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# THE STRATEGIC MANAGEMENT OF INNOVATION: A SYSTEMATIC REVIEW AND PATHS FOR FUTURE RESEARCH

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## Abstract

**Strategic management scholars have long emphasised the importance of innovation for a firm's competitive advantage and performance. However, our current state of knowledge about the strategic management of innovation is characterised by conflicting theoretical predictions, persisting knowledge gaps and theoretical inconsistencies. Adopting a 'systematic' approach to review the literature, we combine different quantitative methods – co-word analysis, cluster analysis, and frequency analysis – to review 342 articles on the strategic management of innovation published in seven journals from 1992 to 2010. On the basis of these analyses, we develop suggestions for future research that can help to promote future theory development and to provide relevant material for policy decisions that managers and executives have to make when they manage innovation.**

## Introduction

Firms can use innovation strategically in order to achieve competitive advantage (Hitt *et al.* 1998; Ireland and Hitt 1999), compete effectively in local and global markets (Subramaniam and Venkatraman 1999), adapt their strategy to changing market and customer demands, create value and growth (Amit and Zott 2001) and achieve superior performance (Grimm and

Smith 1997; Lee *et al.* 2000; Roberts 1999; Zahra *et al.* 2000). Therefore, the strategic management of innovation represents an important component of a firm's strategy (Hamel 2000) and a major contributing factor to a firm's competitive advantage (Elenkov and Manev 2005; Lengnick-Hall 1992; Porter 1985). Consequently, the strategic management of innovation has become a central topic within the strategic management field (e.g., Herrmann 2005; Nag *et al.* 2007). A systematic study of this issue should therefore be beneficial to both academic researchers and practitioners which is why our paper undertakes to review the innovation literature from a strategic management perspective.

We adopt Damanpour's (1991) understanding of innovation: An innovation can be a new product or service, a new production process technology, a new structure or administrative system, or a new plan or program pertaining to organisational members. Since this definition accommodates different forms of innovation, it allows us to minimize the possibility of selection biases rooted in definition issues. Further, we follow Nag *et al.*'s (2007) comprehensive definition of strategic management as a field that deals with the major intended and emergent initiatives taken and the internal organisation adopted by general managers on behalf of owners, involving utilisation of resources to enhance the performance of firms in their external environments.

Combining the two definitions, we suggest that the strategic management of innovation is concerned with using appropriate strategic management techniques and measures such that the impact of the firm's innovation activities for firm growth and performance is maximized.

A number of arguments speak for the theoretical and practical relevance of producing a review on the strategic management of innovation.

First, over the last 20 years the global economic regime has become increasingly liberalized while a focus on innovation has replaced traditional cost-oriented business models in many firms (McGrath *et al.* 1996). Since the 1990s, 1990these developments have triggered an exponential growth in the innovation literature and many novel topics have emerged, such as

international innovation (e.g., Granstrand *et al.* 1993), headquarter-subsidiary relationships (e.g., Birkinshaw *et al.* 1998; Frost *et al.* 2002), knowledge management (e.g., Kogut and Zander 1992), and ‘open innovation’ business models (e.g., Chesbrough 2003; von Hippel and von Krogh 2003). Moreover, theoretical frameworks like the knowledge-based view of the firm or the dynamic capabilities perspective that emerged since then have offered many new ways of theorizing about innovation. All of these developments have led to a fragmentation of the innovation literature, so that its present state is characterized by many inconsistencies, competing theoretical frameworks, diverse conceptualisations of the determinants of innovation, and knowledge gaps (Andries and Debackere 2006; Fagerberg and Verspagen 2009; Lam 2005). Many studies have sought to understand the innovation process but scholars have not yet been able to identify a clear prototypical process for the management of innovation (Gupta *et al.* 2007).

Second, the vast majority of innovation research conducted on the organisational level of analysis has concentrated on three domains: (a) the identification of antecedents that affect the extent to which an organisation is successful at technical innovation; (b) studies of the development of new products and/or new businesses within the established organisation with a focus on ambidexterity; (c) the impact of interfirm linkages on various types of organisational innovation (Gupta *et al.* 2007). This specificity seems problematic since many questions pertaining to the strategic management of innovation are still little understood, such as the relations between innovation, resources, and performance (Argyres and Silverman 2004; Criscuolo and Narula 2007; Frost and Zhou 2005; Nerkar and Paruchuri 2005).

Third, these developments create significant problems for practitioners. Several decades of research into innovation management have failed to provide clear and consistent findings, coherent advice to managers, and convincing ‘best practice’ solutions (Tidd 2001). For instance, firms that produce breakthrough innovations use other management practices than those that focus on incremental innovation (Leifer and Rice 1999). Practitioners are therefore

confronted with an overwhelmingly complex literature but no guidance or insights regarding practical implications that can be derived from this literature. Thus, managing innovation has become a ‘daunting task’ (Drazin and Schoonhoven 1996, p. 1081).

