hypothesized positive relationship with financial innovation performance. However, for only one sub-group does the magnitude of the effect size fulfill all criteria to be generalized:

[515] Non-significant influence might be due also to a second-order sample bias resulting from the very small number of included effect sizes in the sub-groups; cf. Hunter/Schmidt (2004), pp. 399ff.

- Level of management – Project Manager (.41)

Innovation orientation. For this factor, the hypothesized positive relationship with financial innovation performance was confirmed in the complete data set analysis, as well as in the moderator analysis for all sub-groups. For five of eleven moderator sub-groups, the effect size magnitude could be generalized. However, because of the availability bias, the results are only preliminary for the last four of the following:

- Innovation focus – Product (.33)
- Region – Asia (.68)
- Region – Worldwide (.42)
- Data type for performance construct – Objective (.45)
- Items used to measure performance construct – Single-Item (.43)

Learning orientation. For this factor, a positive relationship with financial innovation performance is confirmed in the complete data set analysis; although the explained variance indicated further moderators, none of the defined moderators are confirmed for this factor, so no further details about the precise magnitude of the effect in specific sub-groups could be found in this analysis.

Firm size. While the complete data set analysis indicated a null influence for this factor, the results in the moderator sub-groups did not reveal more details about the effect. Consequently, the effect of firm size on innovation performance will be defined with that strong indication of null influence.

Market dynamism. For this factor, none of the hypothesized directions are confirmed in the complete data analysis. However, from the results of two of four moderator sub-groups, a positive relationship can be generalized. A null influence was confirmed for one moderator sub-group. For the three effect sizes of these three moderators, the magnitude is valid for the complete population of the respective moderator sub-group. However, because of the availability bias, the results for the first and third sub-groups below are only indications:

- Level of management – Mixed (.06)
- Single-informant bias – Yes (non significant influence)[516]
- Single-informant bias – No (.24)

[516] Non-significant influence might also be due to a second-order sample bias resulting from the very small number of included effect sizes in the sub-groups; cf. Hunter/Schmidt (2004), pp. 399ff.

Competitive intensity. The hypothesized negative relationship between this factor and financial innovation performance is not confirmed in the complete data set analysis, and the moderator analysis showed the expected negative correlation in only one sub-group, for which the effect size magnitude could also be generalized. However, because of the availability bias, the findings are only indications.

- Region – Worldwide (-.53)

All of these findings are integrated into the next section's categorization scheme, which serves as the basis for the discussion. A complete summary of all results are reported in Table 5-10.

Identified factors	Confirmed moderator	Moderator specification	Hypothesized direction	Estimated effect size accurate and significant	Direction confirmed in complete data analysis	Hypothesized direction confirmed in moderator analysis	Magnitude from complete data analysis (not confirmed)	Estimated magnitude of effect size from moderator analysis	Magnitude generalizable in moderator analysis	Stability of results
Strategic attributes [SA]										
Explicit innovation strategy	Innovation focus	Product	+	Yes	Yes	Yes	Medium	Medium (.25)	No	Given
		Service		Yes		Yes		Small (.08)	Yes	Only as indication
		Both		Yes		Yes		Medium (.34)	No	Given
	Level of management	Senior Manager		Yes		Yes		Medium (.22)	No	Given
		Project Manager		Yes		Yes		Medium (.20)	Yes	Only as indication
		Mixed		Yes		Yes		Medium (.42)	Yes	Given
	Single-informant bias	Yes		Yes		Yes		Medium (.26)	No	Given
		No		Yes		Yes		Medium (.21)	Yes	Only as indication
	Data type for performance construct	Subjective		Yes		Yes		Medium (.30)	No	Given
		Objective		Yes		Yes		Medium (.16)	Yes	Only as indication
Innovation process characteristics [IPC]										
Reduced cycle time	Region	North America	+	Yes	No	Yes	Medium	Medium (.43)	Yes	Given
		Worldwide		Yes		Yes		Medium (.11)	Yes	Only as indication
	Level of management	Senior Manager		Yes		Yes		Medium (.44)	Yes	Only as indication
		Project Manager		Yes		Yes		Medium (.11)	Yes	Only as indication
		Mixed		Yes		No		Medium (.35)	No	Given
	Single-informant bias	Yes		Yes		No		Medium (.37)	No	Given
		No		Yes		Yes		Medium (.11)	Yes	Only as indication
	Data type for performance construct	Subjective		Yes		No		Medium (.32)	No	Given
		Objective		Yes		No		Medium (.19)	No	Only as indication
	Items used to measure performance construct	Single-Item		Yes		Yes		Medium (.18)	No	Only as indication
		Multi-Item		Yes		No		Medium (.35)	No	Given
Customer input	Innovation focus	Product	+	No	No	No	Medium	Medium (.15)	No	Given
		Service		Yes		No, but (-) confirmed		Medium (-.20)	Yes	Only as indication
		Both		Yes		Yes		Medium (.33)	No	Given
	Region	Europe		Yes	No	Yes		Medium (.29)	No	Only as indication
		North America		Yes		No		Medium (.28)	No	Given
		Worldwide		Yes		No, but (-) confirmed		Small (-.09)	Yes	Only as indication
	Level of management	Senior Manager		Yes		No		Medium (.25)	No	Given
		Project Manager		Yes		No, but (-) confirmed		Small (-.09)	Yes	Only as indication
		Mixed		Yes		Yes		Medium (.34)	No	Given
	Single-informant bias	Yes		Yes		No		Medium (.31)	No	Given
		No		Yes		No, but (-) confirmed		Small (-.09)	Yes	Only as indication
	Data type for performance construct	Subjective		Yes		No		Medium (.33)	No	Given
		Objective		Yes		No		Medium (.18)	No	Given
	Items used to measure performance construct	Single-Item		No		No		Medium (.15)	No	Given
		Multi-Item		Yes		Yes		Medium (.36)	No	Given

Identified factors	Confirmed moderator	Moderator specification	Hypothesized direction	Estimated effect size accurate and significant	Direction confirmed in complete data analysis	Hypothesized direction confirmed in moderator analysis	Magnitude from complete data analysis (not confirmed)	Estimated magnitude of effect size from moderator analysis	Magnitude generalizable in moderator analysis	Stability of results
Innovation process characteristics [IPC] (continued)										
Competitor intelligence	Innovation focus	Product	+	Yes	No	Yes	Medium	Medium (.20)	Yes	Only as indication
		Service		No		No		Small (-.06)	No	Only as indication
		Both		Yes		Yes		Medium (.33)	Yes	Given
	Items used to measure performance construct	Single-Item		No		No		Small (-.06)	No	Only as indication
		Multi-Item		Yes		Yes		Medium (.29)	Yes	Given
Cross-functional coordination	Innovation focus	Product	+	Yes	No	No	Medium	Medium (.28)	No	Given
		Service		Yes		Yes		Medium (.19)	Yes	Only as indication
		Both		Yes		Yes		Medium (.35)	No	Given
	Region	Asia		Yes		Yes		Medium (.45)	No	Only as indication
		North America		Yes		Yes		Medium (.32)	No	Yes
		Worldwide		Yes		Yes		Small (.10)	Yes	Only as indication
	Level of management	Senior Manager		Yes		Yes		Medium (.28)	No	Given
		Project Manager		Yes		Yes		Medium (.13)	Yes	Only as indication
		Mixed		Yes		Yes		Large (.51)	No	Given
	Data type for performance construct	Subjective		Yes		Yes		Medium (.37)	No	Given
		Objective		Yes		Yes		Medium (.11)	Yes	Only as indication
	Items used to measure performance construct	Single-Item		Yes		Yes		Medium (.11)	Yes	Only as indication
		Multi-Item		Yes		Yes		Medium (.41)	No	Given
External networks	Region	Europe	+	Yes	Yes	Yes	Medium	Medium (.19)	No	Given
		Worldwide		No		No influence confirmed*		Small (-.03)	Yes	Given
	Single-informant bias	Yes		Yes		Yes		Medium (.19)	No	Given
		No		No		No influence confirmed*		Small (-.03)	Yes	Given
	Items used to measure performance construct	Single-Item		Yes		Yes		Medium (.16)	No	Given
		Multi-Item		Yes		Yes		Medium (.21)	No	Only as indication
Organization and Culture [O&C]										
Market orientation	Innovation focus	Product	+	Yes	Yes	Yes	Medium	Medium (.36)	No	Given
		Both		Yes		Yes		Medium (.39)	No	Given
	Level of management	Senior Manager		Yes		Yes		Medium (.36)	No	Given
		Project Manager		Yes		Yes		Medium (.41)	Yes	Only as indication
		Mixed		Yes		Yes		Medium (.40)	No	Given
	Single-informant bias	Yes		Yes		Yes		Medium (.34)	No	Given
		No		Yes		Yes		Medium (.44)	No	Given

* Non-significant influence may also be due to a second-order sample bias resulting from the very small number of effect sizes included into the sub-groups analysis

Table 5-10: Summary of results of the moderator analysis

Identified factors	Confirmed moderator	Moderator specification	Hypothesized direction	Estimated effect size accurate and significant	Direction confirmed in complete data analysis	Hypothesized direction confirmed in moderator analysis	Magnitude from complete data analysis (not confirmed)	Estimated magnitude of effect size from moderator analysis	Magnitude generalizable in moderator analysis	Stability of results
Organization and Culture [O&C] (continued)										
Innovation orientation	Innovation focus	Product	+	Yes	Yes	Yes	Medium	Medium (.33)	Yes	Given
		Both		Yes		Yes		Medium (.40)	No	Given
	Region	Asia		Yes		Yes		Large (.68)	Yes	Only as indication
		North America		Yes		Yes		Medium (.39)	No	Given
		Worldwide		Yes		Yes		Medium (.42)	Yes	Only as indication
	Single-informant bias	Yes		Yes		Yes		Medium (.40)	No	Given
		No		Yes		Yes		Medium (.33)	No	Given
	Data type for performance construct	Subjective		Yes		Yes		Medium (.36)	No	Given
		Objective		Yes		Yes		Medium (.45)	Yes	Only as indication
	Items used to measure performance construct	Single-Item		Yes		Yes		Medium (.43)	Yes	Only as indication
		Multi-Item		Yes		Yes		Medium (.37)	No	Given
Firm size	Data type for performance construct	Subjective	+/-	No	No	No	Small	Small (.07)	No	Only as indication
		Objective		No		No		Small (.00)	No	Only as indication
	Items used to measure performance construct	Single-Item		No		No		Small (.00)	No	Only as indication
		Multi-Item		No		No		Small (.07)	No	Only as indication
Environmental characteristics [EC]										
Market dynamism	Level of management	Senior Manager	+/-	Yes	No	No	Small	Medium (.13)	No	Only as indication
		Mixed		Yes		Yes, positive hypothesis		Small (.06)	Yes	Only as indication
	Single-informant bias	Yes		No		No influence confirmed*		Small (.04)	Yes	Given
		No		Yes		Yes, positive hypothesis		Medium (.24)	Yes	Only as indication
Competitive intensity	Innovation focus	Product	-	Yes	No	No	Medium	Medium (-.13)	No	Only as indication
		Both		Yes		No		Medium (-.17)	No	Given
	Region	North America		Yes		No		Medium (-.16)	No	Given
		Worldwide		Yes		Yes		Large (-.53)	Yes	Only as indication
	Single-informant bias	Yes		No		No		Small (-.08)	No	Only as indication
		No		Yes		No		Medium (-.17)	No	Only as indication
	Data type for performance construct	Subjective		Yes		No		Medium (-.14)	No	Only as indication
		Objective		Yes		No		Medium (-.16)	No	Only as indication
	Items used to measure performance construct	Single-Item		Yes		No		Medium (-.14)	No	Only as indication
		Multi-Item		Yes		No		Medium (-.16)	No	Only as indication

* Non-significant influence may also be due to a second-order sample bias resulting from the very small number of effect sizes included into the sub-groups analysis

5.2 Categorization of findings from the meta-analyses

In the final step of the meta-analysis, the findings in the two analyses of the complete data set and moderators are integrated into a categorization to ease the discussion and identification of implications.[517] The categorization scheme is based on the interpretation of the meta-analysis, as described in section 3.4.2. As shown in Table 5-11, the identified factors are categorized by their effect sizes for the specific sub-groups along the calculated credibility interval, confidence interval, and homogeneity level or explained variance (EV).[518] The influence level in the first column of the table describes the extent and level of definition of the impact of the factor on financial innovation performance (e.g., population success factors are valid in the complete population with the detailed direction and magnitude).

Influence level	Type of factor	Characteristics					Interpretation
		valid for					
		Population	Subgroup	Confidence interval without zero value	Credibility interval without zero value	Homogeneity level (EV) above 75%	
4	Population success factor	X		X	X	X	- Factor has one specific estimated true effect size in the whole population.
3	Population subgroup success factor		X	X	X	X	- Factor has one specific estimated true effect for the population subgroup.
2	Heterogeneous success factor with generalizable influence direction ((a) population/ (b) population subgroup)	a	b	X	X		- Factor has a specific direction in (a) population or (b) subgroup population. - Further (hierarchical) moderator analysis is necessary .
1	Factor with undefined influence	X	X	X			- Effect of factor can not be clarified in the analyses - Further (hierarchical) moderator analysis is necessary.
0	Factor without influence	X	X		X		- Factor without influence.

Table 5-11: Categorization scheme for estimated effect sizes in meta-analysis results

All factors have been introduced into this categorization. First, the factors were sorted, based on the complete data analysis results, into levels 4, 2a, 1, and 0. Then the results from the moderator analysis that revealed more insights were added to the levels 3, 2b, and 0. The

[517] See also result illustration of Song et al. (2008), p. 16.
[518] Thus, a factor may be included more than once when the results in the sub-group analysis lead to different conclusions.

complete overview of the results, based on the categorization, is shown in Figure 5-1. The implications of these results are discussed in the following chapter and are based primarily on this central figure.

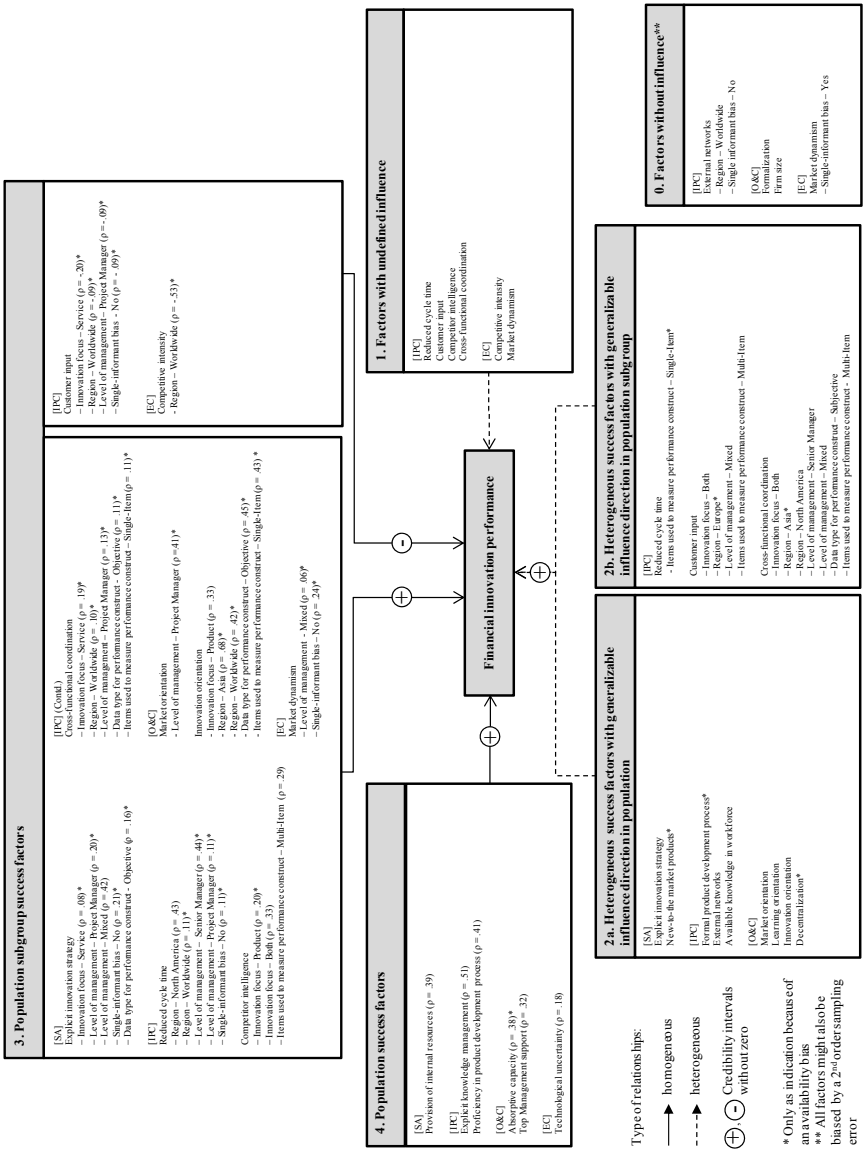

Figure 5-1: Overview of results of the complete meta-analysis

6 Discussion of the findings and implications for practice and research

The following sections discuss the findings in terms of their impact on practice and research. In line with the most published meta-analyses, the managerial implications are presented, followed by the research implications.[519] Finally, the present analysis' limitations are discussed.

6.1 Managerial implications

Success factors identified always need to be set in a practical context;[520] the overview of the statistically relevant success factors identified in the large sample set-up and detailed in Figure 5-12 leads to ideas that may help managers understand innovation management better and give them direction for handling it effectively.

The following sections provide ideas about how the management of innovation can be improved. The necessary differentiation between the innovation focus and the geographic location in which the innovation takes place is detailed, the most important factors[521] are grouped into substantially connected sections, and the impact of acting in a technologically uncertain environment is discussed.

6.1.1 Context matters in innovation management

Two context moderators were analyzed in this meta-analysis: type of innovation (products vs. services) and the geographical region (Asia, Europe, North America and Worldwide). This section discusses the impact on managerial decision-making.

The obvious difference between a physical product and an intangible service also influences the way innovation management needs to be approached, as is shown for several factors for which the moderator *innovation focus* is confirmed (Table 5-4). Even if the detailed results for services rely on a very small database and are, thus, very preliminary, the differences in findings between studies that analyze products only and the ones that include both-products and services-support this contextual relevance and are more reliable. Therefore, the following

[519] Cf., e.g., Troy et al. (2008), Kirca et al. (2005), and Henard/Szymanski (2001).
[520] See discussion in section 2.2.3.
[521] Mainly based on Table 5-3, which ranks the top 10 factors with a homogenous relationship with financial innovation performance.

M. Sattler, *Excellence in Innovation Management,* DOI 10.1007/978-3-8349-6158-7_6,

discussion is based on findings from the analysis of the differences between these two sets of studies.
In general, the tendency of all factors in the moderator analysis to show a larger impact when both products and services, rather than only products, are viewed together indicates that those factors are more important for services than for products. The underlying reason may be found in the different characteristics of products and services; because services are highly variable and often of customer-specific design,[522] the inclusion of external information about customers and competitor activities fosters successful innovation. In addition, the use of cross-functional teams supports the customization of those services by including people in the development team who have expertise in customer needs, which is more important in the development of services than products. This finding is in line with Troy[523].

