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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RESEARCH

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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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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.