However, since the seminal reviews of Lengnick-Hall (1992) and Wolfe (1994), no comprehensive review on the strategic management of innovation has been published, although the innovation literature has grown exponentially since. There are reviews of specialized topics that all relate to innovation, such as the relationship between social capital and innovation (Zheng 2010); the measurement and valuation of the inputs and results of the innovation process (Adams *et al.* 2006; Johnson *et al.* 2002), specific types and typologies of innovation (Garcia and Calantone 2002; Yu and Hang 2010), environmental contingencies (Tidd 2001), the link between innovation and national productivity (Denyer and Neely 2004), new product development (Ernst 2002; Page and Schirr 2008), individual-level cognitive aspects of innovation (Anderson *et al.* 2004), the role of third parties in the innovation process (Bogers *et al.* 2010; Howells 2006), the diffusion of innovations (O'Neill *et al.* 1998), open innovation (Dahlander and Gann 2010), networking (Pittaway *et al.* 2004), the relationship between market orientation and innovation performance (De Luca *et al.* 2010), or the role of organisational size (Camison-Zornoza *et al.* 2003).

Unfortunately, very few of these reviews address the strategic management of innovation. Moreover, few of these reviews devote specific attention to the organisational level of analysis. This seems problematic, since strategic management is fundamentally concerned with the major measures by which firms can achieve competitive advantage (Nag *et al.* 2007; Teece *et al.* 1997). A review on the strategic management of innovation that focuses on the organisational level of analysis therefore seems highly desirable. The purpose of this paper is to deliver a systematic review of the literature on this topic in order to make the following contributions:

- (1.) First, we provide the first comprehensive review on the strategic management of

innovation since the reviews of Lengnick-Hall (1992) and Wolfe (1994). Thus, our article is an attempt to systematically chart out, on an organisational level of analysis, the theoretical conflicts, knowledge gaps, and inconsistencies that exist in research on the strategic management of innovation.

(2.) Based on the identification of these knowledge gaps and inconsistencies in the current state of the literature, we suggest promising paths for future research on the strategic management of innovation.

(3.) By identifying these gaps and inconsistencies and by devising promising paths for future research, we show how our knowledge about the strategic management of innovation can be developed by integrating relevant findings from the innovation field. As insights from the innovation field are typically recognized little in the strategic management field (e.g. Tahai and Meyer 1999), our study should be able to contribute substantially to the development of our understanding regarding the strategic management of innovation by spanning the boundaries between the strategic management and the innovation fields.

(4.) We make a major methodological contribution by introducing analytical methods that are fully consistent with the 'systematic' review method (Tranfield *et al.* 2003) and deploy quantitative techniques which to date have been used little in literature review studies. Our article is among the very first to use the bibliometric technique of co-word analysis (see, e.g., Bhattacharya and Basu 1998; Coulter *et al.* 1998; Ding *et al.* 2001) in this context. Our paper thus benefits from the valuable analytical insights these techniques can deliver (e.g., Furrer *et al.* 2008; Nag *et al.* 2007; Nerur *et al.* 2008; Ramos-Rodríguez and Ruíz-Navarro 2004).

(5.) By organising and consolidating the literature on the strategic management of innovation, our study is likely to stimulate the emergence of valuable insights for managers and executives.

To make these contributions, the paper proceeds as follows: After a description of the methods used to review the literature, we analyse 342 articles on the strategic management of

innovation that have been published in the top-tier strategic management journals since 1992, the last year that Lengnick-Hall (1992) and Wolfe (1994) considered for their reviews. On the basis of this analysis, we are able to identify several important theoretical inconsistencies and knowledge gaps the resolution of which is likely to improve our understanding of the strategic management of innovation. We discuss each gap and inconsistency, and we contribute to advancing theory and practice by suggesting how future research may overcome them. Finally, the conclusion summarizes our findings, suggestions, and contributions.

## **Methods**

We undertake a systematic, quantitative review, consistent with recent suggestions that the methodological rigour of reviews of the management literature should be strengthened (e.g., Denyer and Neely 2004; Thorpe *et al.* 2005; Tranfield *et al.* 2003).

Our choice to review the innovation literature from a strategic management perspective entails two selection decisions: First, we limit our review to double-blind reviewed journal articles published in this field's top-tier journals as described further below.

Second, we focus on the organisational level of analysis, while we declare individual-level innovation (e.g., creativity research) and industry- and/or meta-level research on innovation (e.g., technology diffusion between industries) beyond our scope. This focus on the organisational level of analysis seems justified since strategic management is fundamentally concerned with measures that *firms* use to achieve competitive advantage (Nag *et al.* 2007; Teece *et al.* 1997, emphasis added).

### *Data collection*

We limited our review to non-invited peer-reviewed journal articles, omitting books, book chapters, and other non-refereed publications because journal articles can be considered

validated knowledge and are likely to have the highest impact on the field (Ordanini *et al.* 2008; Podsakoff *et al.* 2005; Ramos-Rodriguez and Ruíz-Navarro 2004). Established influential journals tend to shape the theoretical and empirical work in a field by setting new horizons for inquiry within their frame of reference (Furrer *et al.* 2008, p. 2). We therefore feel that this approach provides an accurate and representative picture of relevant scholarly research.