Beside these process specific characteristics also cultural and strategic aspects show a higher effect on financial innovation performance for service innovations. The development of services with a sustainable competitive advantage is more challenging than it is for products because of the intangible characteristics and other problems related to the protection of services from imitation, while products can be patented.[524] Thus, an explicit strategic orientation to service innovation, in connection with an innovation-oriented culture, supports the development of unique and superior services in the marketplace. While a clear strategic orientation helps a firm focus on the right customer segment and the goals of the new service by setting up a program of activities selected to achieve the goals,[525] an innovation-oriented culture encourages and rewards risk-taking, entrepreneurship, and involvement in service development.[526]

Managers should be aware of these differences when deciding how to set up innovation management for services or products. For example, the innovation process could be adjusted for service development by emphasizing the importance of external informants through a more prominent role of these specific criteria in the respective stage gates of the process. Managers could also highlight the importance of services in their announcements about the future direction of the firm and could adjust the incentive systems to promote development of services.

The second context that managers should take into consideration when deciding about innovation management is the geographic region in which the firm acts. Geographic regions differ primarily in their cultural characteristics, as shown in four cultural dimensions (power distance, uncertainty avoidance/risk-taking, individualism/collectivism, and masculini-

[522] Cf. Zeithaml et al. (1985), p.35.
[523] Cf. Troy et al. (2008), p. 143.
[524] Cf. Cooper/de Brentani (1991), p. 77.
[525] Cf. Bart/Pujari (2007), p. 4.
[526] Cf. Andriopoulos (2001), p. 835.

ty/femininity), as identified by Hofstede (1980).[527] For example, in western regions like Europe and North America, individualism is prominent, but the Asian region is much more collectivist; and in Asian countries, high levels of uncertainty avoidance are more common than they are in North American countries.[528] The results of the meta-analysis in this regional context reveal two very important areas to which managers should pay attention.

First, for all factors connected to the use of information from different sources in the innovation process, the relationship with innovation performance was moderated by cultural influences, and the effect of cross-functional coordination on financial performance is stronger in Asian countries than in North America. This phenomenon is grounded in the very collective culture of Asian countries, which fosters a cross-functional approach to innovation management.[529] The second finding in this context is the great difference between Asia and North America in terms of the influence of the factor *innovation orientation* on financial innovation performance. The results show that, in Asia, innovation orientation has a greater effect on success than it does in North America. In fact, innovation orientation is characterized by risk-taking and entrepreneurship, which is more a part of North American cultures than it is a part of the highly risk-adverse Asian cultures. However, these findings might result from a North American bias in the surveys; since innovation orientation is already something of a basic cultural attribute because of a lower risk adversity, an American respondent might undervalue the effect of innovation orientation in the firm's culture.

Regional culture also has a direct impact on managers' attitudes and decision-making. The high correlation coefficients of innovation orientation indicate the importance of this cultural aspect of a firm in terms of innovation management. Because the North American culture already tends to promote innovation orientation, managers just need to create a good environment for innovations. However, in Asia, managers also need to help employees accept an uncertain environment to support the firm's capabilities in successful innovation management.[530] For example, managers can support an innovation orientation by incenting risk-taking, by being well recognized role models who embrace innovation, or by giving free time to employees to think about innovations. Managers of global companies need to keep cultural differences in mind and adjust their decisions for each part of the company according to region.

[527] Cf. Hofstede (1980). Hofstede's dimensions are used because they are the most accepted dimensions in the marketing and management research; cf. Nakata/Sivakumar (1996), p. 62; they are also used in other studies; cf. Brettel et al. (2008), Elenkov/Manev (2005), or Souder/Jenssen (1999).
[528] Cf. Nakata/Sivakumar (1996), pp. 62f.
[529] This effect was also confirmed by the analysis of Troy et al. (2008), p. 143.
[530] Culture is not seen as a permanent attribute, but one learned over time. Cf. Hofstede (1980), p. 234 and Brettel et al. (2008), p. 86.

In the next sections, the most important factors revealed from the complete data set analysis are discussed in detail.

6.1.2 Building on learning and knowledge

The three factors (absorptive capacity, explicit knowledge management and available knowledge in the workforce) with the highest correlation coefficients in the relationship with successful innovation management are all connected with the abilities of a firm to learn and to extend its knowledge base.[531] Based on the ability to value, assimilate, and apply new knowledge, defined as "*absorptive capacity,*"[532] firms need to manage knowledge actively and to provide employees ways to integrate this knowledge into their individual work. A firm's investment in its own research and development is the central measure of its absorptive capacity,[533] so managers have to keep in mind the importance of investing in research and development activities in developing successful innovations.[534] Along with the financial support of research and development, managers should facilitate the translation of learning from past innovation projects into current activities, a task central to knowledge management in the firm's innovation management system. Marsh and Stock (2006) suggested using activities like formal audits that evaluate prior innovation projects and disseminate the collected information through databases, memos, and presentations in order to ensure the retention and application of the related knowledge.[535] These activities result in sufficient levels of knowledge in the workforce to enable development of new innovations. Furthermore, training and integration of new, knowledgeable external resources can improve the knowledge level of the workforce.

In addition to the three above mentioned factors, two other important cultural and organizational factors contribute to the importance of learning and knowledge: *market orientation*, which is a positive attitude toward integrating market information into the innovation process, and *learning orientation*, which is the "manifestation of the organization's propensity to learn and adapt accordingly."[536] Learning orientation is closely linked to absorptive capacity and knowledge management but adds an integrative and cultural perspective to learning and knowledge. Moreover, learning orientation is reflected by the value of knowledge-questioning, "which affects a firm's propensity to value generative and double-loop learning."[537] In contrast, market orientation is reflected by knowledge-producing behaviors,[538]

[531] For details, see Table 5-3.
[532] Cf. Tsai (2001), p. 998 and Cohen/Levinthal (1990), pp. 128f.
[533] Cf. Cohen/Levinthal (1990), pp. 138ff.
[534] "Own R&D" also contains cooperative R and D ventures.
[535] Cf. Marsh/Stock (2006), p.431.
[536] Mavondo et al. (2005), p. 1237.
[537] Baker/Sinkula (1999), p. 413.

which are necessary for the inclusion of the appropriate market knowledge into the innovation process. Therefore, information directly from customers and indirectly through competitor monitoring or cross-functional collaboration must be generated. Besides the commonly known market research tools, the internet provides alternative tools for better understanding customer needs. A current example is the concept of toolkits for user innovation and design.[539]

In short, management must be aware of the importance of knowledge generation and ongoing learning, first by emphasizing the need for those activities in order to establish a learning-oriented culture; second, by setting the right investment priorities on R&D; and, third, by establishing a sophisticated knowledge management system for integrating market information.

6.1.3 Commitment to innovation

The results of the present study suggest that only firms that consciously decide to be innovative can succeed in innovation management. In this context, three of the four relevant factors belong to the top 10 factors.[540] Among them, *provision of internal resources* appears to have the highest correlation with financial innovation performance. Managers must support innovation projects with adequate and sufficient personnel resources, funds and equipment, and intangible resources like experience and decision power. [541] This factor is closely linked to *top management support*, which is also promoted by the resource-based view: the provision of sufficient resources to critical problems and tasks as an essential attitude and capability of the top management of a firm.[542] However, top management's role incorporates more than just indirect tasks like providing access to resources; it also includes concrete involvement and support with decision power to manage innovations successfully.[543] Top management should also be aware of the necessity of an explicit innovation strategy, a clearly stated and goal-oriented strategy highlighting the importance of innovations for the firm. Strategy is not only about visioning; it also includes the focus of innovation (e.g., a customer segment, a specific technology or process capabilities) and a clear program to guide the innovation teams in an uncertain and risky environment.[544] Overall, top management may move the firm towards an *innovation orientation* through an explicit commitment to innovation, entrepreneurship and risk-taking. For example, top management may attend product development team meetings

[538] Cf. Sinkula et al. (1997), p. 306.
[539] For details, cf. Franke/Piller (2004) and Piller/Walcher (2006).
[540] See Table 5-3.
[541] Cf. Wernerfelt (1984), p.173.
[542] Cf. Helfat/Peteraf (2003), p. 348.
[543] Cf. Kleinschmidt et al. (2007), p. 424.
[544] Cf. Bart/Pujari (2007), p. 4 and Swink (2000), p. 211.

when the project passes important stage gates in the development process to show the own direct commitment to innovations and promote the careers of these employees who are heavily engaged in innovation tasks to demonstrated also indirect support to innovation development.

6.1.4 Excellence in innovation process

The third important building block for successful management of innovations is connected to the innovation process itself. The factor *proficiency in product development* ranks fourth under the top 10 most relevant factors (Table 5-3). Thus, mastery of the details of the innovation process is part of the mosaic of success in innovation management. The complete process should be well controlled because all phases of the innovation process are relevant to reaching success.[545] Achieving mastery in the innovation process is likely to be connected with experience in innovation development, deep understanding of the process, and formalization of the innovation process. Only when the intangible knowledge of individual members of product development teams is transferred into a formal, written form, other–especially new–team members may learn and adapt the available process proficiency and thus improve the efficiency and effectiveness in innovation management.[546]

In fact, the success factor *formal product development process* is actually a consequence of proficiency in product development. A formal product development process does not imply an inflexible process full of rules and bureaucracy, but a kind of stage-gate process that serves as a formal template for activities, routines, and reviews to be implemented throughout the development and commercialization of an innovation. This process is shaped through flexibility and adaption, both of which foster decentralized decision-making by the project team.[547] In this context, *decentralization* is a success factor that keeps the process up to speed and increases efficiency in the process by allowing the development teams to decide which activities it executes.[548] In short, management can stimulate an environment for sophisticated innovation management by enforcing the use of a formal, stage-gate-like process, actively supporting decentralized decision-making, and emphasizing the necessity for learning and thus experience building in the innovation process.

[545] Cf. Im et al. (2003), p. 99.
[546] Cf. Cooper/Kleinschmidt (1991), p. 137.
[547] Cf. Cooper (2008), p. 224.
[548] Cf. Cooper (2001), pp. 317ff.

6.1.5 Technological uncertainty as opportunity for high performance

The results of the meta-analysis show a homogenous positive effect of the factor *technological uncertainty* on financial innovation performance, suggesting that the ability to act in a technologically uncertain environment supports successful innovation management. However, technological uncertainty is characterized by a firm's inability to understand fully or precisely predict the technological environment[549] and is as closely linked to the threat of failure as it is to the opportunity for success. This factor is observed in the primary studies as having only a moderating effect; however, because of the methodology of the meta-analysis, the direct effect size is included.[550] The reason for this unexpected finding of a clear positive relationship between technological uncertainty and financial innovation performance may be found in a bias toward successful innovative firms in the samples used in the eligible studies for the analysis.[551] Because these firms have superior abilities in innovation management, they show strong financial innovation performance. That is, as shown by the findings of this analysis, correlated positively with a technological uncertain environment. One might argue that only those firms that have superior innovation management capabilities can improve their financial innovation performance by consciously acting in a technologically uncertain environment.

In summary, the main implications of the meta-analysis on managerial decision-making are:

- Managers must keep in mind that the relevance of success factors to innovation management depends on the context of the innovation (product vs. service and region).
- Managers should establish a sophisticated means of knowledge management and create an environment for learning.
- Managers should show a clear commitment to innovations and support risk-taking and entrepreneurship.
- Managers should ensure that the firm has a sophisticated innovation process that is mastered by innovation project teams.
- Firms with a superior innovation management system may improve their innovation performance by acting in technologically uncertain environments.

[549] Cf. Song/Montoya-Weiss (2001), p. 64.
[550] See section 4.2.2.4.
[551] Cf. Henard/Szymanski (2001), p. 374.

6.2 Research implications

The central objective of this work is to clarify which factors are relevant to successful innovation management in a firm and to clarify the reasons for the differences in the findings of single studies. The last section discussed the most relevant factors for succeeding in innovation management; however, the hypotheses were not confirmed for several factors, so they should be addressed in further empirical primary research studies. Moreover, the current findings differ in some points from those in the restricted comparable meta-analysis of Henard and Szymanski (2001).[552] In addition, how methodological differences among the studies cause conflicting results should be considered by researchers when defining the next analysis. In the following sections, the factors for which further analysis is necessary and the differences between the current findings and those of an earlier meta-analysis are discussed. Then the methodological issues that cause differences in the results of single studies and areas for further research, based on the moderating elements, are identified.

6.2.1 Not confirmed hypotheses and reflection of further results[553]

As shown in Table 5-2, fifteen hypothesized effect directions are confirmed in the large sample setting, but the hypothesized directions for eight factors could not be extracted. Among the fifteen factors, the direction and magnitude of the effect size could be generalized for six; of the remaining nine factors, four are influenced by moderators, while no influence by the predefined moderators is found for the other five. These results can be split into three central implication blocks for the current and future research.

In the first block, for eight factors, the *hypothesized direction* was *not confirmed* in the analysis.[554] For two of those factors, no influence at all on financial innovation performance could be found:

Formalization. While the use of a formal product development process has a clear positive impact on financial innovation performance, the formalized nature of the overall organization is without influence. In contrast to a formal organization, which is characterized by many rules and procedures and, thus, considerable bureaucracy, the formal product-development

[552] Even if this kind of meta-analysis in innovation management is mainly based on studies on the project level, some factors analyzed in these publications are also relevant and used in the present analysis. Cf. Henard/Szymanski (2001).
[553] The following discussion is heavily depending on the relations shown in table 5-2 and figure 5-12.
[554] Groups 1 and 0 (only O&C category) in Figure 5-12.

process is designed to be highly flexible and adaptable. Consequently, the effect of a formalized organization was hypothesized to be negative since it may reduce the flexibility and performance in an uncertain environment like that of innovation management.[555] However, the estimated null effect on financial innovation performance found in the present analysis indicates that formalization in general is not connected with performance, possibly because of the small number of studies included in this analysis. Thus, further studies to analyze this relationship are necessary. It is also possible that formalization has too many different facets to be analyzed as an overall cumulating factor and that formalization should be analyzed more specifically for specific functional areas, such as formal product development process, formal controlling system, and the like.

Firm size. The effect of firm size on financial innovation performance was without clear direction, as some authors expected a positive effect and others a negative effect.[556] However, the present analysis, after correcting measurement and sampling errors, revealed that firm size has no influence on innovation performance, perhaps because firms are aware of the problem of size in innovation management and counter the issue proactively. While large firms ensure that the innovative units are able to work in a flexible environment that is less formalized than the overall company,[557] small firms are aware of the need for experienced resources and capabilities in innovation management and try to get them from external sources.[558]

The influence of six other factors on financial innovation performance could not be confirmed in a homogenous direction, but all six are influenced by moderators, which may be the reason for this result. A detailed discussion will be conducted in section 6.2.2.

The second block includes the six factors with a *generalizable direction and effect magnitude*[559] the identified variances in the results of the single studies are all caused by sample or measurement errors. This meta-analysis corrected for these errors and thereby reduced the variances in the estimated true effect sizes to where they were all above seventy-five percent. The resulting effect sizes appear to be valid for the complete population of firms, so they are central to further theory-building in innovation management.[560]

The third block includes nine factors for which the influence on 'financial innovation performance' is estimated with a *generalizable positive direction*.[561] For these, all hypotheses about the effect direction were confirmed in a large sample setting, but the magnitudes of the effects

[555] See the definition in section 4.2.2.3.
[556] See Table 4-23.
[557] E.g., through explicit R&D joint ventures (e.g., Bosch-Mahle Turbo Systems).
[558] E.g., through the selected inclusion of experienced business angels.
[559] See Group 4 in Table 5-12.
[560] Two factors may serve only as indications because of an availability bias.
[561] See Group 2a in Table 5-12

are influenced by either contextual or methodological moderators. This influence prevents the generalization of the magnitude of effect size for the complete population, so a moderator analysis was necessary. For only four of the factors were moderators confirmed which will be discussed in section 6.2.2; for the remaining five, either the number of effect sizes was too low or the predefined moderators could not be confirmed, so further analyses are necessary:

New-to-the market products, formal product-development process, available knowledge in workforce, and *'decentralization'*. For these four factors, the number of effect sizes was too low to conduct a thorough moderator analysis, so further studies that contain direct correlation coefficients between the respective factors and financial innovation performance are needed before the magnitude of the real effect size and the reasons for the variances can be understood.

Learning orientation. Although a single moderator analysis could be conducted for this factor, the influence of the *innovation focus* moderator could not be confirmed and, for all other moderating elements, the number of effect sizes was too low. Thus, further analyses are necessary to understand fully the magnitude of the true effect size and the reasons for the variances.

Having discussed the impact of hypotheses confirmation and the overall direct effect on research, the findings will be reflected upon the results of the former meta-analysis of Henard and Szymanski in the next paragraphs.[562] Even though their work was primarily based on studies that analyzed the project level of innovation management, the authors also included some factors that are relevant on the firm level.

In general, none of Henard and Szymanski's comparable factors are generalizable in direction and magnitude, as is the case for the present analysis (Table 6-1). While the factors *provision of internal resources*, *proficiency in product development process* and *top management support* are generalizable in direction in the work of Henard and Szymanski, the present analysis also allows for the generalization of the magnitude across the population of studies. In addition, the explained variance in Henard and Szymanski's analysis was, in most cases, much lower than that in the present meta-analysis, which illustrates the problem of including studies from both the project level and the firm level.

[562] Cf. Henard/Szymanski (2001).

Present analysis				Henard/Szymanski (2001)			
Factor	**ρ**	**CrI**	**Explained Variance (in %)**	**Factor**	**ρ**	**CrI**	**Explained Variance (in %)**
Provision of interal resources	0.39	(0.32, 0.45)	80	Dedicated human resources Dedicated R&D resources	0.52 0.45	(0.05, 0.99) (-0.04, 0.94)	8 35
Proficiency in product development process	0.41		100	Predevelopment task Marketing task proficiency Launch proficiency	0.46 0.50 0.43	(0.34, 0.58) (0.29, 0.71) (0.14, 0.72)	59 52 18
Reduced cycle time	0.27	(-0.15, 0.69)	17	Reduced cycle time	0.22	(0.02, 0.42)	47
Market orientation	0.36	(0.14, 0.59)	29	Market orientation	0.43	(-0.03, 0.89)	10
Customer input	0.25	(-0.19, 0.68)	12	Customer input	0.43	(-0.07, 0.93)	11
Cross-functional coordination	0.29	(-0.04, 0.62)	26	Cross-functional integration Cross-functional communication	0.23 0.09	(-0.01, 0.47) (-0.07, 0.25)	29 22
Top management support	0.32		100	Senior management support	0.27	(0.01, 0.53)	19

Table 6-1: Comparison of results for present analysis and analysis of Henard/Szymanski

Although the analysis of Henard and Szymanski (2001) is comparable to the analysis done in the current work only to a limited extent, each meta-analysis contributes in some way to a wider developing theory on innovation management.[563] While the earlier analysis was able to report results that were only partly generalizable in direction, the current work reports effect sizes for several factors that are generalizable in both direction and magnitude. Still, further meta-analyses that include new individual studies are necessary in this research area to improve the understanding and generalizability of success factors in innovation management. However, these future individual studies should consider several important findings of the past and present meta-analyses, some of which were discussed in this section and others of which will be discussed in the next section.

6.2.2 Variance in findings resulting from contextual and methodological differences

This section discusses the findings and the hypothesis confirmation for the factors influenced by moderators. Before detailing the findings for these factors, the general findings regarding each of the moderators are discussed.