Since we intended to review the literature on the strategic management of innovation, we focused on the most influential journals in the strategic management field. These were identified by using Podsakoff *et al.*'s (2005) citation-based study of 28 renowned management journals as follows: First, we excluded the bottom 14 journals as they have received less than 20% of the citations that were made to the 28 journals in total over the period 1981 - 1999. Second, from the remaining top 14 journals, we selected those that were considered representative and highly relevant for the strategic management field across a range of literature review articles that focus on strategic management (Franke *et al.* 1990; Hutzschenreuter and Israel 2009; MacMillan 1991; Nielsen 2010; Park and Gordon 1996; Rashman *et al.* 2009; Tahai and Meyer 1999). Finally, following Nag *et al.* (2007), we decided to omit the practitioner-oriented *Harvard Business Review*. It was replaced by *Organization Science* which was not considered in Podsakoff *et al.*'s (2005) analysis, but which represents a major publication outlet related to strategic management (Augier *et al.* 2005; Nag *et al.* 2007). Our review thus covers the following journals: *Academy of Management Journal*, *Academy of Management Review*, *Administrative Science Quarterly*, *Journal of Management*, *Management Science*, *Organization Science*, and *Strategic Management Journal*. This wide range of journals also allows us to provide a broad and deep analysis given that prior reviews in the strategic management field only considered subsets of these journals (e.g. Furrer *et al.* 2008; Nag *et al.* 2007).

We used a three-stage selection process to identify relevant articles from these journals.



First, we searched all issues of these journals from 1992 to the last issue of 2010 that was available on-line on July 26, 2010, using various electronic databases (*Business Source Premier*, *JSTOR*, and the journals' homepages). We chose 1992 as the cut-off point for the past since the prior literature is nicely summarised by Lengnick-Hall (1992) and Wolfe (1994). The complete article count over all journals and issues was 9 173.

Consistent with prior approaches to identifying relevant articles (cf. Nielsen 2010; Rashman *et al.* 2009; Thorpe *et al.* 2005; Tranfield *et al.* 2003), we performed keyword searches and retained those 3575 articles that contained the word 'innovation' and/or any of the phrases 'Research and Development', 'Research & Development', 'R&D', 'R & D', or 'R and D' in either of their titles, abstracts, or full texts.

To classify which of these 3575 articles focused on both the strategic management of innovation and an organisational level of analysis, six coders (the authors and three assistants) analysed the extent to which (if any) the article focused on (1) the strategic management of innovation and (2) an organisational level of analysis by rating each article's title and abstract on separate four-point scales anchored at 'not at all' and 'clearly' (cf. Nag *et al.* 2007). Average Cohen's kappas of 0.74 and 0.85 suggested strong interrater agreement (Conger 1980).

We classified an article as relevant if the average score across all coders was 3.0 or above on both scales. 369 articles satisfied this requirement and were forwarded to the third stage at which we looked at the number of citations each individual article received in order to maximise the relevance of our set of articles. Rather than using an arbitrary cut-off point of how many citations an article had to receive (which would place newer articles at a disadvantage), we compared the number of citations each article received to the average number of citations that was received by articles appearing in the respective year in the respective journal.<sup>1</sup> We dropped those 27 articles that received less than one quarter of the average citations for their journal and year. This threshold resulted from Podsakoff *et al.*'s

(2005) observation that an article appearing in the bottom 7 of the studied 28 journals received on average one quarter of the citations an article from the top 14 journals received (which form the pool from which our final journal set was drawn). Put differently, we dropped those articles that were less influential than an average article from journals that have considerably less influence on the field than the journals we selected. Thus, 342 articles (see Appendix S1) remained for analysis.

### *Data analysis*

First, we devised a two-tier review scheme for systematic evaluation in order to reduce subjective bias and enhance validity (Ginsberg and Venkatraman 1985).

We used the seven elements in Nag *et al.*'s (2007) definition of strategic management to delineate the domain since this definition reflects scholars' latent conception of the field and is therefore unlikely to be affected by subjective bias. Second, in order to minimise subjective interpretation biases, the authors read each of the 342 articles and independently analysed the research focus, data and methods, variables (if applicable) and results. The individual assessments were then combined and synthesised. If there were disagreements (which were few), the issue was discussed and resolved. This process yielded a coding matrix that included all articles and provided information for the subsequent analyses. Moreover, we performed a co-word analysis on the titles of all 342 articles and used its results to run cluster analyses in order to identify clusters of related issues and topics. We performed these analyses as follows.

Co-word analysis is a content analysis technique that reveals patterns in discourse by measuring the association strengths of terms representative of relevant publications produced in the corresponding field (Coulter *et al.* 1998, p. 1206). While this is a well established bibliometric method that has generally been used extensively (see Onyanha and Ocholla (2009) for an overview), management scholars have only recently begun to employ bibliometric and lexicographic techniques (e.g., Furrer *et al.* 2008; Nag *et al.* 2007; Nerur

*et al.* 2008). Since these scholars generally conclude that such techniques represent useful tools to analyse the field, we are confident that a co-word analysis can also yield useful insights about the strategic management of innovation.

To perform the co-word analysis, we applied the software Bibexcel (Ramos-Rodriguez and Ruíz-Navarro 2004; Persson *et al.* 2009). First, we downloaded each article's full title from ISI's Web of Knowledge and imported it into Bibexcel. We then instructed Bibexcel to create a file in which all the words from the articles' titles were listed together with an identification number of the respective article.