[563] The quality and explanatory power of meta-analyses develop over time, depending on the individual studies available in the respective research area. The more information available, the better the analysis and the more valid the results. Cf. Hunter/Schmidt (2004), pp. 403ff.

Each of the six moderators has been confirmed for at least six of the factors analyzed for moderators. Thus, each moderator is relevant and needs to be considered in further primary research. However, contextual moderators are based in the nature of the research object firm, so they need to be considered, but not necessarily corrected for. In contrast, methodological moderators are biases brought into the analyses by the researchers, so researchers must be aware of their potential influence and try to reduce that influence as much as possible.[564]

The context-specific moderator *innovation focus*, which differentiates between products and services, is confirmed for factors from all four categories.[565] Unfortunately, the low number of studies that focused solely on services necessitates using studies that observed a mixture of both product and service innovations to analyze the different relationship effects with financial innovation performance.[566] The resulting analysis reveals that all moderated factors have a higher correlation coefficient when both objects are observed than they do for product innovations alone. This finding may indicate that services are the reason for the higher combined correlation coefficient.[567] To substantiate these findings, further studies should be carried out that either focus solely on services or analyze the differences between products and services. In the current work, only 15 effect sizes out of a total of 277 could be extracted for the moderator specification *services*.[568]

The second context-specific moderator, region, which differentiates the effect sizes between geographical areas, is confirmed for factors from three categories with a strong focus on innovation process characteristics.[569] However, as shown in Table 4-29, nearly 60 percent of the effect sizes included are from studies conducted in North America, while only 15 percent are from Asia and around 10 percent are from Europe. This extreme disproportion in the distribution of available studies may be why, even if the moderator was confirmed for specific factors, further interpretation has been difficult. Consequently, further studies that either compare the results between the regional/cultural differences or focus on countries and regions other than North America are necessary.

The first methodological moderator *level of management* was confirmed for factors in all four categories. The main influence was reported in the category of *innovation process characteristics*,[570] probably because of the context of the specific work carried out by the different levels of management. While project managers are much more involved in day-to-day activities

[564] Cf. Homburg (2007); Ernst (2001), pp. 195ff.; and Homburg/Giering (1996).
[565] See Table 5-4.
[566] When the sub-group *services* could be built, the results were extremely biased because of the low number of available effect sizes, leading to conflicting results.
[567] The reasons for those higher correlations are discussed in section 6.1.1.
[568] See Table 4-27.
[569] See Table 5-5. The reasons for the differences are discussed in section 6.1.1.
[570] See Table 5-6.

and are likely to have an accurate command of the process details, senior managers will answer the questions with a more global view.[571] This result suggests the importance of assessing both views in future studies in order to differentiate the results in terms of the level of management and to better understand the real effect of the factors on financial innovation performance. Furthermore, interpretation of results should add the level of management surveyed in order to put the findings in perspective.

The second methodological moderator, single informant bias, was detected in 77 percent of the included studies.[572] Remarkably, the effect of this bias revealed strong differences among the moderators. These results, calculated in a large sample size, support the findings of Ernst[573] and suggest that researchers should use multi-informants when conducting survey-based research in innovation management.

The third and fourth methodological moderators differentiate the effect sizes along two characteristics of the performance construct. For the first characteristic, *data type of performance construct*, almost all relationships[574] measured with objective data have a lower correlation coefficient than when subjective data are used,[575] possibly because of either a systematic overestimation of the innovation performance when subjective data is used or an issue related to measuring the effect of the specific factors directly through objective financial performance measures. Thus, researchers should keep in mind the differences between the data types used to assess the performance construct. In general, objective information, if available, is more accurate and, by definition, without biases. However, the available data needs to fit with the goals of the analysis. When objective data is difficult to retrieve, subjective data may be the only option;[576] in fact, of the studies included in this meta-analysis, 73 percent used subjective data to measure the performance construct. Nevertheless, more studies using objective data would improve comparability and the reflection of the meta-analysis results.

The second characteristic of the performance construct differentiates the performance measures in terms of the items used in the constructs. Multi-item data appears, in general, to have a higher correlation coefficient than single-item data, and multi-item measures tend to be more reliable than single-item measures. Thus, researcher should use only multi-item measures their future publications.

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[571] Cf. Montoya-Weiss/Calantone (1994), p. 414.
[572] See Table 4-30.
[573] Cf. Ernst (2001), pp. 87ff
[574] Except for innovation orientation, which might be biased because of a very low number of effect sizes included in the *objective data* sub-group.
[575] See Table 5-8.
[576] Cf. Ford et al. (1990), pp. 434ff. Compare also the measures defined by Griffin/Page (1996) for the most adequate performance measurement.

The detailed conclusions about the hypothesized relationships of the analyzed factors with financial innovation performance are discussed in the next paragraphs. Ten factors are detailed: first, the four factors with confirmed positive hypotheses and, second, the six factors for which the hypotheses could not be confirmed.[577]

Explicit innovation strategy. For this factor, the moderator analysis reveals that methodological issues cause the variance in the findings. Except for the number of items used to measure performance construct, all other methodological moderators allow the effect size to be generalized for one or more moderator specifications. However, since sub-group results could not be generalized for any of the moderators, a final effect size could not be established; the available data does not allow for the further hierarchical moderator analysis that would be necessary. To reach a final conclusion in a meta-analysis in the future, more studies about the effect of this factor on financial innovation performance are necessary in which researchers keep in mind the influence of the applied methodology as well as that of the contextual elements of the study samples.

External networks. Even if the effect direction of the factor was confirmed in the complete data set analysis, the moderator analysis for this factor does not offer further details about the true effect size.[578] However, in two sub-groups, the influence of this factor is calculated as null, which may be an effect of a second-order sampling error resulting from the low number of effects used in the sub-group.[579] Thus, further primary analyses of the effect of external networks are necessary to understand more fully the influence of contextual and methodological moderators on this factor.

Market orientation. The moderator analysis for market orientation did not offer further detail about the positive effect on innovation performance found in the total set analysis.[580] However, since three moderators seem to influence the relationship between this factor and financial innovation performance, a future hierarchical moderator analysis might reveal further information. Thus, researchers should focus on analyzing the influence of the innovation focus, the level of management surveyed, and the single-informant bias on this relationship.

Innovation orientation. The magnitude of the effect size of innovation orientation is stable for the innovation object *product*.[581] However, since the other sub-groups for innovation focus could not be generalized, no final results have been reached for this factor; further hierarchical moderator analysis would be necessary to reveal more detailed findings but, because of the

[577] See Table 5-12 and the discussion in 6.2.1: Five factors from category 5 and four from category 3a.
[578] See Table 5-10.
[579] Cf. Hunter/Schmidt (2004), pp. 399ff.
[580] See Table 5-10.
[581] See Table 5-4.

small number of available studies in the sub-groups, this analysis could not be carried out. Consequently, further studies should be conducted that investigate the relationships of the context parameters while keeping the methodological influences in mind.

In contrast to these four factors, the hypothesized effect direction could not be confirmed for the following six factors.[582]

Reduced cycle time. While the direction of the effect could not be confirmed in the complete data set analysis for this factor, the moderator sub-groups confirm for some specifications the positive influence of the factor.[583] However, a clear statement about the true effect sizes in the different sub-groups is still not possible because some data points show clearly that sample sub-groups are interlinked (e.g., worldwide region, project manager level of management, and no single-informant bias) and because only a hierarchical moderator analysis, which could not be conducted here, may reveal more detailed results. Thus, further analyses are necessary to assess the effect in the defined context and in consideration of the methodological biases. Future researchers should keep in mind that reduced cycle time might have a negative influence on financial innovation performance, especially when it may affect the quality of the innovation launched. Therefore, future researchers might develop a more specific construct for reduced cycle time that divides it into concrete activities.[584]

Customer input. The moderator analysis does not reveal any more detailed findings about the true effect sizes of this factor, although it does give some indications of significant differences between the moderator sub-groups[585] that would indicate a negative impact of customer input on financial innovation performance. Future empirical work could address this issue in more detail. Christensen argued that, especially for radical innovations, managers should be aware of how to include customer information in the process.[586] Future meta-analysts may have the opportunity to divide the data between effect sizes, focusing on the differences between radical and incremental innovations, to address the issue for this factor.

Competitor intelligence. The moderator analysis conducted for this factor did not offer additional details about the direction of the effect of competitor intelligence, although some results hinted at a positive effect. Nevertheless, further primary analysis should be conducted for this factor to improve understanding of its effect on financial innovation performance. As was suggested for customer input, the degree of innovativeness might be a reason for the large variances in the results.

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[582] See Table 5-2.
[583] See Table 5-10.
[584] As has been done by Ittner/Larcker (1997), for example.
[585] See Table 5-10.
[586] Cf. Christensen (2006), pp. 51f.

Cross-functional coordination. Although the complete data set analysis revealed an undefined relationship of cross-functional coordination with financial innovation performance, the moderator sub-groups generally confirmed the hypothesized positive effect.[587] However, the large number of moderating elements does not allow for generalization of true effect size magnitudes, for which a further hierarchical moderator analysis would be helpful. However, the low number of available studies precludes this analysis from being conducted here. Further studies in the context of cross-functional coordination that differentiate between innovation object (product or service) and region and that take methodological influences into account may improve the currently unclear situation and allow a more detailed hierarchical moderator analysis.

Market dynamism. The moderator analysis for market dynamism confirms only two methodological elements as moderators, and none of the moderators indicated the true direction for this factor.[588] Therefore, further studies are necessary to improve understanding of the effect of market dynamism on financial innovation performance. Researchers should keep in mind that sampling bias might influence the results of the direct relationship between market dynamism and performance.[589]

Competitive intensity. The hypothesized effect size was not confirmed for this factor in the moderator analysis,[590] either because of a null effect in financial innovation performance or because of the high number of confirmed moderators. The effect size of this factor should be analyzed hierarchically, which was not possible in this analysis because of the low number of available studies. Therefore, further analyses are necessary to determine the influence of competitive intensity on financial innovation performance under different moderating influences. The objective of these analyses should be to support a future meta-analysis in which a hierarchical moderator analysis is possible.

To conclude, even if all of the moderators have been confirmed as true influencing elements, the moderator analysis confirmed the direction of the effect only for the *cross-functional coordination*. Nevertheless, for all ten factors, further analyses are necessary to get a better understanding of the true effect size direction and/or magnitude of the factors. These future studies should consider confirmed context-specific moderators as well as the methodological issues identified.

[587] See Table 5-10.
[588] See Table 5-10.
[589] Also compare the discussion for the factor *technology uncertainty* in section 6.1.5.
[590] See Table 5-10.

In summary, for 16 factors, a final effect size that is generalizable in both direction and magnitude could not be found in the present meta-analysis, so further empirical individual studies are necessary. These 16 factors are:

- Explicit innovation strategy
- New-to-the market products
- Formal product development process
- Reduced cycle time
- Customer input
- Competitor intelligence
- Cross-functional coordination
- External networks
- Available knowledge in workforce
- Market orientation
- Innovation orientation
- Learning orientation
- Formalization
- Decentralization
- Market dynamism
- Competitive intensity

To improve the results of the future studies regarding these factors, researchers should take into account the suggestions detailed in Figure 6-1 in the design of their individual studies.

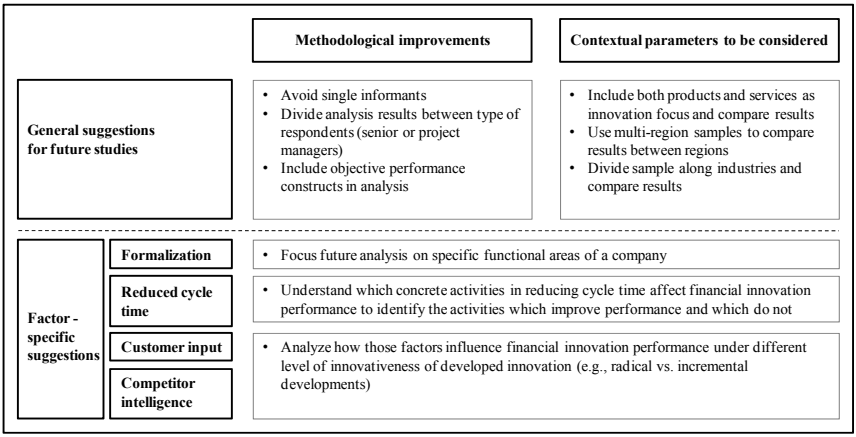

Figure 6-1: Suggested improvements for future studies

The next section will discuss more general avenues of future research, based on the findings of the meta-analysis.

6.3 Avenues for future research in innovation management

In contrast to the detailed, factor-level suggestions in the previous section, this chapter provides general indications for future research topics in the context of innovation management. These remarks are based primarily on Figure 6-2, which reports the factors with the highest correlations with financial innovation performance (relevance) and the number of effect sizes identified (quantity) for the respective factors.[591]

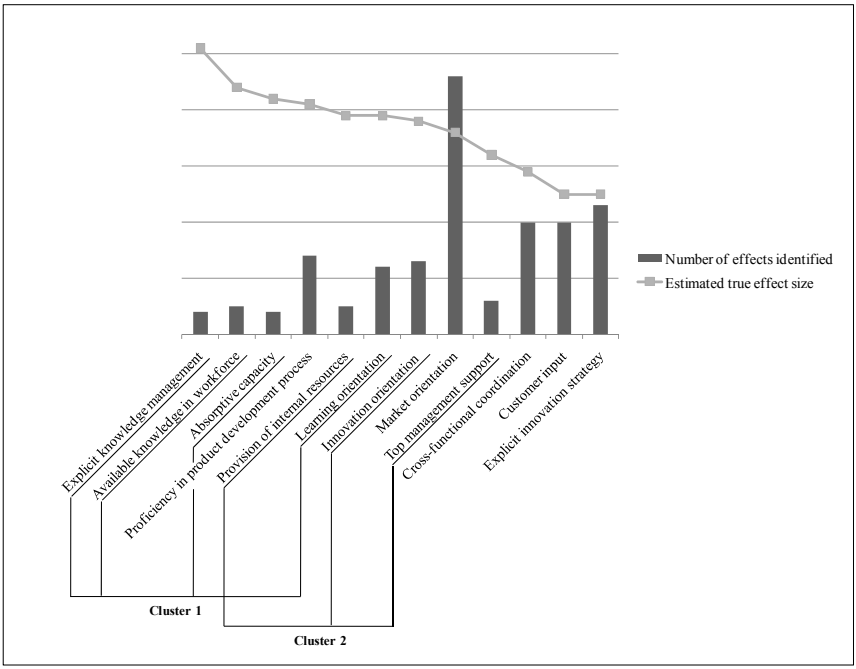

Figure 6-2: Relevance and quantity in current innovation management research

A general observation from Figure 6-2 is the discrepancy between the factors regularly reported (high quantity) and the estimated effect sizes of these factors. Those factors that are clearly linked to being successful in innovation management—market-orientation, proficiency in product development, customer knowledge, and cross-functional coordination—are commonly found in empirical publications. Although these factors play an important role in innovation management, two other clusters of factors have a much greater influence on successful innovation management: The first cluster is linked to the learning innovation management

[591] Data is based on the results reported in Table 5-1.

organization, which is constantly developing and integrating new knowledge into the organization to improve innovation management, and the second cluster contains factors connected to an organizational culture that fosters the development of innovations. For these two clusters, the number of empirical publications in the context of innovation management is very limited.

For the first cluster, a better perception of the abstract concept of *learning orientation* in the context of innovation management would be particularly useful. While several publications have demonstrated the importance of learning orientation in new-product development,[592] they have not provided concrete instructions on how managers can implement a learning orientation in their firms. Thus, future analysis may detail the activities that support learning-orientated innovation management to help managers introduce the concept into practice. In addition, the construct of learning orientation may serve as a mediating factor in relationships between process-specific success factors and innovation performance, so they should be analyzed in future studies. In this context, the type of learning (adaptive vs. generative) may also have an important role, especially when the firm develops innovations with different degrees of innovativeness (incremental vs. radical innovations).

Another interesting research question relates to how to manage newly generated knowledge or that adapted from external sources. While De Luca (2007) focused on the management of market knowledge, Marsh (2006) detailed some activities for a general knowledge management. However, the management of technical knowledge, especially tacit knowledge, in the context of innovation management has not yet been analyzed.[593] A final aspect of this cluster to consider is linked to the factor *available knowledge in workforce;* researchers may answer the questions how to keep knowledge in the firm and protect it from spilling over to competitors, and further which specific knowledge should be available in the innovation project teams to allow them to develop innovations successfully.

In the second cluster, the construct of *innovation orientation* is of central importance. Even if several researchers have referred to this construct,[594] its transformation into practice remains vague. A first approach to understanding the antecedents of innovation orientation was undertaken by Chandler (2000), although the small sample size and the limited number of antecedents did not allow for a complete explanation.[595] In addition to understanding the activities behind an innovation orientation, researchers should also deepen the comprehension of the effects of innovation orientation as a mediating factor in the context of innovation management. Another factor in this cluster is that of *provision of resources*. While researchers who

[592] Cf. Atuahene-Gima et al. (2005) and Baker/Sinkula (1999).
[593] Cf. De Luca/Atuahene-Gima (2007) and Marsh/Stock (2006).
[594] Cf. Kleinschmidt et al. (2007), p. 423; Olson et al. (2005), p. 52; and Cooper/Kleinschmidt (1995), p. 377.
[595] Cf. Chandler et al. (2000).

have analyzed this constructs have emphasized the importance of providing necessary resources,[596] which resources and how much of them are needed to be provided to be successful remains unclear. There may also be different resources of interest, depending on the specific step in the innovation process or the innovation's degree of innovativeness.

In summary, future analysis should focus on more sophisticated and detailed understanding of how organizations should set up their innovation management to foster learning and develop a culture of innovation. The next section will detail the limitations of the meta-analysis and derive further opportunities for future research.

[596] Cf. Kleinschmidt et al. (2007), p. 424 and Cooper/Kleinschmidt (1995), p. 378.

6.4 Limitations of the results

The next paragraphs detail the limitations of this work. As widely acknowledged and documented in the meta-analysis literature,[597] any quantitative synthesis is constrained by the nature and scope of the original studies on which it is based, so limitations should be kept in mind when interpreting the findings.

First, not all available studies are included in the meta-analysis since several studies did not report correlations and their authors did not respond to the request to send the missing details. Authors of future studies should include all information concerning the measures used (e.g., reliability information for independent and dependent variables), as well as correlation matrices (e.g., into the annex of a publication).
Second, the selection of study characteristics that influence financial innovation performance was limited to variables that could be coded from the information provided in the studies or requested from the authors of the studies.
Third, only those factors were included for which the impact on financial innovation performance had been studied with a certain level of frequency. Future meta-analyses may have the opportunity to extend the number of factors included if the number of studies on factors that were not be included in the present study (e.g., portfolio management, new-to-the-firm products, quality management) has increased.