Following standard practice among bibliometricians, we ran the co-word analysis using each article's title words (cf. Bhattacharya and Basu 1998; Leydesdorff 1989; Onyancha and Ocholla 2009). First, we deleted words of little contentual meaning (such as 'and', 'the', or many prepositions) and reduced words to their stems in order to consolidate different variants of the same word (cf. Rokaya *et al.* 2008; Tseng *et al.* 2008; van den Besselaar and Heimeriks 2006). The resulting list was then checked manually to eliminate remaining inconsistencies (such as different spellings). After Bibexcel was instructed to treat multiple occurrences of a word within the same title as a single occurrence, the software calculated the frequency with which the consolidated words occurred across the 342 titles. Keeping those words that occurred more than twice across the titles (cf. Ding *et al.* 2001), Bibexcel finally calculated the frequency with which both elements of individual word pairs appeared together in the same titles. We then exported the two frequency lists of occurrences and co-occurrences, respectively, to MS Excel in order to prepare a cluster analysis based on these results. Using cluster analysis in conjunction with co-word analysis is again common practice among bibliometricians (e.g., Courtial 1994; Ding *et al.* 2001; Leydesdorff 1989; Rodriguez *et al.* 2007).

Next, we programmed an Excel macro in order to produce a (224x224)-matrix with the 224 individual words in the rows and the columns and the frequency of their co-occurrence in the

respective cell. Subsequently, the absolute frequency values were transformed into a normalised measure of association between the two words using the Cosine formula (e.g., Peters and van Raan 1993: 48):

$$C_{ij} = \frac{c_{ij}}{\sqrt{c_i c_j}}$$

where  $c_i$  is the frequency of the word in row  $i$ ,  $c_j$  is the frequency of the word in column  $j$ , and  $c_{ij}$  is the number of co-occurrences of these two words.  $C_{ij}$  is limited between 0 and 1 and functions as the similarity measure for our cluster analysis. Since we used the econometric software package STATA Vol. 11 to run the cluster analysis, we exported values of  $1 - C_{ij}$  because STATA performs the cluster analysis on a *dissimilarity* matrix (StataCorp. 2009: 95).

We performed the cluster analysis in several steps. The number of clusters in each step was chosen on the basis of the Duda-Hart  $Je(2)/Je(1)$  index which has been identified as one of the best rules to determine the number of clusters (Milligan and Cooper 1985). Associated with the Duda-Hart index is a pseudo-T-squared value, and smaller pseudo-T-squared values indicate more distinct clustering (Duda *et al.* 2001). To choose a cluster solution, we therefore compared the pseudo-T-squared values for the solutions comprising 2 to 30 clusters.

First, we performed a single-linkage cluster analysis to detect outliers (cf. Flanagan *et al.* 2008; Marchette 2004). Seven words were detected as outliers and deleted. On the remaining 217 words, we performed the final cluster analysis using Ward's method which is consistent with our Cosine measure of the strength of co-word association (cf. Lee and Jeong 2008; Leydesdorff 1989). The individual clusters from the 25 cluster solution are shown in Figure 1.<sup>2</sup> Note that cluster membership is mutually exclusive; i.e., each word is a member of only one cluster.

<< Insert Figure 1 about here >>

We further used our coding matrix to create the following tables: Table 1 presents a detailed

account of where and when the 342 reviewed articles were published. Table 2 provides the type of innovation on which each article focuses. Table 3 gives the dependent variables that the 223 quantitative studies among the 342 articles have employed, while Table 4 tabulates the independent variables.<sup>3</sup> Table 5 lists the analytical methods that each article has adopted and Table 6 summarises the industries that were studied by the 248 empirical articles.

<< Insert Table 1 to 6 about here >>

We now describe how we used the cluster analysis and the tables to identify research gaps.

### *Data interpretation*

We interpreted the results from the cluster analysis and the tables as follows to present findings and derive research gaps. We use information on the particular words that each cluster covers<sup>4</sup> and on the frequency with which these words appear across all titles of the 342 articles we have sampled (note that multiple occurrences within the same title were only counted once). For example, only three out of 342 titles (0.88%)<sup>5</sup> contain the term ‘constraints’ in any version using its word stem (see Note b to Fig. 1), suggesting that scant attention has been devoted to this issue. To validate such claims, we triangulate these cluster analysis data with the diverse frequency counts and analyses reported in Table 1 through 6. We only claim that such a gap exists if *both* the cluster analysis *and* at least one of the tables suggest that this issue is under-represented.

### **Paths for future research**

The results from the cluster analysis and tabulations of variables suggested that multiple knowledge gaps and theoretical inconsistencies exist that all restrict our knowledge about the strategic management of innovation. In the following, we explicate these and make suggestions of how future research may overcome them. These discussions are structured

according to Nag *et al.*'s (2007) seven elements that constitute scholars' implicit, consensual definition of the strategic management field. Using bibliometric analyses, Nag *et al.* (2007, pp. 942, 947) show that the field of strategic management comprises seven major thematic aspects: (a) the major intended and emergent initiatives taken (b) and the internal organisation adopted (c) by general managers on behalf of owners (d) involving utilisation of resources (e) to enhance the performance (f) of firms (g) in their external environments.