Fourth, all studies included here used cross-sectional data, which restricts the ability to draw causal conclusions. For causal conclusions to be drawn with any confidence, time-series data, which is currently not available in the innovation management literature, are necessary. Therefore, the reliance on cross-sectional data is given by the nature of the research area.
Fifth, the relationships reported in the studies used in the meta-analysis might be positively biased as a result of oversampling from the efficient frontier of firms. Firms that fail to innovate successfully are more likely to have exited the marketplace and so are less likely to have been captured in the samples used in innovation management studies. Unfortunately, only very limited data about the sample selection in the identified studies is available, so a correction of this range restriction through the original studies was not possible. Researchers might support future meta-analyses by adding more detailed information about the sample selection in their publications.

Sixth, a meta-analysis is limited to examining only those moderating elements that can be coded from the extant literature. Because the remaining variance for some factors could not be fully explained in the available moderator sub-groups, other moderating elements might be

[597] Cf. Lipsey/Wilson (2001), p. 157 and Hunter/Schmidt (2004), pp. 511ff.

influencing the analyzed relationship; other contextual factors (e.g., industry, innovativeness of innovation, or age of company) or methodological factors (e.g., respondent characteristics or department surveyed) may be the reason for these variances and should be reported in future studies conducted in this field.
Seventh, the use of correlation coefficients allows measurement only of the strength of a linear relationship between two variables. However, if a zero correlation is estimated, there is a chance of observing a vivid curvilinear relationship between variables.

The final limitation of the study is the sample size of the meta-analysis, which consisted of 45 studies. Although this is a common sample size in the management literature,[598] it is also the reason for two restrictions in this work. First, the available effect size information did not allow a multivariate analysis to be conducted, although such an analysis might have revealed further information about the interactions between the dependent variables. Second, the low number of effect sizes made a hierarchical moderator analysis impossible. Consequently, the findings from the moderator analysis should be denoted as preliminary, although all of them are the best possible estimations currently available for the true effect size.[599]

[598] Cf. Hunter/Schmidt (2004), p. 472, and compare the studies of Troy et al. (2008) (25 studies used), Song et al. (2008) (31 studies used), Henard/Szymanski (2001) (41 studies used). In other research areas, like psychology, meta-analysis often includes many more studies, e.g., Combs et al. (2006) (92 studies used), Kristof-Brown et al. (2005) (172 studies used).
[599] Following the argumentation of Song et al. (2008), p. 17 and Hunter/Schmidt (2004), p. 406.

7 Conclusions

Innovations can be both a blessing and a curse. Firms may be propelled into dominating market positions by innovations, while others may lose the ability to survive in their original markets. Therefore, innovation management is commonly understood as a central system and function of a firm's ability to keep up with developments in the market. Understanding of successful innovation management has been deepened by a great number of primary empirical studies, but these studies often show conflicting results, making it difficult for managers and researchers to act on them. At the same time, extant meta-analyses have substantial deficits in reaching conclusions about the generalizability of effect sizes for firms: Most analyses focus only on product-level performance, precluding the ability to draw conclusions about the firm as a whole. The objective of this dissertation was to deepen the understanding of the factors that influence the success of innovation management in a firm by performing a meta-analytic review procedure that facilitates reflections on and explanations of the differences among the single studies.

Based on a meta-analysis sample of 45 studies, with 47 samples and 277 effect sizes, 23 different success factors were analyzed, classified into four categories: (1) strategic attributes, (2) innovation-process characteristics, (3) organizational or cultural aspects and (4) environmental specifications. The meta-analysis conducted generally follows the suggestions of Hunter and Schmidt (2004)[600] and is divided into a complete data set analysis and moderator analyses.

The hypothesized direction could be generalized for fifteen of the twenty-three factors in a large sample-size setting with more than 11,000 individual observations. For six of these factors, the magnitude of the effect size could be generalized, but further primary analyses were needed for the eight remaining factors in order to determine their true effect on success in innovation management. The analyses also revealed some interesting insights for managers, leading to recommendations about the topics on which they should reflect during decision-making in the context of innovation management. In particular, the role of knowledge management and an environment of learning are important success factors on which managers can have a substantial effect. A clear managerial commitment to innovations and a sophisticated innovation process also support successful innovation management.

[600] Hunter/Schmidt (2004).

M. Sattler, *Excellence in Innovation Management,* DOI 10.1007/978-3-8349-6158-7_7,

Appendix

(1) Overview of databases for literature search

No.	Author	Titel	Year	Journal	Issue	Rating Journal (VHB Ranking)	Document ID (Endnote-number)	copied	read
1	Haiyang Li; Kwaku Atuahene-Gima	PRODUCT INNOVATION STRATEGY AND THE PERFORM	2001	Acad.MJ	6	A+	23	x	x
2	Wenpin Tsai	KNOWLEDGE TRANSFER IN INTRAORGANIZATIONAL NE	2001	Acad.MJ	5	A+	24	x	x
3	Chander, Gaylen N.; Keller, Chalon; Lyon, Douglas W	Unraveling the Determinants and Consequences of an Innov	2000	Entr.: T&P	1	C	179	x	x
4	Pek-Hooi Soh, Roberts, Edward B	Technology Alliances and Networks: An External Link to Rese	2005	IEEE EM	4	B	180	x	x
5	Langerak, Fred Hultink, Erik Jan	The Impact of New Product Development Acceleration Appro	2005	IEEE EM	1	B	182	x	x
6	DeTienne, Dawn R.; Koberg, Christine S.	The Impact of Environmental and Organizational Factors on E	2002	IEEE EM	4	B	185	x	x
7	Sandvik, Izabela Leskiewicz; Sandvik, Kåre	The impact of market orientation on product innovativeness a	2003	IJRM	4	A	328	x	x
8	Frambach, Ruud T.; Prabhu, Jaideep; Verhallen, Theo	The influence of business strategy on new product activity: Th	2003	IJRM	4	A	329	x	x
9	Gemünden, Hans Georg; Ritter, Thomas; Heydebreck, Peter	Network configuration and innovation success: An empirical a	1996	IJRM	5	A	334	x	x
10	Cordón-Pozo, Eulogio; García-Morales, Víctor; Aragón	Inter-departmental collaboration and new product developme	2006	IJTM	5,No.1-4	C	199	x	x
11	Xueli Huang; Steffens, Paul; Schroder, Bill	Managing new product development in the Chinese steel indu	2002	IJTM	4, No.5/6	C	216	x	x
12	Shahid Yamin; A. Gunasekaran; Felix T. Mavondo	Innovation index and its implications on organisational perfor	1999	IJTM	17, No. 5	C	204	x	x
13	Malerba, Franco; Marengo, Luigi	Competence, innovative activities and economic performanc	1995	IJTM	0, No.4-6	C	207	x	x

Table 7-1: Extract of database used to display identified studies

Datenbank	Keywords	Filter	Status	Comments
EBSCO Business	Innova*	JN "IEEE Transactions on Engineering Management"	Done	
EBSCO Business	Product Development	JN "IEEE Transactions on Engineering Management"	Done	
EBSCO Business	New product	JN "IEEE Transactions on Engineering Management"	Done	
EBSCO Business	Innova*	JN "R&D Management"	Done	
EBSCO Business	Product Development	JN "R&D Management"	Done	
EBSCO Business	New product	JN "R&D Management"	Done	
EBSCO Business	Innova*	JN "Journal of Business Venturing"	Done	
EBSCO Business	Product Development	JN "Journal of Business Venturing"	Done	
EBSCO Business	New product	JN "Journal of Business Venturing"	Done	
EBSCO Business	Innova*	JN "Academy of Management Journal"	Done	
EBSCO Business	Product Development	JN "Academy of Management Journal"	Done	
EBSCO Business	New product	JN "Academy of Management Journal"	Done	
EBSCO Business	Innova*	JN "Management Science"	Done	
EBSCO Business	Product Development	JN "Management Science"	Done	

Table 7-2: Extract of database used to report identification process

M. Sattler, *Excellence in Innovation Management,* DOI 10.1007/978-3-8349-6158-7,

(2) Studies identified

Authors	Title of publication	Eligible constructs	Performance measures
Atuahene-Gima, Slater & Olson (2005)	The Contingent Value of Responsive and Proactive Market Orientations for New Product Program Performance	- Explicit innovation strategy - Provision of resources - Market orientation - Learning orientation - Firm size - Market dynamism - Technological uncertainty	- New products program performance
Baker & Sinkula (1999)	The Synergistic Effect of Market Orientation and Learning Orientation on Organizational Performance	- Market orientation - Learning orientation	- New product success (all products) - Overall performance
Baker & Sinkula (2005)	Market Orientation and the New Product Paradox	- New-to-the market products - Market orientation	- Relative profitability change - Relative change of market shares
Bart & Pujari (2007)	The Performance Impact of Content and Process in Product Innovation Charters	- Explicit innovation strategy*	- New product performance (all products)
Bart (2002)	Product Innovation Charters: Mission Statements for New Products	- Explicit innovation strategy*	- New product performance (all products)
Belderbos, Carree & Lokshin (2004)	Cooperative R&D and Firm Performance	- Customer input - External networks - Customer input	- Growth in sales of new products
Calantone, Garcia & Dröge (2003)	The Effects of Environmental Turbulence on New Product Development Strategy Planning	- Reduced cycle time - Cross-functional coordination - Market orientation - Innovation orientation - Top management support - Firm size - Market dynamism - Technological uncertainty	- New product development program performance
Calantone, Vickery & Dröge (1995)	Business Performance and Strategic New Product Development Activities: An Empirical Investigation	- Proficiency in product development process - Reduced cycle time	- Relative ROI growth - Relative market growth - Relative ROS growth

* different underlying original constructs

Authors	Title of publication	Eligible constructs	Performance measures
Chandler, Keller & Lyon (2000)	Unraveling the Determinants and Consequences of an Innovation-Supportive Organizational Culture	- Innovation orientation - Firm size - Competitive intensity	- Sales growth - Profitability
Cooper & Kleinschmidt (1995)	Benchmarking the Firm's Critical Success Factors in New Product Development	- Explicit innovation strategy - Provision of resources - Formal product development process - Cross-functional coordination - Available knowledge in workforce - Innovation orientation - Absorptive capacity - Top management support	- Relative program profitability - Program impact
De Luca & Atuahene-Gima (2007)	Market Knowledge Dimensions and Cross-Functional Collaboration: Examining the Different Routes to Product Innovation Performance	- New-to-the market products - Provision of resources - Cross-functional coordination - Explicit knowledge management - Market orientation - Market dynamism - Technological uncertainty	- Product innovation performance (all products)
Deshpande & Farley (1999)	Executive Insights: Corporate Culture and Market Orientation: Comparing Indian and Japanese Firms	- Market orientation - Innovation orientation	- Firm performance
Hult, Hurley & Knight (2004)	Innovativeness: Its Antecedents and Impact on Business Performance	- Customer input - Competitor intelligence - Cross-functional coordination - Innovation orientation - Learning orientation - Market dynamism	- Relative business performance
Im, Nakata, Park & Ha (2003)	Determinants of Korean and Japanese New Product Performance: An Interrelational and Process View	- Proficiency in product development process - Cross-functional coordination - Available knowledge in workforce - Market orientation	- New products performance (all products)
Ittner & Larcker (1997)	Product Development Cycle Time and Organizational Performance	- Explicit innovation strategy - Reduced cycle time - Customer input - Cross-functional coordination - External networks	- Perceived performance - ROA - ROS - Growth
Jaworski & Kohli (1993)	Market Orientation: Antecedents and Consequences.	- Market orientation - Competitive intensity	- Relative overall performance - Market share

Authors	Title of publication	Eligible constructs	Performance measures
Kleinschmidt, Brentani & Salomo (2007)	Performance of Global New Product Development Programs: A Resource-Based View	- Provision of resources - Formal product development process - Proficiency in product development process - Innovation orientation - Top management support	- Relative firm financial performance
Kropp, Lindsay, & Shoham (2006)	Entrepreneurial, Market, and Learning Orientations and International Entrepreneurial-Business Venture Performance in South African Firms	- Market orientation - Innovation orientation - Learning orientation	- Objective firm performance - Subjective firm performance
Langerak & Hultink (2005)	The Impact of New Product Development Acceleration Approaches on Speed and Profitability: Lessons for Pioneers and Fast Followers	- Reduced cycle time - Customer input - Cross-functional coordination - External networks - Available knowledge in workforce - Decentralization	- Subjective satisfaction with firm financial performance
Langerak, Hultink & Robben (2004)*	The Impact of Market Orientation, Product Advantage, and Launch Proficiency on New Product Performance and Organizational Performance	- Market orientation*	- Organizational performance
Langerak, Hultink & Robben (2004)*	The Role of Predevelopment Activities in the Relationship Between Market Orientation and Performance	- Market orientation* - Market dynamism - Technological uncertainty	- Organizational performance
Li & Atuahene-Gima (2001)	Product Innovation Strategy and the Performance of New Technology Ventures in China	- Explicit innovation strategy - External networks - Firm size - Market dynamism	- Relative firm performance
Marsh & Stock (2006)	Creating Dynamic Capability: The Role of Intertemporal Integration, Knowledge Retention, and Interpretation	- Explicit knowledge management - Absorptive capacity - Firm size	- Relative new product development performance
Matsuno & Mentzer (2000)	The Effects of Strategy Type on the Market Orientation-Performance Relationship	- Market orientation	- Relative ROI - Relative market share growth - Relative sales growth

* different journals and underlying original constructs

Authors	Title of publication	Eligible constructs	Performance measures
Mavondo, Chimhanzi & Stewart (2005)	Learning Orientation and Market Orientation: Relationship with Innovation, Human Resource Practices and Performance.	- Market orientation - Learning orientation	Financial performance
Moorman & Rust (1999)	The Role of Marketing	- Customer input - Competitor intelligence - Cross-functional coordination - Market orientation - Firm size	- New product performance (all products) - Firm financial performance
Morgan & Vorhies (2001)	Product Quality Alignment and Business Unit Performance	- Cross-functional coordination - Firm size - Competitive intensity	- Relative business performance
Narver, Slater & MacLachlan (2004)	Responsive and Proactive Market Orientation and New-Product Success	- Explicit innovation strategy - Market orientation	- New product success (all products)
Olson, Slater & Hult (2005)	The Performance Implications of Fit Among Business Strategy, Marketing Organization Structure, and Strategic Behavior	- Customer input - Competitor intelligence - Innovation orientation - Formalization - Decentralization - Firm size - Market dynamism - Technological uncertainty	- Overall firm performance
Pelham & Wilson (1996)	A Longitudinal Study of the Impact of Market Structure, Firm Structure, Strategy, and Market Orientation Culture on Dimensions of Small-Firm Performance	- Explicit innovation strategy - Market orientation - Formalization - Decentralization - Market dynamism - Competitive intensity	- Average sales growth/market share - Profitability
Pelham (2000)	Market Orientation and Other Potential Influences on Performance in Small and Medium-Sized Manufacturing Firms	- Explicit innovation strategy - Customer input - Competitor intelligence - Market orientation - Competitive intensity	- Relative profitability - Relative growth/market share
Sandvik & Sandvik (2003)	The Impact of Market Orientation on Product Innovativeness and Business Performance	- New-to-the market products - Market orientation	- Sales growth - Profitability

Authors	Title of publication	Eligible constructs	Performance measures
Slater & Narver (1994)	Does Competitive Environment Moderate the Market Orientation-Performance Relationship?	- Market orientation - Firm size - Market dynamism - Technological uncertainty - Competitive intensity	- Relative ROA - Relative sales growth - Relative new product success (all products)
Slater, Hult & Olson (2007)	On the Importance of Matching Strategic Behavior and Target Market Selection to Business Strategy in High-Tech Markets	- Customer input - Competitor intelligence - Technological uncertainty - Competitive intensity	Overall firm performance
Souitaris (2002)	Firm-Specific Competencies Determining Technological Innovation: A Survey in Greece	- Cross-functional coordination - Top management support	- Percentage of current sales due to new products
Thornhill (2006)	Knowledge, Innovation and Firm Performance in High- and Low-Technology Regimes	- Competitive intensity	- Revenue growth
Tsai (2001)	Knowledge Transfer in Intraorganizational Networks: Effects of Network Position and Absorptive Capacity on Business Unit Innovation and Performance	- Absorptive capacity - Firm size - Competitive intensity	- Profitability achieved rate
Tuominen & Anttila (2006)	Strategising for Innovation and Inter-Firm Collaboration: Capability Analysis in Assessing Competitive Superiority	- External networks - Customer input	- Performance advantage
Vázquez, Santos & Álvarez (2001	Market Orientation, Innovation and Competitive Strategies in Industrial Firms.	- Market orientation - Innovation orientation	- Relative company performance
Voss & Voss (2000)	Strategic Orientation and Firm Performance in an Artistic Environment	- Explicit innovation strategy - Customer input - Competitor intelligence - Cross-functional coordination	- Perceived financial performance - Total income - Net surplus/deficit

Authors	Title of publication	Eligible constructs	Performance measures
Wei & Morgan (2004)	Supportiveness of Organizational Climate, Market Orientation, and New Product Performance in Chinese Firms	- Market orientation - Firm size	- Relative new product performance (all products)
Wirtz, Mathieu & Schilke (2007)	Strategy in High-Velocity Environments	- Explicit innovation strategy - External networks - Learning orientation	- Profitability - Growth
Wong & Ellis (2007)	Is Market Orientation Affected by the Product Life Cycle?	- Market orientation - Market dynamism - Technological uncertainty - Competitive intensity	- Relative market performance
Yam, Guan, Pun & Tang (2004)	An Audit of Technological Innovation Capabilities in Chinese Firms: Some Empirical Findings in Beijing, China	- Explicit innovation strategy - Formal product development process	- Sales growth
Zahrah & Covin (1993)	Business Strategy, Technology Policy and Firm Performance	- Innovation orientation	- Firm performance

Table 7-3: Included studies into meta-analysis

Authors	Title of publication	Reason for exclusion
Barczak (1995)	New Product Strategy, Structure, Process, and Performance in the Telecommunications Industry	Author didn't send requested data
Calantone, Di Benedetto & Divine (1993)	Organisational, Technical and Marketing Antecedents for Successful New Product Development	Author didn't send requested data
Capon, Farley, Lehmann & Hulbert (1992)	Profiles of Product Innovators among Large U.S. Manufacturers	Author didn't send requested data
Cordón-Pozo, García-Morales & Aragôn-Correa (2006)	Inter-Departmental Collaboration and New Product Development Success	Author didn't send requested data
De Brentani & Kleinschmidt (2004)	Corporate Culture and Commitment: Impact on Performance of International New Product Development Programs	Author didn't send requested data
Deshpande, Farley & Webster Jr. (1993)	Corporate Culture Customer Orientation, and Innovativeness in Japanese Firms	Same sample as in other study
Dyer & Song (1997)	The Impact of Strategy on Conflict: A Cross-National Comparative Study of U.S. and Japanese Firms	Same sample as in other study
Dyer & Song (1998)	Innovation Strategy and Sanctioned Conflict: A New Edge in Innovation?	Unique constructs
Gemser & Leenders (2001)	How Integrating Industrial Design in the Product Development Process Impacts on Company Performance	Unique constructs
Gemünden, Heydebreck & Herden (1992)	Technological Interweavement: A Means of Achieving Innovation Success	Author didn't send requested data
Hadjimanolis (2000)	An Investigation of Innovation Antecedents in Small Firms in the Context of a Small Developing Country	Author didn't send requested data
Han, Kim & Srivastava (1998)	Market Orientation and Organizational Performance: Is Innovation a Missing Link	Author didn't send requested data
Kahn (1996)	Interdepartmental Integration: A Definition with Implications for Product Development Performance	Same sample as in other study
Markham & Griffin (1998)	The Breakfast of Champions: Associations Between Champions and Product Development Environments, Practices and Performance.	Unique constructs
Matsuno, Mentzer & Özsomer (2002)	The Effects of Entrepreneurial Proclivity and Market Orientation on Business Performance	Same sample as in other study

Authors	Title of publication	Reason for exclusion
Narver & Slater (1990)	The Effect of a Market Orientation on Business Profitability	Same sample as in other study
Nicholson, Rees & Brooics-Rooney (1990)	Strategy, Innovation and Performance	Author didn't send requested data
Nijssen, Biemans & De Kort (2002)	Involving Purchasing in New Product Development	Author didn't send requested data
Oczkowski & Farrell (1998)	Discriminating Between Measurement Scales Using Non-Nested Tests and Two-Stage Least Squares Estimators: The Case of Market Orientation	Author didn't send requested data
Page (1993)	Assessing New Product Development Practices and Performance: Establishing Crucial Norms	Author didn't send requested data
Pelham (1997)	Mediating Influences on the Relationship Between Market Orientation and Profitability in Small Firms	Same sample as in other study
Song & Parry (1992)	The R&D-Marketing Interface in Japanese High-Technology Firms	Unique constructs
Song, Dyer & Thieme (2006)	Conflict Management and Innovation Performance: An Integrated Contingency Perspective.	Unique constructs
Song, Montoya-Weiss & Schmidt (1997)	Antecedents and Consequences of Cross-Functional Cooperation: A Comparison of R&D, Manufacturing, and Marketing Perspectives	Author didn't send requested data
Song, Xie & Dyer (2000)	Antecedents and Consequences of Marketing Managers' Conflict-Handling Behaviors	Author didn't send requested data
Tajeddini, Trueman & Larsen (2006)	Examining the Effect of Market Orientation on Innovativeness	Author didn't send requested data
Terwiesch, Loch & Niederkofler (1998)	When Product Development Performance Makes a Difference: A Statistical Analysis in the Electronics Industry	Unique constructs
Verhees & Meulenberg (2004)	Market Orientation, Innovativeness, Product Innovation, and Performance in Small Firms	Author didn't send requested data
Xie, Song & Stringfellow (1998)	Interfunctional Conflict, Conflict Resolution Styles, and New Product Success: A Four Culture Comparison	Author didn't send requested data
Youngbae, Song & Lee (1993)	Determinants of Technological Innovation in the Small Firms of Korea	Author didn't send requested data

Table 7-4: Excluded studies

(3) Coding Protocol

SUBJECT	CODING PROCEDURE
1. General study and coding information	
Document ID (Endnote):	Number
Title:	Study Title
Authors:	Name
Year:	Date
Publication:	1 = Journal of Product Innovation Management
	2 = Journal of Marketing
	3 = Journal of Marketing Research
	4 = Academy of Management Journal
	5 = Journal of the Academy of Marketing
	6 = Management Science
	7 = Marketing Science
	8 = Journal of International Marketing
	9 = R&D Management
	10 = Organization Science
	11 = Strategic Management Journal
	12 = Journal of Small Business Management
	13 = IEEE Transactions on Engineering Management
	14 = Journal of Business Venturing
	15 = Other Journal (specify)
Coder:	Name
Time needed (in minutes) to code this report:	Time
Reason for rejection:	Text
Interesting links to other studies in bibliography:	Denotation (Text)
2. Study context parameters	
Industry:	Denotation (Text)
Country:	Denotation (Text)
Region:	1 = North America
	2 = Europe
	3 = Asia-Pacific
	4 = Africa
	5 = South America
	6 = Worldwide
	7 = not specified
Size of companies in sample:	1 = Large
	2 = Medium
	3 = Large
	4 = Mix
	5 = not specified
Indicator used to define size of companies:	1 = Financial ratio (Sales, Profitability, etc.)
	2 = Employees
	3 = Other indicator (specify)
Type of companies:	1 = B-to-B
	2 = B-to-C
	3 = Both
	4 = Not specified
Type(s) of innovations in focus:	1 = Product
	2 = Service
	3 = Both
	4 = Not specified

SUBJECT	CODING PROCEDURE
3. Theoretical backgrounds of study	
Theories used in argumentation:	1 = Resource-based view
	2 = Contingency theory
	3 = Organizational theory
	4 = Other theory (specify…)
4. Survey design information	
Selection of sample:	1 = Randomly selected from database
	2 = Pre-defined companies
	3 = Other selection (specify)
	4 = Not specified
Design of survey:	1 = New developed constructs used
	2 = Constructs adapted from …. (specify source)
	3 = Constructs taken from …. (specify source)
	4 = Not specified
Test for construct validity:	1 = Expert Interviews
	2 = Pre-test of survey
	3 = Factor analysis
	4 = Other validity test (specify)
	5 = Mixed
	6 = Not specified
Test for construct reliability:	1 = Cronbach Alpha
	2 = AVE
	3 = Other reliability measure (specify)
	4 = Mixed
	5 = Not specified
5. Survey execution information	
Total sample size:	Number
Level of analysis object:	1 = Company
	2 = Business Unit
	3 = Program
	4 = Project
	5 = Product
	6 = Mix (specify)
	7 = Not specified
Financial performance measure on same level as analysis:	1 = Yes
	2 = No
	3 = Not specified
Type of management level of respondent:	1 = Senior Management
	2 = Project Management
	3 = Not specified
Functional perspective of respondent:	1 = R&D
	2 = Marketing
	3 = General Management
	4 = Production
	5 = Strategy
	6 = Other perspective (specify)
	7 = Not specified
Single-informant bias:	1 = Yes
	2 = No
	3 = Not specified
Common source bias:	1 = Yes
	2 = No
	3 = Not specified
Non response bias:	1 = Yes
	2 = No
	3 = Not specified

SUBJECT	CODING PROCEDURE
Common method bias:	1 = Yes
	2 = No
	3 = Not specified
Number of effects in study relevant in the innovation management context:	Number
6. General effect size Information	
Type of effect size:	1 = Differences between means
	2 = Odds-Ratio
	3 = Pearson correlation coefficient
	4 = Point-biserial correlation coefficient
	5 = Regression coefficient
	6 = Canoncial correlation coefficient
	7 = Spearman correlation coefficient
	8 = Partial correlation coefficient
	9 = Structural equation model coefficient
	10 = Others (specify)
Usability of effect size type in meta-analysis:	1 = Yes
	2 = No
	3 = Further information necessary
Missing information to be requested from author of study:	Details (Text)
7. Specific effect size information (for each effect size in study separately)	
Effect ID:	Doc_ID_n (n = number of effect)
Independent variable:	Denotion (Text)
Defintion of independent variable:	Denotion (Text)
Mean of independent variable:	Value
S.D. of independent variable:	Value
Scale used to measure independent variable:	1 = 5-Point Likert Scale
	2 = 7-Point Likert Scale
	3 = 10-Point Likert Scale
	4 = Dichomotized Scale
	5 = Other scale (specify)
Type of reliablity measure of independent variable:	1 = Cronbach Alpha
	2 = AVE
	3 = Other reliability measure (specify)
	4 = Not specified
Reliablity measure of independent variable:	Value
Dependent variable (performance measure):	Denotion (Text)
Defintion of dependent variable:	Denotion (Text)
Mean of dependent variable:	Value
S.D. of dependent variable:	Value
Data type for dependent variable:	1 = Objective measure
	2 = Subjective measure
	3 = Both
	4 = Not specified
Items used to measure dependent variable:	1 = Single-item
	2 = Multi-item
	3 = Not specified
Scale used to measure dependent variable:	1 = 5-Point Likert Scale
	2 = 7-Point Likert Scale
	3 = 10-Point Likert Scale
	4 = Dichomotized Scale
	5 = Other scale (specify)

SUBJECT	CODING PROCEDURE
Type of reliablity measure of dependent variable:	1 = Cronbach Alpha
	2 = AVE
	3 = Other reliability measure (specify)
	4 = Not specified
Reliablity measure of dependent variable:	Value
Effect size:	Value
Significance level of effect size:	1 = $p < 0.05$
	2 = $p < 0.01$
	3 = $p < 0.001$
	4 = Other (specify)
	5 = Not significant
	6 = Not specified

Table 7-5: Coding protocol

(4) Averaged reliability coefficient for the success factors and the performance variable

Variables	**Averaged reliability coefficient**
New-to-the-market products	0.870
Provision of internal resources	0.847
Formal product development process	0.915
Proficiency in product development process	0.713
Reduced cycle time	0.716
Customer input	0.798
Competitor intelligence	0.798
Cross-functional coordination	0.768
External networks	0.740
Available knowledge in workforce	0.853
Market orientation	0.819
Innovation orientation	0.807
Learning orientation	0.836
Top management support	0.740
Formalization	0.730
Decentralization	0.867
Firm size	0.918
Market dynamism	0.695
Technological uncertainty	0.708
Competitive intensity	0.728
Financial innovation performance	0.795

Table 7-6: Averaged reliability coefficient for variables

Bibliography

Adams, R./Bessant, J./Phelps, R. (2006): Innovation Management Measurement: A Review, in: International Journal of Management Reviews, 8 (1), pp. 21-47.

Allen, T. J. (1971): Communications, Technology Transfer, and the Role of Technical Gatekeeper, in: R&D Management, 1 (1), pp. 14-21.

Allen, T. J. (1977): Managing the Flow of Technology: Technology Transfer and the Dissemination of Technological Information within the R and D Organization, Cambridge.

Ancona, D. G./Caldwell, D. F. (1990): Beyond Boundary Spanning: Managing External Dependence in Product Development Teams, in: Journal of High Technology Management Research, 1 (1), pp. 119-135.

Ancona, D. G./Caldwell, D. F. (1992a): Bridging the Boundary: External Activity and Performance in Organizational Teams, in: Administrative Science Quarterly, 37 (4), pp. 634-665.

Ancona, D. G./Caldwell, D. F. (1992b): Demography and Design: Predictors of New Product Team Performance, in: Organization Science (OS), 3 (3), pp. 321-341.

Andriopoulos, C. (2001): Determinants of Organizational Creativity: A Literature Review, in: Management Decision, 39 (10), pp. 834-840.

Annacker, D. (2001): Unbeobachtbare Einflussgrößen in der Strategischen Erfolgsfaktorenforschung: Ein Kausalanalytischer Ansatz auf Basis von Paneldaten, Wiesbaden.

Assael, H./Keon, J. (1982): Nonsampling vs. Sampling Errors in Survey Research, in: Journal of Marketing (JoM), 46 (2), pp. 114-123.

Atuahene-Gima, K. (1995): An Exploratory Analysis of the Impact of Market Orientation on New Product Performance, in: Journal of Product Innovation Management (JPIM), 12 (4), pp. 275-293.

Atuahene-Gima, K. (2005): Resolving the Capability - Rigidity Paradox in New Product Innovation, in: Journal of Marketing (JoM), 69 (4), pp. 61-83.

Atuahene-Gima, K./Slater, S. F./Olson, E. M. (2005): The Contingent Value of Responsive and Proactive Market Orientations for New Product Program Performance, in: Journal of Product Innovation Management (JPIM), 22 (6), pp. 464-482.

Bagozzi, R. P. (1998): A Prospectus for Theory Construction in Marketing: Revisited and Revised, in: Hildebrandt, L./Homburg, C. (Eds.): Die Kausalanalyse ein Instrument der Empirischen Betriebswirtschaftlichen Forschung, Stuttgart, pp. 45-81.

Bagozzi, R. P./Youjae, Y./Phillips, L. W. (1991): Assessing Construct Validity in Organizational Research, in: Administrative Science Quarterly, 36 (3), pp. 421-458.

M. Sattler, *Excellence in Innovation Management,* DOI 10.1007/978-3-8349-6158-7,

Baker, W. E./Sinkula, J. M. (1999): The Synergistic Effect of Market Orientation and Learning Orientation on Organizational Performance, in: Journal of the Academy of Marketing Science, 27 (4), pp. 411-427.

Baker, W. E./Sinkula, J. M. (2005): Market Orientation and the New Product Paradox, in: Journal of Product Innovation Management (JPIM), 22 (6), pp. 483-502.

Balachandra, R./Friar, J. H. (1997): Factors for Success in R&D Projects and New Products, in: IEEE Transactions on Engineering Management, 44 (3), pp. 276-287.

Bangert-Drowns, R. L. (1986): Review of Developments in Meta-Analytic Method, in: Psychological Bulletin, 99 (3), pp. 388-399.

Bangert-Drowns, R. L./Kulik, J. A./Kulik, C.-l. C. (1984): Effects of Coaching Programs on Achievement Test Performance, in: Review of Educational Research, 53 (4), pp. 571-585.

Barczak, G. (1995): New Product Strategy, Structure, Process, and Performance in the Telecommunications Industry, in: Journal of Product Innovation Management (JPIM), 12 (3), pp. 224-234.

Barczak, G./Griffin, A./Kahn, K. B. (2009): Perspective: Trends and Drivers of Success in NPD Practices: Results of the 2003 PDMA Best Practices Study, in: Journal of Product Innovation Management (JPIM), 26 (1), pp. 3-23.

Bart, C./Pujari, A. (2007): The Performance Impact of Content and Process in Product Innovation Charters, in: Journal of Product Innovation Management (JPIM), 24 (1), pp. 3-19.

Bart, C. K. (2002): Product Innovation Charters: Mission Statements for New Products, in: R&D Management, 32 (1), pp. 23-34.

Bauer, H. H./Sauer, N. E. (2004): Die Erfolgsfaktorenforschung als Schwarzes Loch?, in: Die Betriebswirtschaft (DBW), 64 (4), pp. 621-623.

Becker, B. J. (1988): Synthesizing Standardized Mean-Change Measures, in: British Journal of Mathematical and Statistical psychology, 41 (2), pp. 257-278.

Begg, C. B. (1994): Publication Bias, in: Cooper, H./Hedges, L. V. (Eds.): The Handbook of Research Synthesis, New York, pp. 399-409.

Belderbos, R./Carree, M./Lokshin, B. (2004): Cooperative R&D and Firm Performance, in: Research Policy (RP), 33 (10), pp. 1477-1492.

Benkenstein, M. (1987): Koordination von Forschung u. Entwicklung und Marketing, in: Marketing ZFP, 9 (2), pp. 123-132.

Bertalanffy, L. v. (1960): Problems of Life, American ed., New York.

Bertalanffy, L. v. (1968): General System Theory: Foundations, Development, Applications, New York.

Bertalanffy, L. v. (1972): The History and Status of General Systems Theory, in: Academy of Management Journal, 15 (4), pp. 407-426.

Bijmolt, T./Pieters, R. (2001): Meta-Analysis in Marketing when Studies Contain Multiple Measurements, in: Marketing Letters, 12 (2), pp. 157-169.

Billing, F. (2003): Koordination in Radikalen Innovationsvorhaben, Wiesbaden.

Bleicher, K. (1981): Organisation: Formen und Modelle, Wiesbaden.

Blessin, B. (1998): Innovation und Innovationsmanagement in Kleinen und Mittleren Unternehmen, Hohenheim.

Bobrow, E. E. (1994): Successful New Products are Product of Process, in: Marketing News, 28 (9), p. E10.

Bonner, J. M./Ruekert, R. W./Walker Jr, O. C. (2002): Upper Management Control of New Product Development Projects and Project Performance, in: Journal of Product Innovation Management (JPIM), 19 (3), pp. 233-245.

Brettel, M./Engelen, A./Heinemann, F./Vadhanasindhu, P. (2008): Antecedents of Market Orientation: A Cross-Cultural Comparison, in: Journal of International Marketing (JIM), 16 (2), pp. 84-119.

Brockhoff, K. (1989): Schnittstellen-Management: Abstimmungsprobleme zwischen Marketing u. Forschung u. Entwicklung, Stuttgart.

Brockhoff, K. (1995): Innovationsmanagement, in: Tietz, B./Koehler, R./Zentes, J. (Eds.): Handwörterbuch des Marketings, 2nd ed., Stuttgart, Cols. 981-995.

Brockhoff, K. (1999a): Forschung und Entwicklung: Planung und Kontrolle, 5., erg. u. erw. Aufl., München, Wien.

Brockhoff, K. (1999b): Produktpolitik, 4., neubearb. und erw. Aufl., Stuttgart.

Brockhoff, K. (2002): Technologie- und Innovationsmanagement - zur Entfaltung einer Betriebswirtschaftlichen Teildisziplin, in: Bruhn, M./Steffenhagen, H. (Eds.): Marktorientierte Unternehmensführung: Reflexion - Denkanstoesse - Perspektiven, 2nd ed., Wiesbaden, pp. 351-370.

Brown, S. L./Eisenhardt, K. M. (1995): Product Development: Past Research, Present Findings, and Future Directions, in: Academy of Management Review, 20 (2), pp. 343-378.

Brown, S. P./Homer, P. M./Inman, J. (1998): A Meta-Analysis of Relationships Between Ad-Evoked Feelings and Advertising Responses, in: Journal of Marketing Research (JMR), 35 (1), pp. 114-126.

Bürgel, H. D./Haller, C./Binder, M. (1996): F&E-Management, München.

Burgelman, R. A./Christensen, C. M./Wheelwright, S. C. (2004): Strategic Management of Technology and Innovation, 4th ed., Maidenhead.

Buzzell, R. D./Gale, B. T. (1987): The PIMS Principles: Linking Strategy to Performance, New York.

Calantone, R./Garcia, R./Droge, C. (2003): The Effects of Environmental Turbulence on New Product Development Strategy Planning, in: Journal of Product Innovation Management (JPIM), 20 (2), pp. 90-104.

Calantone, R. J./Chan, K./Cui, A. S. (2006): Decomposing Product Innovativeness and Its Effects on New Product Success, in: Journal of Product Innovation Management (JPIM), 23 (5), pp. 408-421.

Calantone, R. J./Di Benedetto, C. A./Divine, R. (1993): Organisational, Technical and Marketing Antecedents for Successful New Product Development, in: R&D Management, 23 (4), pp. 337-351.

Calantone, R. J./Vickery, S. K./Dröge, C. (1995): Business Performance and Strategic New Product Development Activities: An Empirical Investigation, in: Journal of Product Innovation Management (JPIM), 12 (3), pp. 214-223.

Callender, J. C./Osburn, H. G. (1980): Development and Test of a New Model for Validity Generalization, in: Journal of Applied Psychology, 65 (5), pp. 543-558.

Capon, N./Farley, J. U./Hoenig, S. (1990): Determinants of Financial Performance: A Meta-Analysis, in: Management Science, 36 (10), pp. 1143-1151.

Capon, N./Farley, J. U./Lehmann, D. R./Hulbert, J. M. (1992): Profiles of Product Innovators among Large U.S. Manufacturers, in: Management Science, 38 (2), pp. 157-169.

Capra, F. (1996): The Web of Life: A New Syntific Understanding of Living Systems, New York.

Chandler, G. N./Keller, C./Lyon, D. W. (2000): Unraveling the Determinants and Consequences of an Innovation-Supportive Organizational Culture, in: Entrepreneurship: Theory & Practice, 25 (1), pp. 59-76.

Chang, Y.-C. (2003): Benefits of Co-operation on Innovative Performance: Evidence from Integrated Circuits and Biotechnology Firms in the UK and Taiwan, in: R&D Management, 33 (4), pp. 425-437.