The first definitional element, 'the major intended and emergent initiatives taken', is concerned with the means, measures and activities by which firms aim to induce performance improvements. In Nag *et al.*'s (2007) analysis, it is represented by means such as 'strategy', 'acquisition', and 'diversification' which are typically characterised by substantial deliberate planning, but it also includes means such as 'learning' that tend to exhibit a strong emergent component. The second element of the definition, 'the internal organisation adopted', is represented by words such as 'practices', 'structure', 'process', 'organizing', and 'behavior'. The third element, 'by general managers on behalf of owners', which is represented by terms such as 'CEO', 'top', 'directors', and 'boards' illustrates that the upper echelons and governing bodies of companies are the key actors on whom strategy research focuses its attention. Moreover, words such as 'agency' and 'ownership' show that owners assume primacy over any other stakeholders. The fourth definitional element, 'involving utilisation of resources', pertains to the resources that managers use in their strategic initiatives; these are represented by words such as 'capability', 'knowledge', 'assets', and 'financial'. The fifth element, 'to enhance the performance', indicates that outcomes such as 'growth', 'returns', 'performance', and 'advantage' are of primary interest to strategic management scholars. The sixth definitional element, 'of firms' reflects the focal unit of analysis of strategic management which is represented by words such as 'firm', 'enterprise', 'multibusiness', and 'strategic business unit'. The seventh element, 'in their external environments', is finally represented by words such as 'market', 'competition', and 'industry' on the one hand which

refer to the business environment of a firm, and by words such as ‘environment’, ‘uncertainty’, and ‘contingency’ on the other hand which indicate a potentially broader external context.

As these seven elements constitute the ‘very essence’ of the strategic management field (Nag *et al.* 2007, p. 938), they are useful to structure the identification of promising opportunities for future research on the strategic management of innovation. Overcoming research gaps related to the seven elements is likely to generate knowledge that contributes essentially to a better understanding of the strategic management of innovation. We therefore use these seven elements to structure the identification of paths for future research.<sup>6</sup>

#### *Intended and emergent initiatives*

*Inter-firm governance and performance.* The choice of collaborative governance mechanisms such as R&D alliances (e.g., Hagedoorn 1993; Sampson 2007), joint ventures (e.g., Keil et al. 2008; Oxley and Wada 2009), or ‘open innovation’ (e.g., Chesbrough 2006) is frequently addressed in the literature we reviewed. The cluster analysis suggest a strong representation of terms indicating an inter-firm relationship (such as ‘relationship’, ‘collaboration’, ‘network’, ‘cooperation’, and ‘alliance’). Clusters 19 to 22 are exclusively concerned with inter-firm governance, with subtopics such as the governance of the relationship (Cluster 19), the formation of a collaboration (Cluster 20), and the structure of an alliance (Cluster 22), while Cluster 21 suggests that the access to complementary assets may be a common motive to cooperate. Further, Table 4 shows that a total of 68 independent variables are related to inter-firm collaborations.

Still, important knowledge gaps remain. First, the cluster analysis shows that relatively little attention has been devoted to the performance consequences of such collaborations.

From four clusters concerned with inter-firm collaborations, only Cluster 22 contains words that relate to performance implications. Table 3 substantiates the finding that little attention has been devoted to the performance implications of inter-firm governance modes by showing that only three of the reviewed articles (Oxley and Wada 2009; Sobrero and Roberts 2001; Vassolo *et al.* 2004) measure such performance outcomes. This underrepresentation is disturbing given that most innovation-related collaborations between firms actually fail to meet their targets and do not live up to expectations, irrespective of the particular mode of collaboration (Bleeke and Ernst 1993; Inkpen and Ross 2001; Keasler and Denning 2009; Lang and Stulz 1994; Park and Ungson 2001; Sadowski and Duysters 2008). As a result of this gap, the reasons for this widespread underperformance or failure of inter-firm governance mechanisms in the context of R&D and innovation are not well known. From a theoretical perspective, it would therefore be desirable to develop an understanding of the mechanisms that induce positive outcomes from innovation-related collaborations, e.g., by hypothesizing on antecedents that can relate performance differentials to specific types of inter-firm governance. For example, the relationship between complementarities among organisational structures, resources, and innovation strategies on the one hand and collaboration performance on the other hand could be studied. None of the studies we reviewed has yet addressed such questions which are nevertheless highly relevant from a strategic management perspective.

Second, the cluster analysis reveals that research interest in particular subtopics of inter-firm collaborations seems to be quite fragmented as almost all terms in clusters 19 to 22 that capture such subtopics exhibit a relatively low count (exceptions are ‘structure’ which occurs 16 times – i.e. across 4.68% of the titles – and, to some extent, the role of ‘complementary assets’, appearing 8 times - 2.34%). Accordingly, Tables 3 and 4 suggest that the problems and hazards of inter-firm collaborations in the context of innovation have been rarely addressed. This neglect seems not only problematic because the high failure rates imply that such problems persist, but also because those firms that depend most on alliances tend to be



particularly affected by opportunistic behaviour of and exploitation by their partners (Dickson *et al.* 2006; Miles *et al.* 1999). We believe that it would be interesting to deepen our knowledge about how firms counter these hazards. To do so, scholars could hypothesise on how and why organisational behaviour within cooperative agreements may affect these hazards and use outcome constructs that capture the problems and risks of inter-firm governance. An example for such an approach is the study of Schilling and Steensma (2002) who find that the threat of experiencing opportunism in an inter-firm relationship affects the mode by which firms govern this relationship. We believe that to extend this line of research seems promising in order to contribute to resolving the above knowledge gaps.