Chiesa, V./Coughian, P./Voss, C. A. (1996): Development of a Technical Innovation Audit, in: Journal of Product Innovation Management (JPIM), 13 (2), pp. 105-136.

Christensen, C. M. (2006): The Ongoing Process of Building a Theory of Disruption, in: Journal of Product Innovation Management (JPIM), 23 (1), pp. 39-55.

Churchill, G. A. J. (1979): A Paradigm for Developing Better Measures of Marketing Constructs, in: Journal of Marketing Research (JMR), 16 (1), pp. 64-73.

Clark, K. B./Chew, W. B./Fujimoto, T. (1987): Product Development in the World Auto Industry, in: Brookings Papers on Economic Activity, 1987 (3), pp. 729-781.

Clark, K. B./Fujimoto, T. (1991): Product Development Performance: Strategy, Organization, and Management in the World Auto Industry, Boston.

Cleland, D. I./Bursic, K. M. (1992): Strategic Technology Management, Systems for Product and Processes, New York.

Cohen, J. (1988): Statistical Power Analysis for the Behavioral Sciences, 2nd ed., Hillsdale, N.J.

Cohen, W. M./Levinthal, D. A. (1990): Absorptive Capacity: A New Perspective on Learning and Innovation, in: Administrative Science Quarterly, 35 (1), pp. 128-152.

Combs, J./Yongmei, L./Hall, A./Ketchen, D. (2006): How Much Do High-Performance Work Practices Matter? A Meta-Analysis of Their Effects on Organizational Performance, in: Personnel Psychology, 59 (3), pp. 501-528.

Cooper, H. M. (1997): Some Finer Points in Meta-Analysis, in: Hunt, M. (Ed.): How Science Takes Stock: The Story of Meta-Analysis, New York, pp. 169-181.

Cooper, H. M. (1998a): Synthesizing Research: A Guide for Literature Reviews, 3rd edition, Thousand Oaks, Calif.

Cooper, R. G. (1979a): The Dimensions of Industrial New Product Success and Failure, in: Journal of Marketing (JoM), 43 (3), pp. 93-103.

Cooper, R. G. (1979b): Identifying Industrial New Product Success: Project NewProd, in: Industrial Marketing Management, 8 (2), pp. 124-135.

Cooper, R. G. (1983): The New Product Process: An Empirically-based Classification Scheme, in: R&D Management, 13 (1), pp. 1-13.

Cooper, R. G. (1993): Winning at New Products: Accelerating the Process from Idea to Launch, 2nd edition, Cambrige.

Cooper, R. G. (1994): Third-Generation New Product Processes, in: Journal of Product Innovation Management, 11 (1), pp. 3-14.

Cooper, R. G. (1998b): Product Leadership: Creating and Launching Superior New Products, Cambridge.

Cooper, R. G. (2001): Winning at New Products: Accelerating the Process from Idea to Launch, 3rd edition, Cambridge.

Cooper, R. G. (2008): Perspective: The Stage-Gate® Idea-to-Launch Process - Update, What's New, and NexGen Systems, in: Journal of Product Innovation Management (JPIM), 25 (3), pp. 213-232.

Cooper, R. G./de Brentani, U. (1991): New Industrial Financial Services: What Distinguishes the Winners, in: Journal of Product Innovation Management (JPIM), 8 (2), pp. 75-90.

Cooper, R. G./Kleinschmidt, E. J. (1987): New Products: What Separates Winners from Losers?, in: Journal of Product Innovation Management (JPIM), 4 (3), pp. 169-184.

Cooper, R. G./Kleinschmidt, E. J. (1991): New Product Processes at Leading Industrial Firms, in: Industrial Marketing Management, 20 (2), pp. 137-147.

Cooper, R. G./Kleinschmidt, E. J. (1995): Benchmarking the Firm's Critical Success Factors in New Product Development, in: Journal of Product Innovation Management (JPIM), 12 (5), pp. 374-391.

Cooper, R. G./Kleinschmidt, E. J. (1996): Winning Businesses in Product Development: The Critical Success Factors, in: Research Technology Management, 39 (4), pp. 18-29.

Cordero, R. (1990): The Measurement of Innovation Performance in the Firm: An Overview, in: Research Policy (RP), 19 (2), pp. 185-192.

Cordón-Pozo, E./García-Morales, V. J./Aragón-Correa, J. A. (2006): Inter-Departmental Collaboration and New Product Development Success: A Study on the Collaboration Between Marketing and R&D in Spanish High-Technology Firms, in: International Journal of Technology Management, 35 (1/4), pp. 52-79.

Cormican, K./O'Sullivan, D. (2004): Auditing Best Practice for Effective Product Innovation Management, in: Technovation, 24 (10), pp. 819-829.

Corsten, H./Goessinger, R./Schneider, H. (2006): Grundlagen des Innovationsmanagements, München.

Cortina, J. M. (2003): Apples and Oranges (and Pears, Oh My!): The Search for Moderators in Meta-Analysis, in: Organizational Research Methods, 6 (4), pp. 415-439.

Craig, A./Hart, S. (1992): Where to Now in New Product Development Research?, in: European Journal of Marketing, 26 (11), pp. 2-49.

Cronbach, L. J. (1947): Test "Reliability": Its Meaning and Determination, in: Psychometrika, 12 (1), pp. 1-16.

Dalton, D. R./Daily, C. M./Ellstrand, A. E./Johnson, J. L. (1998): Meta-Analytic Reviews of Board Composition, Leadership Structure, and Financial Performance, in: Strategic Management Journal (SMJ), 19 (3), pp. 269-290.

Dalton, D. R./Daily, C. M./Johnson, J. L./Ellstrand, A. E. (1999): Number of Directors and Financial Performance: A Meta-Analysis, in: Academy of Management Journal, 42 (6), pp. 674-686.

Damanpour, F. (1991): Organizational Innovation: A Meta-Analysis of Effects of Determinants and Moderators, in: Academy of Management Journal, 34 (3), pp. 555-590.

Damanpour, F. (1996): Organizational Complexity and Innovation: Developing and Testing Multiple Contingency Models, in: Management Science, 42 (5), pp. 693-716.

Daniel, D. R. (1961): Management Information Crisis, in: Harvard Business Review, 39 (5), pp. 111-121.

Danneels, E. (2002): The Dynamics of Product Innovation and Firm Competences, in: Strategic Management Journal (SMJ), 23 (12), pp. 1095-1121.

Danneels, E./Kleinschmidt, E. J. (2001): Product Innovativeness from the Firm's Perspective: Its Dimensions and Their Relation with Project Selection and Performance, in: Journal of Product Innovation Management (JPIM), 18 (6), pp. 357-373.

De Brentani, U. (2001): Innovative versus Incremental New Business Services: Different Keys for Achieving Success, in: Journal of Product Innovation Management (JPIM), 18 (3), pp. 169-187.

De Brentani, U./Kleinschmidt, E. J. (2004): Corporate Culture and Commitment: Impact on Performance of International New Product Development Programs, in: Journal of Product Innovation Management (JPIM), 21 (5), pp. 309-333.

De Luca, L. M./Atuahene-Gima, K. (2007): Market Knowledge Dimensions and Cross-Functional Collaboration: Examining the Different Routes to Product Innovation Performance, in: Journal of Marketing (JoM), 71 (1), pp. 95-112.

Deshpandé, R./Farley, J. U. (1998): Measuring Market Orientation: Generalization and Synthesis, in: Journal of Market-Focused Management, 2 (3), pp. 213-232.

Deshpandé, R./Farley, J. U. (1999): Executive Insights: Corporate Culture and Market Orientation: Comparing Indian and Japanese Firms, in: Journal of International Marketing (JIM), 7 (4), pp. 111-127.

Deshpandé, R./Farley, J. U./Webster Jr., F. E. (1993): Corporate Culture Customer Orientation, and Innovativeness in Japanese Firms: A Quadrad Analysis, in: Journal of Marketing (JoM), 57 (1), pp. 23-37.

Donaldson, L. (2001): The Contingency Theory of Organizations, Thousand Oaks, London, New Dehli.

Dougherty, D. (1990): Understanding New Markets for New Products, in: Strategic Management Journal (SMJ), 11 (4), pp. 59-78.

Dougherty, D. (1992a): Interpretive Barriers to Successful Product Innovation in Large Firms, in: Organization Science (OS), 3 (2), pp. 179-202.

Dougherty, D. (1992b): A Practice-Centered Model of Organizational Renewal through Product Innovation, in: Strategic Management Journal (SMJ), 13 pp. 77-92.

Drucker, P. F. (1954): The Practice of Management, New York.

Dyer, B./Song, X. M. (1997): The Impact of Strategy on Conflict: A Cross-National Comparative Study of U.S. and Japanese Firms, in: Journal of International Business Studies, 28 (3), pp. 467-493.

Dyer, B./Song, X. M. (1998): Innovation Strategy and Sanctioned Conflict: A New Edge in Innovation?, in: Journal of Product Innovation Management (JPIM), 15 (6), pp. 505-519.

Eden, D. (2002): From the Editors: Replication, Meta-Analysis, Scientific Progress, and AMJ's Publication Policy, in: Academy of Management Journal, 45 (5), pp. 841-846.

Elenkov, D. S./Manev, I. M. (2005): Top Management Leadership and Influence on Innovation: The Role of Sociocultural Context, in: Journal of Management, 31 (3), pp. 381-402.

Ernst, H. (2001): Erfolgsfaktoren Neuer Produkte: Grundlagen fuer eine Valide Empirische Forschung, 1. Aufl., Wiesbaden.

Ernst, H. (2002): Success Factors of New Product Development: A Review of the Empirical Literature, in: International Journal of Management Reviews, 4 (1), pp. 1-40.

Ettlie, J. E./Bridges, W. P./O'Keefe, R. D. (1984): Organization Strategy and Structural Differences for Radical Versus Incremental Innovation, in: Management Science, 30 (6), pp. 682-695.

European Communities (2009): European Year of Creativity and Innovation 2009, http://create2009.europa.eu/, 29/06/2009.

Felix, R. (2003): A Proposed Taxonomy of Management Systems, in: Systems Research & Behavioral Science, 20 (1), pp. 21-29.

Field, A. P. (2003): The Problem in Using Fixed-Effects Models of Meta-Analysis on Real-World Data, in: Understanding Statistics, 2 (2), pp. 105-124.

Field, A. P. (2005): Is the Meta-Analysis of Correlation Coefficients Accurate When Population Correlations Vary?, in: Psychological Methods, 10 (4), pp. 444-467.

Ford, G. T./Smith, D. B./Swasy, J. L. (1990): Consumer Skepticism of Advertising Claims: Testing Hypotheses from Economics of Information, in: Journal of Consumer Research, 16 (4), pp. 433-441.

Franke, G. R. (2001): Applications of Meta-Analysis for Marketing and Public Policy: A Review, in: Journal of Public Policy & Marketing, 20 (2), pp. 186-200.

Franke, G. R./Park, J.-E. (2006): Salesperson Adaptive Selling Behavior and Customer Orientation: A Meta-Analysis, in: Journal of Marketing Research (JMR), 43 (4), pp. 693-702.

Franke, N./Piller, F. (2004): Value Creation by Toolkits for User Innovation and Design: The Case of the Watch Market, in: Journal of Product Innovation Management (JPIM), 21 (6), pp. 401-415.

Frese, E. (1992): Organisationstheorie: Historische Entwicklung, Ansaetze, Perspektiven, 2., überarb. und wesentl. erw. Aufl., Wiesbaden.

Fricke, R./Treinies, G. (1985): Einfuehrung in die Metaanalyse, Bern et al.

Fritz, W. (2004a): Die Erfolgsfaktorenforschung - ein Misserfolg?, in: Die Betriebswirtschaft (DBW), 64 (5), pp. 623-625.

Fritz, W. (2004b): Ueber Tautologien, gesicherte Erkenntnisse und ein Problematisches Wissenschaftsverständnis, in: Technische Universitaet Braunschweig, Arbeitspapier Nr. 04/06, pp. 1-37.

Garcia, R./Calantone, R. (2002): A Critical Look at Technological Innovation Typology and Innovativeness Terminology: A Literature Review, in: Journal of Product Innovation Management (JPIM), 19 (2), pp. 110-132.

Gatignon, H./Tushman, M. L./Smith, W./Anderson, P. (2002): A Structural Approach to Assessing Innovation: Construct Development of Innovation Locus, Type, and Characteristics, in: Management Science, 48 (9), pp. 1103-1122.

Gemser, G./Leenders, M. A. A. M. (2001): How Integrating Industrial Design in the Product Development Process Impacts on Company Performance, in: Journal of Product Innovation Management (JPIM), 18 (1), pp. 28-38.

Gemuenden, H. G. (1981): Innovationsmarketing - Interaktionsbeziehungen zwischen Hersteller und Verwender Innovativer Investitionsgueter, Tuebingen.

Gemuenden, H. G./Heydebreck, P./Herden, R. (1992): Technological Interweavement: A Means of Achieving Innovation Success, in: R&D Management, 22 (4), pp. 359-376.

Gerpott, T. J. (2005): Strategisches Technologie- und Innovationsmanagement, 2., ueberarb. u. erw. Aufl., Stuttgart.

Gerwin, D./Barrowman, N. J. (2002): An Evaluation of Research on Integrated Product Development, in: Management Science, 48 (7), pp. 938-953.

Gerybadze, A. (1995): Innovationsmanagement, in: Corsten, H./Reiss, M. (Eds.): Handbuch Unternehmungsführung: Konzepte - Instrumente - Schnittstellen, Wiesbaden, pp. 829-845.

Geyskens, I./Steenkamp, J.-B. E. M./Kumar, N. (2006): Make, Buy, or Ally: A Transaction Cost Theory Meta-Analysis, in: Academy of Management Journal, 49 (3), pp. 519-543.

Glass, G. V. (1976): Primary, Secondary and Meta-Analysis of Research, in: Educational Researcher, 5 (10), pp. 3-8.

Glass, G. V./McGaw, B./Smith, M. L. (1981): Meta-analysis in Social Research, Beverly Hills.

Goffin, K./Pfeiffer, R. (1999): Innovation Management in UK and German Manufacturing Companies, London.

Green, B. F./Hall, J. A. (1984): Quantitative Methods for Literature Reviews, in: Annual Review of Psychology, 35 (1984), pp. 37-53.

Green, S. G./Gavin, M. B./Aiman-Smith, L. (1995): Assessing a Multidimensional Measure of Radical Technological Innovation, in: IEEE Transactions on Engineering Management, 42 (3), pp. 203-214.

Griffin, A. (1997): PDMA Research on New Product Development Practices: Updating Trends and Benchmarking Best Practices, in: Journal of Product Innovation Management (JPIM), 14 (6), pp. 429-458.

Griffin, A./Hauser, J. R. (1996): Integrating R&D and Marketing: A Review and Analysis of the Literature, in: Journal of Product Innovation Management (JPIM), 13 (3), pp. 191-215.

Griffin, A./Page, A. L. (1993): An Interim Report on Measuring Product Development Success and Failure, in: Journal of Product Innovation Management (JPIM), 10 (4), pp. 291-308.

Griffin, A./Page, A. L. (1996): PDMA Success Measurement Project: Recommended Measures for Product Development Success and Failure, in: Journal of Product Innovation Management (JPIM), 13 (6), pp. 478-496.

Gruner, K. E. (1997): Kundeneinbindung in den Produktinnovationsprozess, Wiesbaden.

Grunert, K. G./Ellegaard, C. (1993): The Concept of Key Success Factors: Theory and Method, in: Baker, M. J. (Ed.): Perspectives on Marketing Management, 3rd ed., Chichester, pp. 245-274.

Gupta, A. K./Wilemon, D. (1990): Improving R&D/Marketing Relations: R&D Perspective, in: R&D Management, 20 (4), pp. 277-290.

Gutenberg, E. (1983): Grundlagen der Betriebswirtschaftslehre. Band 1: Die Produktion, 24., unveraend. Aufl., Berlin et al.

Hadjimanolis, A. (2000): An Investigation of Innovation Antecedents in Small Firms in the Context of a Small Developing Country, in: R&D Management, 30 (3), pp. 235-245.

Haenecke, H. (2002): Methodenorientierte Systematisierung der Kritik an der Erfolgsfaktorenforschung, in: Zeitschrift für Betriebswirtschaft, 72 (2), pp. 165-183.

Hall, J. A./Rosenthal, R./Tickle-Degnen, L./Mosteller, F. (1994): Hypotheses and Problems in Research Synthesis, in: Cooper, H./Hedges, L. V. (Eds.): The Handbook of Research Synthesis, New York, pp. 17-28.

Han, J. K./Kim, N./Srivastava, R. K. (1998): Market Orientation and Organizational Performance: Is Innovation a Missing Link?, in: Journal of Marketing (JoM), 62 (4), pp. 30-45.

Hart, S. (1993): Dimensions of Success in New Product Development: an Exploratory Investigation, in: Journal of Marketing Management, 9 (1), pp. 23-41.

Haß, H.-J. (1983): Die Messung des technischen Fortschritts, Muenchen.

Hauschildt, J. (1991): Zur Messung des Innovationserfolges, in: Zeitschrift für Betriebswirtschaft, 61 (4), pp. 451-476.

Hauschildt, J. (1993): Innovationsmanagement - Determinanten des Innovationserfolges, in: Hauschildt, J./Grün, O. (Eds.): Ergebnisse Empirischer Betriebswirtschaftlicher Forschung: Zu einer Realtheorie der Unternehmung, Stuttgart, pp. 295-326.

Hauschildt, J. (2004): Innovationsmanagement, 3., voellig ueberarb. und erw. Aufl., Muenchen.

Hauschildt, J./Salomo, S. (2007): Innovationsmanagement, 4., ueberarb. und erg. Auflage, Muenchen.

Hauser, J./Tellis, G. J./Griffin, A. (2006): Research on Innovation: A Review and Agenda for Marketing Science, in: Marketing Science, 25 (6), pp. 687-717.

Hayes, R. H./Wheelwright, S. C./Clark, K. B. (1988): Dynamic Manufacturing: Creating the Learning Organization, New York, London.

Hedges, L. V./Olkin, I. (1985): Statistical Methods for Meta-Analysis, Boston, London.

Hedges, L. V./Pigott, T. D. (2001): The Power of Statistical Tests in Meta-Analysis, in: Psychological Methods, 6 (3), pp. 203-217.

Hedges, L. V./Vevea, J. L. (1998): Fixed- and Random-Effects Models in Meta-Analysis, in: Psychological Methods, 3 (4), pp. 486-504.

Hegarty, W. H./Hoffman, R. C. (1990): Product/Market Innovations: A Study of Top Management Involvement among Four Cultures, in: Journal of Product Innovation Management (JPIM), 7 (3), pp. 186-199.

Heinemann, F. (2007): Organisation von Projekten zur Neuproduktentwicklung, Wiesbaden.

Helfat, C. E./Peteraf, M. A. (2003): The Dynamic Resource-Based View: Capability Lifecycles, in: Strategic Management Journal (SMJ), 24 (10), pp. 997-1010.

Helm, R. (2001): Planung und Vermarktung von Innovationen, Stuttgart.

Henard, D. H./Szymanski, D. M. (2001): Why Some New Products are More Successful than Others, in: Journal of Marketing Research (JMR), 38 (3), pp. 362-375.

Hertweck, A. (2002): Strategische Erneuerung durch integriertes Management industrieller Dienstleistungen, Frankfurt am Main et al.

Heugens, P. P. M. A. R./Lander, M. W. (2009): Structure! Agency! (and ither Quarrels): A Meta-Analysis of Institutional Theories of Organization, in: Academy of Management Journal, 52 (1), pp. 61-85.

Hildebrandt, L. (2001): Erfolgsfaktoren, in: Diller, H. (Ed.): Vahlens Großes Marketinglexikon, 2., voellig ueberarb. u. erw. Aufl. ed., München, pp. 420-421.

Hise, R. T./O'Neal, L./Parasuraman, A./McNeal, J. U. (1990): Marketing/R&D Interaction in New Product Development: Implications for New Product Success Rates, in: Journal of Product Innovation Management (JPIM), 7 (2), pp. 142-155.

Hofstede, G. H. (1980): Culture's Consequences: International Differences in Work-Related Values, Beverly Hills.

Homburg, C. (2007): Betriebswirtschaftslehre als Empirische Wissenschaft - Bestandsaufnahme und Empfehlungen, in: Zeitschrift fuer betriebswirtschaftliche Forschung (ZfbF), Sonderheft (56/07), pp. 27-60.

Homburg, C./Giering, A. (1996): Konzeptualisierung und Operationalisierung komplexer Konstrukte, in: Marketing. Zeitschrift fuer Forschung und Praxis ZFP 18 (1), pp. 5-24.

Homburg, C./Krohmer, H. (2003): Marketingmanagement, Studienausg., 1. Aufl., Nachdr., Wiesbaden.

Homburg, C./Krohmer, H. (2004): Die Fliegenpatsche als Instrument des Wissenschaftlichen Dialogs, in: Die Betriebswirtschaft (DBW), 64 (5), pp. 626-631.

Hübner, H. (2002): Integratives Innovationsmanagement: Nachhaltigkeit als Herausforderung für Ganzheitliche Erneuerungsprozesse, Berlin.

Hult, G. T. M./Hurley, R. F./Knight, G. A. (2004): Innovativeness: Its Antecedents and Impact on Business Performance, in: Industrial Marketing Management, 33 (5), pp. 429-438.

Hunt, M. M. (1997a): How Science Takes Stock: The Story of Meta-Analysis, New York.

Hunt, S. D. (1997b): Resource-Advantage Theory: An Evolutionary Theory of Competitive Firm Behavior?, in: Journal of Economic Issues, 31 (1), pp. 59-77.

Hunter, J. E./Schmidt, F. L. (1977): Critical Analysis of the Statistical and Ethical Implications of Various Definitions of Test Bias, in: Psychological Bulletin, 83 (6), pp. 1053-1071.

Hunter, J. E./Schmidt, F. L. (1990a): Dichotomization of Continuous Variables: The Implications for Meta-Analysis, in: Journal of Applied Psychology, 75 (3), pp. 334-349.

Hunter, J. E./Schmidt, F. L. (1990b): Methods of Meta-Analysis: Correcting Error and Bias in Research Findings, Newbury Park.

Hunter, J. E./Schmidt, F. L. (2000): Fixed Effects vs. Random Effects Meta-Analysis Models: Implications for Cumulative Research Knowledge, in: International Journal of Selection and Assessment, 8 (4), pp. 275-292.

Hunter, J. E./Schmidt, F. L. (2004): Methods of Meta-Analysis: Correcting Error and Bias in Research Findings, 2nd, Thousand Oaks, CA.

Hunter, J. E./Schmidt, F. L./Jackson, G. B. (1982): Meta-Analysis: Cumulating Research Findings Across Studies, Beverly Hills.

Hurley, R. F./Hult, G. T. M. (1998): Innovation, Market Orientation, and Organizational Learning: An Integration and Empirical Examination, in: Journal of Marketing (JoM), 62 (3), pp. 42-54.

Iansiti, M. (1993): Real-World R&D: Jumping the Product Generation Gap, in: Harvard Business Review, 71 (3), pp. 138-147.

Im, S./Nakata, C./Park, H./Ha, Y.-W. (2003): Determinants of Korean and Japanese New Product Performance: An Interrelational and Process View, in: Journal of International Marketing (JIM), 11 (4), pp. 81-112.

Im, S./Workman Jr., J. P. (2004): Market Orientation, Creativity, and New Product Performance in High-Technology Firms, in: Journal of Marketing (JoM), 68 (2), pp. 114-132.

Imai, K./Ikujiro, N./Takeuchi, H. (1985): Managing the New Product Development Process: How Japanese Companies Learn and Unlearn, in: Hayes, R. H./Lorenz, C./Clark, K. B. (Eds.): The Uneasy Alliance: Managing the Productivity-Technology Dilemma, Boston, Mass., pp. 337-375.

Irwin, J. R./McClelland, G. H. (2003): Negative Consequences of Dichotomizing Continuous Predictor Variables, in: Journal of Marketing Research (JMR), 40 (3), pp. 366-371.

Ittner, C. D./Larcker, D. F. (1997): Product Development Cycle Time and Organizational Performance, in: Journal of Marketing Research (JMR), 34 (1), pp. 13-23.

Jackson, G. B. (1980): Methods for Integrative Reviews, in: Review of Educational Research, 50 (3), pp. 438-460.

Jaworski, B. J./Kohli, A. K. (1993): Market Orientation: Antecedents and Consequences, in: Journal of Marketing (JoM), 57 (3), pp. 53-70.

Jensen, O./Mertesdorf, S. (2006): Einführung in die Meta-Analyse, in: Wirtschaftswissenschaftliches Studium, 35 (12), pp. 657-663.

Johne, F. A./Snelson, P. A. (1988): Success Factors in Product Innovation: A Selective Review of the Literature, in: Journal of Product Innovation Management (JPIM), 5 (2), pp. 114-128.

Kahn, K. B. (1996): Interdepartmental Integration: A Definition with Implications for Product Development Performance, in: Journal of Product Innovation Management (JPIM), 13 (2), pp. 137-151.

Kast, F. E./Rosenzweig, J. E. (1972): General System Theory: Applications for Organization and Management, in: Academy of Management Journal, 15 (4), pp. 447-465.

Katz, R. (1982): The Effects of Group Longevity on Project Communication and Performance, in: Administrative Science Quarterly, 27 (1), pp. 81-104.

Katz, R./Allen, T. J. (1985): Project Performance and the Locus of Influence in the R&D Matrix, in: Academy of Management Journal, 28 (1), pp. 67-87.

Katz, R./Tushman, M. L. (1981): An Investigation into the Managerial Roles and Career Paths of Gatekeepers and Project Supervisors in a Major R&D Facility, in: R&D Management, 11 (3), pp. 103-110.

Keller, R. T. (1986): Predictors of the Performance of Project Groups in R & Organizations, in: Academy of Management Journal, 29 (4), pp. 715-726.

Kern, W./Schroeder, H.-H. (1977): Forschung und Entwicklung in der Unternehmung, Reinbeck b. Hamburg.

Kieser, A. (1993): Anleitung zum Kritischen Umgang mit Organisationstheorien, in: Kieser, A. (Ed.): Organisationstheorien, 2nd ed., Stuttgart, pp. 1-35.

Kirca, A. H./Jayachandran, S./Bearden, W. O. (2005): Market Orientation: A Meta-Analytic Review and Assessment of Its Antecedents and Impact on Performance, in: Journal of Marketing (JoM), 69 (2), pp. 24-41.

Kirsch, W./Knyphausen, D. z. (1993): Strategische Unternehmensfuehrung, in: Hauschildt, J./Witte, E. (Eds.): Ergebnisse Empirischer Betriebswirtschaftlicher Forschung: Zu einer Realtheorie der Unternehmung, Stuttgart, pp. 83-114.

Kleinschmidt, E. J./de Brentani, U./Salomo, S. (2007): Performance of Global New Product Development Programs: A Resource-Based View, in: Journal of Product Innovation Management (JPIM), 24 (5), pp. 419-441.

Kohli, A. K./Jaworski, B. J. (1990): Market Orientation: The Construct, Research Propositions, and Managerial Implications, in: Journal of Marketing (JoM), 54 (2), pp. 1-18.

Krasnikov, A./Jayachandran, S. (2008): The Relative Impact of Marketing, Research-and-Development, and Operations Capabilities on Firm Performance, in: Journal of Marketing (JoM), 72 (4), pp. 1-11.

Krishnan, V./Ulrich, K. T. (2001): Product Development Decisions: A Review of the Literature, in: Management Science, 47 (1), pp. 1-21.

Kristof-Brown, A. L./Zimmerman, R. D./Johnson, E. C. (2005): Consequences of Individuals' Fit at Work: A Meta-Analysis of Person-Job, Person-Organization, Person-Group, and Person-Supervisor Fit, in: Personnel Psychology, 58 (2), pp. 281-342.

Kropp, F./Lindsay, N. J./Shoham, A. (2006): Entrepreneurial, Market, and Learning Orientations and International Entrepreneurial-Business Venture Performance in South African Firms, in: International Marketing Review, 23 (5), pp. 504-523.

Krueger, W. (1988): Die Erklärung von Unternehmenserfolg: Theoretischer Ansatz und emprirische Ergebnisse, in: Die Betriebswirtschaft (DBW), 48 (1), pp. 27-43.

Kumar, N./Stern, L. W./Anderson, J. C. (1993): Conducting Interorganizational Research Using Key Informants, in: Academy of Management Journal, 36 (6), pp. 1633-1651.

Langerak, F./Hultink, E. J. (2005): The Impact of New Product Development Acceleration Approaches on Speed and Profitability: Lessons for Pioneers and Fast Followers, in: IEEE Transactions on Engineering Management, 52 (1), pp. 30-42.

Langerak, F./Hultink, E. J./Robben, H. S. J. (2004a): The Impact of Market Orientation, Product Advantage, and Launch Proficiency on New Product Performance and Organizational Performance, in: Journal of Product Innovation Management (JPIM), 21 (2), pp. 79-94.

Langerak, F./Hultink, E. J./Robben, H. S. J. (2004b): The Role of Predevelopment Activities in the Relationship Between Market Orientation and Performance, in: R&D Management, 34 (3), pp. 295-309.

Langerak, F./Jan Hultink, E. (2006): The Impact of Product Innovativeness on the Link between Development Speed and New Product Profitability, in: Journal of Product Innovation Management (JPIM), 23 (3), pp. 203-214.

Law, K. S./Schmidt, F. L./Hunter, J. E. (1994): Nonlinearity of Range Corrections in Meta-Analysis: Test of an Improved Procedure, in: Journal of Applied Psychology, 79 (3), pp. 425-438.

Leidecker, J. K./Bruno, A. V. (1984): Identifying and Using Critical Success Factors, in: Long Range Planning, 17 (1), pp. 23-32.

Li, H./Atuahene-Gima, K. (2001a): The Impact of Interaction Between R&D and Marketing on New Product Performance: An Empirical Analysis of Chinese High Technology Firms, in: International Journal of Technology Management, 21 (1/2), pp. 61-75.

Li, H./Atuahene-Gima, K. (2001b): Product Innovation Strategy and the Performance of New Technology Ventures in China, in: Academy of Management Journal, 44 (6), pp. 1123-1134.

Liker, J. K./Collins, P. D. (1999): Flexibility and Standardization: Test of a Contingency Model of Product Design-Manufacturing Integration, in: Journal of Product Innovation Management (JPIM), 16 (3), pp. 248-267.

Lipsey, M. W./Wilson, D. B. (1993): The Efficacy of Psychological, Educational, and Behavioral Treatment: Confirmation from Meta-Analysis, in: American Psychologist, 48 (12), pp. 1181-1209.

Lipsey, M. W./Wilson, D. B. (2001): Practical Meta-Analysis, Thousand Oaks, CA

Lumpkin, G. T./Dess, G. G. (2001): Linking Two Dimensions of Entrepreneurial Orientation to Firm Performance: The Moderating Role of Environment and Industry Life Cycle, in: Journal of Business Venturing, 16 (5), pp. 429-451.

MacCallum, R. C./Zhang, S./Preacher, K. J./Rucker, D. D. (2002): On the Practice of Dichotomization of Quantitative Variables, in: Psychological Methods, 7 (1), pp. 19-40.

Macharzina, K./Wolf, J. (2008): Unternehmensfuehrung: Das Internationale Managementwissen; Konzepte, Methoden, Praxis, 6., vollst. überarb. und erw. Aufl., Wiesbaden.

Maidique, M. A./Zirger, B. J. (1984): A Study of Success and Failure in Product Innovation: The Case of the U.S. Electronics Industry, in: IEEE Transactions on Engineering Management, 31 (4), pp. 192-203.

Maidique, M. A./Zirger, B. J. (1985): The New Product Learning Cycle, in: Research Policy (RP), 14 (6), pp. 299-313.

March, J. G./Sutton, R. I. (1997): Organizational Performance as a Dependent Variable, in: Organization Science (OS), 8 (6), pp. 698-706.

Markham, S. K./Griffin, A. (1998): The Breakfast of Champions: Associations Between Champions and Product Development Environments, Practices and Performance, in: Journal of Product Innovation Management (JPIM), 15 (5), pp. 436-454.

Marr, R. (1991): Innovationsmanagement, in: Die Betriebswirtschaft (DBW), 3 (51), pp. 355-371.

Marsh, S. J./Stock, G. N. (2006): Creating Dynamic Capability: The Role of Intertemporal Integration, Knowledge Retention, and Interpretation, in: Journal of Product Innovation Management (JPIM), 23 (5), pp. 422-436.

Matsuno, K./Mentzer, J. T. (2000): The Effects of Strategy Type on the Market Orientation-Performance Relationship, in: Journal of Marketing (JoM), 64 (4), pp. 1-16.

Matsuno, K./Mentzer, J. T./Özsomer, A. (2002): The Effects of Entrepreneurial Proclivity and Market Orientation on Business Performance, in: Journal of Marketing (JoM), 66 (3), pp. 18-32.

Mavondo, F. T./Chimhanzi, J./Stewart, J. (2005): Learning Orientation and Market Orientation: Relationship with Innovation, Human Resource Practices and Performance, in: European Journal of Marketing, 39 (11/12), pp. 1235-1263.

McNemar, Q. (1960): At Random: Sense and Nonsense, in: American Psychologist, 15 (5), pp. 295-300.

Miller, J. G. (1978): Living Systems, New York, London.

Montoya-Weiss, M. M./Calantone, R. (1994): Determinants of New Product Performance: A Review and Meta-Analysis, in: Journal of Product Innovation Management (JPIM), 11 (5), pp. 397-417.

Moorman, C./Rust, R. T. (1999): The Role of Marketing, in: Journal of Marketing (JoM), 63 (4), pp. 180-197.

Morgan, N. A./Vorhies, D. W. (2001): Product Quality Alignment and Business Unit Performance, in: Journal of Product Innovation Management (JPIM), 18 (6), pp. 396-407.

Myers, S./Marquis, D. (1969): Successful Industrial Innovations: A Study of Factors Underlying Innovation in Selected Firms, Washington.

Nakata, C./Sivakumar, K. (1996): National Culture and New Product Development: An Integrative Review, in: Journal of Marketing (JoM), 60 (1), pp. 61-72.

Narver, J. C./Slater, S. F. (1990): The Effect of a Market Orientation on Business Profitability, in: Journal of Marketing (JoM), 54 (4), pp. 20-35.

Narver, J. C./Slater, S. F./MacLachlan, D. L. (2004): Responsive and Proactive Market Orientation and New-Product Success, in: Journal of Product Innovation Management (JPIM), 21 (5), pp. 334-347.

National Research Council (1992): Combining Information: Statistical Issues and Opportunities for Research, Washington, D.C.

Nicholson, N./Rees, A./Brooics-Rooney, A. (1990): Strategy, Innovation and Performance, in: Journal of Management Studies, 27 (5), pp. 511-534.

Nicolai, A./Kieser, A. (2002): Trotz eklatanter Erfolglosigkeit: Die Erfolgsfaktorenforschung weiter auf Erfolgskurs, in: Die Betriebswirtschaft (DBW), 62 (6), pp. 579-596.

Nijssen, E. J./Biemans, W. G./De Kort, J. F. (2002): Involving Purchasing in New Product Development, in: R&D Management, 32 (4), pp. 281-289.

Nonaka, I. (1990): Redundant, Overlapping Organization: A Japanese Approach to Managing the Innovation Process, in: California Management Review, 32 (3), pp. 27-38.

O'Connor, G. C. (2008): Major Innovation as a Dynamic Capability: A Systems Approach, in: Journal of Product Innovation Management (JPIM), 25 (4), pp. 313-330.

O'Reilly, B./Rao, R. M. (1997): The Secrets of America's Most Admired Corporations: New Ideas - New Products, in: Fortune, 135 (4), pp. 60-64.

Oczkowski, E./Farrell, M. A. (1998): Discriminating Between Measurement Scales Using Non-Nested Tests and Two-Stage Least Squares Estimators: The Case of Market Orientation, in: International Journal of Research in Marketing, 15 (4), pp. 349-366.

OECD (1991): The Nature of Innovation and the Evolution of the Productive System. Technology and Productivity - The Challenge for Economic Policy, in: Paris: OECD, pp. 303-314.

OECD (1997): Oslo Manual. Proposed Guidlines for Collecting and Interpreting Technological Innovation Data, Paris: OECD.

Olson, E. M./Slater, S. F./Hult, G. T. M. (2005): The Performance Implications of Fit Among Business Strategy, Marketing Organization Structure, and Strategic Behavior, in: Journal of Marketing (JoM), 69 (3), pp. 49-65.

Olson, E. M./Walker, J. O. C./Ruekert, R. W. (1995): Organizing for Effective New Product Development: The Moderating Role of Product Innovativeness, in: Journal of Marketing (JoM), 59 (1), pp. 48-62.

Orwin, R. G. (1983): A Fail-Safe 'N' for Effect Size in Meta-Analysis, in: Journal of Educational and Behavioral Statistics, 8 (2), pp. 157-159.

Orwin, R. G. (1994): Evaluating Coding Decisions, New York.

Page, A. L. (1993): Assessing New Product Development Practices and Performance: Establishing Crucial Norms, in: Journal of Product Innovation Management (JPIM), 10 (4), pp. 273-290.

Page, A. L./Schirr, G. R. (2008): Growth and Development of a Body of Knowledge: 16 Years of New Product Development Research, 1989-2004, in: Journal of Product Innovation Management (JPIM), 25 (3), pp. 233-248.

Palmatier, R. W./Dant, R. P./Grewal, D./Evans, K. R. (2006): Factors Influencing the Effectiveness of Relationship Marketing: A Meta-Analysis, in: Journal of Marketing (JoM), 70 (4), pp. 136-153.

Pappas, R. A./Remer, D. S. (1985): Measuring R&D Productivity, in: Research Management, 28 (3), pp. 15-22.

Parry, M. E./Song, X. M. (1994): Identifying New Product Successes in China, in: Journal of Product Innovation Management (JPIM), 11 (1), pp. 15-30.

Pattikawa, L. H./Verwaal, E./Commandeur, H. R. (2006): Understanding New Product Project Performance, in: European Journal of Marketing, 40 (11/12), pp. 1178-1193.