*Appropriation strategy and performance.* Appropriation strategies describe the measures taken by a firm to capture value from its innovations (Ceccagnoli 2009, p. 82). Firms which first introduce an innovation are not necessarily those that profit most from it (Teece 1986). Since a major focus of strategic management research is to explain performance differences between firms (Bryson and Bromiley 1993), the question of what firms can do to maximise returns from innovation is highly relevant. However, cluster 8 which addresses the issues of introduction, commercialisation, and appropriation indicates that appropriation strategies might have received very little attention as the word ‘appropriation’ appears in only 4 out of 342 titles (1.17%). Tables 3 and 4 suggest that from all the 342 studies in our sample, only that of Ceccagnoli (2009) addresses this question. He finds support for his claim that the type of appropriation strategy a firm chooses is associated with its performance. Therefore, studies that would explore under which internal and external conditions firms select a particular appropriation strategy and how (if at all) these external and internal conditions interact are highly desirable. The relevance of such contributions is likely to increase further if the question of how, if at all, foreign firms must adapt their appropriation strategies to local appropriability conditions is additionally considered (e.g., Keupp *et al.* 2010).

*Neglected types of innovation.* It is essential to delve deeper into the ‘black box’ of innovative processes to understand both their content and the forces that drive them (Galloway and Weinstein 1997). The results of our cluster analysis as well as Tables 2, 3, and 4 consistently suggest that this call has been addressed little to date and that relatively few articles focus on the strategic management of process innovations, administrative innovations, and service innovations. While the word ‘product’ (cluster 16) occurs across 61 titles (17.84%), the word ‘service’ (cluster 9) is only part of three titles (0.88%); the count of ‘manufacturing’ (cluster 13) is almost five times as high. Few titles (1.17% and 1.75%, respectively) comprise the terms ‘renewal’ and ‘adaptation’ (cluster 3) which can refer to administrative innovations (e.g., Bartlett and Ghoshal 1993; Sastry 1997). The higher count of the word ‘process’ (cluster 4) which is contained in 16 titles (4.68%) is somewhat qualified if one takes into consideration that this word can be used to designate at least two fundamentally different phenomena – process innovations and the innovation process. Table 3 illustrates that, in comparison to the 38 dependent variables that are related to product innovation, very few dependent variables focus on process (3 occurrences), administrative (1) or service innovations (4). Table 2 corroborates these analyses by showing that relatively few of the 342 reviewed articles have focused on these types of innovations.

The relative neglect of process innovations seems problematic since these are vital for generating returns from an introduced product, albeit in different stages of its life-cycle (Utterback 1994; Utterback and Abernathy 1975). For example, the increase in the competitiveness of Japanese firms since the 1980s can be attributed to their proficiency in process innovations (Bhoovaraghavan *et al.* 1996). Thus, a deeper understanding of how firms can strategically manage process innovations would be desirable. With the exemption of Macher (2006) and Tyre and Hauptman (1992) who both confirm an association between process innovation complexity and ‘working’ outcomes, validated empirical knowledge on the strategic management of process innovations is very scarce. Research is also needed

regarding the questions of how process innovations are generated and how and why their performance differs, particularly since antecedents that may increase product innovation do not necessarily also spur process innovations (He and Wong 2004).

Antecedents that determine scope and extent of *administrative* innovation are very different from those that determine scope and extent of *technical* innovation (Aiken *et al.* 1980; Damanpour 1991; Evan and Black 1967; Kimberly and Evanisko 1981). These differences may signal that different decision making mechanisms and resource allocation rules exist for administrative, as opposed to technical, innovations (cf. Daft 1978). For decades, there have been repeated calls for a better understanding of administrative innovation (Arrow 1971; Chandler 1977; Cole 1968; Drazin and Schoonhoven 1996; Mezas and Glynn 1993; Williamson 1983); however, our findings suggest that these have not been answered sufficiently so far. Since organisational structure and control systems – which are altered by administrative innovation – are important for organisational survival (Tushman and Romanelli 1985) and firm performance (Virany *et al.* 1992), research that would study the relationship between the manipulation of organisational structures and control systems by administrative innovation on the one hand and the performance implications of this manipulation on the other hand seems highly desirable.

Finally, service innovation has been studied very little in the strategic management literature. Some pioneering work exists, e.g. the formal economics-based attempt of Gallouj and Weinstein (1997) to build a theory of innovation that explains service innovation, or the pioneering article of Tether (2005) who provides mostly descriptive evidence of service innovation within the EU. However, the strategic management literature has not yet referred to this work or attempted to use these foundations to elaborate on their propositions and to test theory by hypothesis-driven, large-sample studies of service innovation. We believe that such research would be promising for the strategic management field, especially since longstanding theoretical debates persist between the demarcation view that emphasises the dynamic and

fluid nature of service innovation as opposed to manufacturing innovation (e.g., Gallouj and Weinstein 1997), the critics of this view (e.g., Drejer 2004) and a third approach that tries to synthesise service and manufacturing innovation (e.g., Coombs and Miles 2000).