Pauwels, K./Silva-Risso, J./Srinivasan, S./Hanssens, D. M. (2004): New Products, Sales Promotions, and Firm Value: The Case of the Automobile Industry, in: Journal of Marketing (JoM), 68 (4), pp. 142-156.

Pelham, A. M. (1997): Mediating Influences on the Relationship Between Market Orientation and Profitability in Small Industrial Firms, in: Journal of Marketing Theory & Practice, 5 (3), pp. 55-76.

Pelham, A. M. (2000): Market Orientation and Other Potential Influences on Performance in Small and Medium-Sized Manufacturing Firms, in: Journal of Small Business Management, 38 (1), pp. 48-67.

Pelham, A. M./Wilson, D. T. (1996): A Longitudinal Study of the Impact of Market Structure, Firm Structure, Strategy, and Market Orientation Culture on Dimensions of Small-Firm Performance, in: Journal of the Academy of Marketing Science, 24 (1), pp. 27-43.

Peters, T. J./Waterman, R. H. (1982): In Search of Excellence: Lessons from America's Best-Run Companies, New York et al.

Peterson, R. A./Brown, S. P. (2005): On the Use of Beta Coefficients in Meta-Analysis, in: Journal of Applied Psychology, 90 (1), pp. 175-181.

Piller, F. T./Walcher, D. (2006): Toolkits for Idea Competitions: A Novel Method to Integrate Users in New Product Development, in: R&D Management, 36 (3), pp. 307-318.

Pleschak, F./Sabisch, H. (1996): Innovationsmanagement, Stuttgart.

Popper, K. R. (1994): Logik der Forschung, 10., verb. und verm. Aufl., Tuebingen.

Porter, M. E. (1979): How Competitive Forces Shape Strategy, in: Harvard Business Review, 57 (2), pp. 137-145.

Porter, M. E. (1998): Competitive Strategy: Techniques for Analyzing Industries and Competitors, 1st Free Press, New York.

Quinn, J. B. (1985): Managing Innovation: Controlled Chaos, in: Harvard Business Review, 63 (3), pp. 73-84.

Raju, N. S./Burke, M. J. (1983): Two New Procedures for Studying Validity Generalization, in: Journal of Applied Psychology, 68 (3), pp. 382-395.

Reed, J. G./Baxter, P. M. (1994): Using Reference Databases, in: Cooper, H./Hedges, L. V. (Eds.): The Handbook of Research Synthesis, New York, pp. 57-70.

Rockart, J. F. (1979): Chief Executives Define Their Own Data Needs, in: Harvard Business Review, 57 (2), pp. 81-93.

Rosenthal, M. C. (1994a): The Fugitive Literature, in: Cooper, H./Hedges, L. V. (Eds.): The Handbook of Research Synthesis, New York, pp. 85-94.

Rosenthal, R. (1979): The 'file drawer problem' and Tolerance for Null Results, in: Psychological Bulletin, 86 (3), pp. 185-193.

Rosenthal, R. (1994b): Parametric Measures of Effect Sizes, in: Cooper, H./Hedges, L. V. (Eds.): The Handbook of Research Synthesis, New York, pp. 231-244.

Rosenthal, R. (1994c): Statistically Describing and Combining Studies, in: Cooper, H. M./Hedges, L. V. (Eds.): The Handbook of Research Synthesis, New York, pp. 231-244.

Rosenthal, R./DiMatteo, M. R. (2001): Meta-Analysis: Recent Developments in Quantitative Methods for Literature Reviews, in: Annual Review of Psychology, 52 (1), pp. 59-82.

Rosenthal, R./Rubin, D. B. (1982): Further Meta-Analytic Procedures for Assessing Cognitive Gender Differences, in: Journal of Educational Psychology, 74 (5), pp. 708-712.

Rothstein, H. R./Sutton, A. J./Borenstein, M. (2005): Publication Bias in Meta-Analysis: Prevention, Assessment and Adjustments, Chichester, West Sussex et al.

Rothwell, R. (1972): Factors tor Success in Industrial Innovations from Project SAPPHO - A Comparative Study of Success and Failure in Industrial Innovation, Brighton.

Rothwell, R./Freeman, C./Horsley, A./Jervis, V. T. P./Andrew, R./Townsend, J. F. (1974): SAPPHO Updated - Project SAPPHO Phase II, in: Research Policy (RP), 3 (3), pp. 258-291.

Rubenstein, A. H./Chakrabarti, A. K./O'Keefe, R. D./Souder, W. E./Young, H. C. (1976): Factors Influencing Success at the Project Level, in: Research Management, 16 (1), pp. 15-20.

Rubin, D. B. (1990): A New Perspective on Meta-Analysis, in: Wachter, K. W./Straf, M. L. (Eds.): The Future of Meta-Analysis, New York, pp. 155-165.

Ruekert, R. W./Walker Jr, O. C./Roering, K. J. (1985): The Organization of Marketing Activities: A Contingency Theory of Structure and Performance, in: Journal of Marketing (JoM), 49 (1), pp. 13-25.

Sackett, P. R./Harris, M. M./Orr, J. M. (1986): On Seeking Moderator Variables in the Meta-Analysis of Correlational Data: A Monte Carlo Investigation of Statistical Power and Resistance to Type I Error, in: Journal of Applied Psychology, 71 (2), pp. 302-310.

Salomo, S. (2003): Konzept und Messung des Innovationsgrades: Ergebnisse einer Empirischen Studie zu Innovativen Entwicklungsvorhaben, in: Schwaiger, M./Harhoff, D. (Eds.): Empirie und Betriebswirtschaft: Entwicklungen und Perspektiven, Stuttgart, pp. 399-427.

Sandvik, I. L./Sandvik, K. (2003): The Impact of Market Orientation on Product Innovativeness and Business Performance, in: International Journal of Research in Marketing, 20 (4), pp. 355-376.

Schewe, G. (2000): Produktimitation, in: Albers, S./Herrmann, A. (Eds.): Handbuch Produktmanagement, Wiesbaden, pp. 55-74.

Schlaak, T. M. (1999): Der Innovationsgrad als Schluesselvariable: Perspektiven fuer das Management von Produktentwicklungen, Wiesbaden.

Schmidt, F. L./Huy, L./Ilies, R. (2003): Beyond Alpha: An Empirical Examination of the Effects of Different Sources of Measurement Error on Reliability Estimates for Measures of Individual Differences Constructs, in: Psychological Methods, 8 (2), pp. 206-224.

Schmidt, F. L./Le, H. (2004): Software for the Hunter-Schmidt Meta-Analysis Methods,

Schmidt, G. n. (1997): Prozessmanagement: Modelle und Methoden, Berlin et al.

Schrader, S. (1996): Innovationsmanagement, in: Kern, W./Schroeder, H.-H./Weber, J. (Eds.): Handwoerterbuch der Produktionswirtschaft, 2. Auflage ed., Stuttgart, Cols. 744-758.

Schuh, G./Friedli, T. (2005): Service-Innovation, in: Albers, S./Gassmann, O. (Eds.): Handbuch Technologie- und Innovationsmanagement, Wiesbaden, pp. 659-676.

Schulze, R. (2007): Current Methods for Meta-Analysis: Approaches, Issues, and Developments, in: Journal of Psychology, 215 (2), pp. 90-103.

Schumpeter, J. (1926): Theorie der Wirtschaftlichen Entwicklung: Eine Untersuchung über Unternehmergewinn, Kapital, Kredit, Zins und den Konjunkturzyklus, 2., neubearb. Aufl., Muenchen.

Schumpeter, J. A. (1939): Business Cycles - A Theoretical, Historical, and Statistical Analysis of the Capitalist Process, 1st, New York, London.

Schumpeter, J. A. (1943): Capitalism, Socialism, and Democracy, London.

Scott, W. G. (1961): Organization Theory: An Overview and an Appraisal, in: Journal of the Academy of Management, 4 (1), pp. 7-26.

Sharp, D. (1997): Of Apples and Oranges, File Drawers and Garbage, in: Clinical Psychology Review, 17 (8), pp. 881-901.

Siemers, S. H. A. (1997): Innovationsprozess im Mittelstand: Teamorientierte Arbeitsformen zur Foerderung von Innovationen, Wiesbaden.

Sinkula, J. M./Baker, W. E./Noordewier, T. (1997): A Framework for Market-Based Organizational Learning: Linking Values, Knowledge, and Behavior, in: Journal of the Academy of Marketing Science, 25 (4), pp. 305-318.

Slater, S. F./Hult, G. T. M./Olson, E. M. (2007): On the Importance of Matching Strategic Behavior and Target Market Selection to Business Strategy in High-Tech Markets, in: Journal of the Academy of Marketing Science, 35 (1), pp. 5-17.

Slater, S. F./Narver, J. C. (1994): Does Competitive Environment Moderate the Market Orientation-Performance Relationship?, in: Journal of Marketing (JoM), 58 (1), pp. 46-55.

Slater, S. F./Narver, J. C. (1995): Market Orientation and the Learning Organization, in: Journal of Marketing (JoM), 59 (3), pp. 63-74.

Slavin, R. E. (1986): Best-Evidence Synthesis: An Alternative to Meta-Analytic and Traditional Reviews, in: Educational Researcher, 15 (9), pp. 5-11.

Smith, M./Busi, M./Ball, P./Van Der Meer, R. (2008): Factors Influencing an Organisation's Ability to Manage Innovation: A Structured Literature Review and Conceptual Model, in: International Journal of Innovation Management, 12 (4), pp. 655-676.

Song, M./Dyer, B./Thieme, R. J. (2006): Conflict Management and Innovation Performance: An Integrated Contingency Perspective, in: Journal of the Academy of Marketing Science, 34 (3), pp. 341-356.

Song, M./Jinhong, X. (2000): Does Innovativeness Moderate the Relationship Between Cross-Functional Integration and Product Performance?, in: Journal of International Marketing (JIM), 8 (4), pp. 61-89.

Song, M./Montoya-Weiss, M. M. (2001): The Effect of Perceived Technological Uncertainty on Japanese New Product Development, in: Academy of Management Journal, 44 (1), pp. 61-80.

Song, M./Podoynitsyna, K./van der Bij, H./Halman, J. I. M. (2008): Success Factors in New Ventures: A Meta-Analysis, in: Journal of Product Innovation Management (JPIM), 25 (1), pp. 7-27.

Song, X. M./Montoya-Weiss, M. M. (1998): Critical Development Activities for Really New versus Incremental Products, in: Journal of Product Innovation Management (JPIM), 15 (2), pp. 124-135.

Song, X. M./Montoya-Weiss, M. M./Schmidt, J. B. (1997): Antecedents and Consequences of Cross-Functional Cooperation: A Comparison of R&D, Manufacturing, and Marketing Perspectives, in: Journal of Product Innovation Management (JPIM), 14 (1), pp. 35-47.

Song, X. M./Parry, M. E. (1992): The R&D-Marketing Interface in Japanese High-Technology Firms, in: Journal of Product Innovation Management (JPIM), 9 (2), pp. 91-112.

Song, X. M./Parry, M. E. (1997): The Determinants of Japanese New Product Successes, in: Journal of Marketing Research (JMR), 34 (1), pp. 64-76.

Song, X. M./Xie, J./Dyer, B. (2000): Antecedents and Consequences of Marketing Managers' Conflict-Handling Behaviors, in: Journal of Marketing (JoM), 64 (1), pp. 50-66.

Souder, W. E./Jenssen, S. A. (1999): Management Practices Influencing New Product Success and Failure in the United States and Scandinavia: A Cross-Cultural Comparative Study, in: Journal of Product Innovation Management (JPIM), 16 (2), pp. 183-203.

Souitaris, V. (2002): Firm-Specific Competencies Determining Technological Innovation: A Survey in Greece, in: R&D Management, 32 (1), pp. 61-77.

Specht, G./Beckmann, C./Amelingmeyer, J. (2002): F&E-Management: Kompetenz im Innovationsmanagement, 2., ueberarb. und erw. Aufl.. Stuttgart.

Staehle, W. H./Conrad, P./Sydow, J. r. (1994): Management: Eine Verhaltenswissenschaftliche Perspektive, 7., ueberarb. Aufl., Muenchen.

Stock, W. A. (1994): Systematic Coding for Research Synthesis, in: Cooper, H./Hedges, L. V. (Eds.): The Handbook of Research Synthesis, New York, pp. 231-244.

Strauss, B. (2001): Technologie in der Dienstleistungsmarketing-Forschung, in: Die Unternehmung, 55 (4/5), pp. 307-326.

Swink, M. (2000): Technological Innovativeness as a Moderator of New Product Design Integration and Top Management Support, in: Journal of Product Innovation Management (JPIM), 17 (3), pp. 208-220.

Tajeddini, K./Trueman, M./Larsen, G. (2006): Examining the Effect of Market Orientation On Innovativeness, in: Journal of Marketing Management, 22 (5/6), pp. 529-551.

Takeuchi, H./Nonaka, I. (1986): The New New Product Development Game, in: Harvard Business Review, 64 (1), pp. 137-146.

Terwiesch, C./Loch, C./Niederkofler, M. (1998): When Product Development Performance Makes a Difference: A Statistical Analysis in the Electronics Industry, in: Journal of Product Innovation Management (JPIM), 15 (1), pp. 3-15.

Thornhill, S. (2006): Knowledge, Innovation and Firm Performance in High- and Low-Technology Regimes, in: Journal of Business Venturing, 21 (5), pp. 687-703.

Totterdell, P./Leach, D./Birdi, K./Clegg, C./Wall, T. (2002): An Investigation of the Contents and Consequences of Major Organizational Innovations, in: International Journal of Innovation Management, 6 (4), pp. 343-368.

Troy, L. C./Hirunyawipada, T./Paswan, A. K. (2008): Cross-Functional Integration and New Product Success: An Empirical Investigation of the Findings, in: Journal of Marketing (JoM), 72 (6), pp. 132-146.

Tsai, W. (2001): Knowledge Transfer in Intraorganizational Networks: Effects of Network Position and Absorptive Capacity on Business Unit Innovation and Performance, in: Academy of Management Journal, 44 (5), pp. 996-1004.

Tuominen, M./Anttila, M. (2006): Strategising for Innovation and Inter-Firm Collaboration: Capability Analysis in Assessing Competitive Superiority, in: International Journal of Technology Management, 33 (2/3), pp. 214-233.

Tushman, M. L./Anderson, P. (1986): Technological Discontinuities and Organizational Environments, in: Administrative Science Quarterly, 31 (3), pp. 439-465.

Tversky, A./Kahneman, D. (1974): Judgement under Uncertainty: Heuristics and Biases, in: Science, 18 (5), pp. 1124-1131.

Ulrich, H. (1970): Die Unternehmung als Produktives Soziales System: Grundlagen der Allgemeinen Unternehmungslehre, 2., ueberarb. Aufl., Bern.

Utterback, J. M. (1996): Mastering the Dynamics of Innovation, Boston.

Vahs, D./Burmester, R. (2005): Innovationsmanagement: Von der Produktidee zur Erfolgreichen Vermarktung, 3. Auflage, Stuttgart.

Vazquez, R./Santos, M. L./Alvarez, L. I. (2001): Market Orientation, Innovation and Competitive Strategies in Industrial Firms, in: Journal of Strategic Marketing, 9 (1), pp. 69-90.

Verhaeghe, A./Kfir, R. (2002): Managing Innovation in a Knowledge Intensive Technology Organisation (KITO), in: R&D Management, 32 (5), pp. 409-417.

Verhees, F. J. H. M./Meulenberg, M. T. G. (2004): Market Orientation, Innovativeness, Product Innovation, and Performance in Small Firms, in: Journal of Small Business Management, 42 (2), pp. 134-154.

Viswesvaran, C./Sanchez, J. I. (1998): Moderator Search in Meta-Analysis: A Review and Cautionary, in: Educational & Psychological Measurement, 58 (1), pp. 77-87.

Voeth, M./Gawantka, A. (2005): Produktbegleitende Dienstleistungen auf Industriegueterm aerkten: Eine Empiriegestuetzte Untersuchung, in: Amelingmeyer, J./Harland, P. E. (Eds.): Technologiemanagement & Marketing: Herausforderung eines Integriertem Innovationsmanagements, Wiesbaden, pp. 469-486.

Vollmer, G. (1985): Was Koennen Wir Wissen? Band 1: Die Natur der Erkenntnis, Stuttgart.

Voss, G. B./Voss, Z. G. (2000): Strategic Orientation and Firm Performance in an Artistic Environment, in: Journal of Marketing (JoM), 64 (1), pp. 67-83.

Wei, Y./Morgan, N. A. (2004): Supportiveness of Organizational Climate, Market Orientation, and New Product Performance in Chinese Firms, in: Journal of Product Innovation Management (JPIM), 21 (6), pp. 375-388.

Weidler, A. (1997): Entwicklung integrierter Innovationsstrategien, Frankfurt am Main et al.

Wernerfelt, B. (1984): A Resource-Based View of the Firm, in: Strategic Management Journal (SMJ), 5 (2), pp. 171-180.

Wheelwright, S. C./Clark, K. B. (1992): Revolutionizing Product Development, 7th ed., New York.

White, H. D. (1994): Scientific Communication and Literature Retrieval, in: Cooper, H./Hedges, L. V. (Eds.): The Handbook of Research Synthesis, New York, pp. 41-55.

Whitener, E. M. (1990): Confusion of Confidence Intervals and Credibility Intervals in Meta-Analysis, in: Journal of Applied Psychology, 75 (3), pp. 315-321.

Willke, H. (1993): Systemtheorie: Eine Einfuehrung in die Grundprobleme der Theorie Sozialer Systeme, 4., ueberarb. Aufl., Stuttgart.

Wirtz, B. W./Mathieu, A./Schilke, O. (2007): Strategy in High-Velocity Environments, in: Long Range Planning, 40 (3), pp. 295-313.

Wong, H.-K./Ellis, P. D. (2007): Is Market Orientation Affected by the Product Life Cycle?, in: Journal of World Business, 42 (2), pp. 145-156.

Xie, J./Song, X. M./Stringfellow, A. (1998): Interfunctional Conflict, Conflict Resolution Styles, and New Product Success: A Four-Culture Comparison, in: Management Science, 44 (12), pp. S192 - S206.

Yam, R. C. M./Guan, J. C./Pun, K. F./Tang, E. P. Y. (2004): An Audit of Technological Innovation Capabilities in Chinese Firms: Some Empirical Findings in Beijing, China, in: Research Policy (RP), 33 (8), pp. 1123-1140.

Youngbae, K./Song, K./Lee, J. (1993): Determinants of Technological Innovation in the Small Firms of Korea, in: R&D Management, 23 (3), pp. 215-226.

Zahra, S. A./Covin, J. G. (1993): Business Strategy, Technology Policy and Firm Performance, in: Strategic Management Journal (SMJ), 14 (6), pp. 451-478.

Zeithaml, V. A./Parasuraman, A./Berry, L. L. (1985): Problems and Strategies in Services Marketing, in: Journal of Marketing (JoM), 49 (2), pp. 33-46.

Zhou, K. Z./Yim, C. K./Tse, D. K. (2005): The Effects of Strategic Orientations on Technology- and Market-Based Breakthrough Innovations, in: Journal of Marketing (JoM), 69 (2), pp. 42-60.

Zirger, B. J./Maidique, M. A. (1990): A Model of New Product Development: an Empirical Test, in: Management Science, 36 (7), pp. 867-883.