*Deliberate non-innovation.* Another important area where theoretical inconsistencies exist is defined by the case of non-innovating firms, i.e. firms that *deliberately* do *not* innovate (e.g., Iwamura and Jog 1991). Using data from the EU's community innovation survey, Roper (1997) finds that the fraction of non-innovators ranges from 5.3% for large firms in Germany to 44.0% for small firms in the UK. These data seem to shed some doubt on the assertion that innovation is paramount for the generation of competitive advantage and firm survival (Banbury and Mitchell 1995; Bayus and Agarwal 2007; Cefis and Marsili 2006; D'Aveni 1994; Porter 1990). As a consequence of these surprising findings, the EU's Community Innovation Survey (CIS) questionnaire has been extended by pilot modules that attempt to explore the reasons for non-innovation (e.g., Robson and Haigh 2008), however this evidence is preliminary and descriptive only. Yet, both the cluster analysis and the tables suggest that none of the articles in our sample discussed this issue. We believe that our understanding of the strategic management of innovation can be deepened considerably if these issues are studied, and research may take advantage of the forthcoming EU data to look for empirical evidence.

### *Internal organisation*

*Ambiguity in the causal relationship between internal organisation and innovation.* The internal organisation determines how resources are allocated within a firm, what internal routines are used, what the communication networks look like, and how information and tasks flow (Chandler 1962; Galunic and Eisenhardt 1996; Helfat and Eisenhardt 2004; Karim 2009; Levitt and March 1988). It therefore affects the efficiency with which existing resources can

be utilised (Zahra and Nielsen 2002) and further provides a context for strategic choices (Lefebvre et al. 1997). Thus, the internal organisation of a firm is likely to be associated with the quantity and quality of the innovations it produces and the innovation policy it pursues (e.g., Argyres and Silverman 2004; Jansen et al. 2006; Lefebvre et al. 1997; Terziovski 2010; Zahra and Nielsen 2002). Thus, internal organisation is an important topic in research on the strategic management of innovation, especially since a firm's choices of how to structure its internal organisation 'represent some of the most powerful strategic levers available to the top management of the modern corporation' (Gulati et al. 2009, p. 575).

The internal organisation of firms influences innovatory outcomes, but it is also affected by these outcomes since innovation evokes a continuing need for organisational adaptation (Lengnick-Hall 1992, p. 423). Consequently, the causal paths between internal organisation and innovatory outcomes may be everything but linear, evoking the need for longitudinal and endogeneity-controlling research designs. Heterogeneity attributable to between-period, rather than within-period variation should be controlled for when theoretical relationships are postulated and tested, such that antecedents can be clearly separated from outcomes of innovatory activities (Eisenhardt and Tabrizi 1995; Lengnick-Hall 1992). However, our analysis shows that extant empirical literature that focuses on the internal organisation in the context of innovation has hardly deployed longitudinal designs.

The low frequency count for the word 'longitudinal' (cluster 23), which appears in only three titles (0.88%) contrasts with the fact that 97 of the 342 articles we review (28.36%) use longitudinal quantitative methods such as survival time or panel regression analyses (cf. Table 5). However, when we reviewed these 97 articles in terms of their variables, we find that these are scattered very unevenly across the topics depicted by the entries in Tables 3 and 4.<sup>7</sup> With few exceptions (e.g., Zahra and Nielsen 2002), very little attention has been paid to issues such as organisational design, whereas some initiatives (e.g., the product-market strategy and R&D investments) and the number of patents are relatively frequently

examined.<sup>8</sup> We therefore believe that future innovation research should seek to retest extant theoretical relationships between internal organisation and innovation using longitudinal datasets and methods.

### *Managerial and ownership issues*

*Implementation of innovation.* Implementation designates the process of gaining targeted employees' appropriate and committed actions towards the initiative (Klein and Sorra 1996). Firm performance is not only driven by appropriate initiatives, but also by how these are implemented. The problems that managers face during implementation are considered a pivotal cause for the inability of many organisations to achieve the intended benefits of the innovations they adopt (Dougherty 2001; Klein and Sorra 1996; Repping 2002).

Despite this relevance, the cluster analysis and Table 4 consistently suggest that the strategic management literature has neglected the question of how firms' innovatory concepts may be implemented successfully. The words 'implementation' and 'leadership' (cluster 4) appear only three and five times, respectively, across all 342 titles (0.88% and 1.46%, respectively), and most other clusters do not relate to such issues. The nine entries in the category 'process management issues' in Table 4 shed only little light on this issue.

While there are a few conceptual articles and qualitative case studies on innovation implementation, empirical evidence is largely missing. Consequently, there have been repeated calls to study the implementation of innovation (Klein and Sorra 1996; Repping 2002), however our analysis suggests that few studies have addressed this issue, such that important questions remain unanswered.

For example, impediments to innovation may exist within the firm or be induced from the firm's environment, and these are likely to stall the implementation of innovatory activities or even lead to their complete abandonment (Baldwin and Lin 2002; Galia and Legros 2004). Thus, such obstacles are highly likely to have a substantial impact on firm performance. One

promising path for future research could therefore be to empirically study the negative performance implications (if any) of different types of impediments, and, on this basis, to propose managerial actions that are likely to mitigate or remove such impediments. For example, Shane *et al.* (1995) find that firms that have an uncertainty-avoiding workforce might benefit when they employ an innovation championing strategy that relies on norms, rules, and procedures. The low count of ‘constraints’ (cluster 4), appearing in only three titles (0.88%), and the low count of ‘barriers to innovation’ in Table 4 consistently suggest that such research is yet an exemption.

*Influence of ownership structure on innovation strategy.* Over the last 20 years, the traditional model of innovating entrepreneurs that found and control their firm (Schumpeter 1934) has been challenged by the evolution of novel forms of ownership. For example, large pension funds and other institutional investors have extended and intensified their operations globally (e.g., Hoskisson *et al.* 2002; Kochhar and David 1996). Another important development is the emergence of holdings and conglomerates that comprise large numbers of subsidiaries and affiliated companies that the holding or conglomerate controls (e.g., Chang *et al.* 2006; Feinberg and Gupta 2004). As different types of owners may differ with respect to investment horizon, risk aversion, diversification plans, and return aspirations (Thomsen and Pedersen 2000), ownership structure is likely to affect the firm’s innovatory activities (Hoskisson *et al.* 2002; Kochhar and David 1996). For instance, Kochhar and David (1996) find that firms controlled by so-called ‘pressure-resistant’ institutions have a higher rate of new product announcements than firms that are controlled by ‘pressure-sensitive’ institutions. Hoskisson *et al.* (2002) observe that public pension funds prefer firms they control to innovate internally only (i.e., without collaboration with other firms), while professional investment funds prefer external innovation, i.e. collaborative innovation with other firms and institutions.

While such questions should be highly relevant to the strategic management of innovation,

our analysis suggests that they have received little attention to date. The cluster analysis illustrates that only three titles (0.88%) contain the term ‘ownership’ (cluster 12) and that most clusters do not refer to related issues, while Table 4 shows that only eight of the 223 quantitative articles include an independent variable related to ownership structure. Thus, future research could focus on studying ownership structure as an important antecedent to the understanding of how and why firms choose and implement particular innovation-related initiatives.

### *Resource utilisation*

*Resource development.* The cluster analysis suggests that the topic ‘resources’ plays a major role in the reviewed literature as 16 titles (4.68%) comprise the word ‘resource’ (cluster 13) itself; moreover, 37 titles (10.82%) refer to the intangible resource ‘knowledge’ (cluster 7). Table 4 corroborates this assessment as the articles use 108 resource-related independent variables.

Many scholars thus agree that resources are important for the creation of innovations. For instance, applying a firm’s knowledge to emergent opportunities in its environment can lead to the generation of innovative output (Wadhwa and Kotha 2006) and tangible assets can influence the strategic options that a firm is likely to pursue with regard to innovation, e.g. regarding outsourcing and inter-firm collaboration (Nair 1995; Novak and Stern 2008; Robertson and Gatignon 1998). However, crucial knowledge gaps with regard to resources remain. For instance, clusters 7 and 13 do not point directly at specific initiatives and processes that may play a role in managing resources for innovatory purposes. This fact indicates that little evidence is available on the question of how specific initiatives and processes can contribute to resource creation. Table 4 shows that only three articles include an independent variable that captures resource creation directly (Collins and Smith 2006; Hult and Ketchen 2001; Robertson and Gatignon 1998). Table 3 shows that, compared to the count



of resource-related independent variables, resource-related *dependent* variables are underrepresented. From the few articles that do use such a dependent variable, only a small fraction (e.g., Choo *et al.* 2007; Danneels 2008) sheds light on particular initiatives and processes by which firms can develop resources for innovatory purposes. To date, only these few articles undertake to expand our knowledge about the creation of resources for innovatory purposes beyond the well-established point that investing in particular resources may enhance a firm's corresponding resource endowments (e.g., Henderson and Cockburn 1994; Yeoh and Roth 1999).<sup>9</sup>

This neglect seems problematic for two interconnected reasons: First, firms are heterogeneous with respect to their resource endowments, and resources may be highly specific to the particular firm (Barney 1991; Crook *et al.* 2008). Second, resources that the firm requires but which cannot be acquired in factor markets will have to be developed by the firm itself in an often lengthy process (Dierickx and Cool 1989; Teece *et al.* 1997). Since firms are therefore 'to some degree stuck with what they have and may have to live with what they lack' (Teece *et al.* 1997, p. 514) in the short run, the question of how firms can develop resources for innovation becomes a fundamental strategic issue (Teece *et al.* 1997). Further, a firm's resources can depreciate over time (e.g., Argote *et al.* 1990; Darr *et al.* 1995), and changing external conditions might require firms to adapt their technology and thus their resource endowments accordingly (Greve and Taylor 2000; Teece *et al.* 1997). We therefore believe that more research is needed to clarify how firms create and dynamically adapt resources for innovation. Bowman and Collier's (2006) conceptual contingency framework for resource-creation processes might serve as a starting point to build hypotheses.

### *Performance*

*Alternative measures of performance.* The cluster analysis indicates that the performance implications of innovation have received great attention. The word 'performance' (cluster 12)

alone is an element of 48 titles (14.04%) and most of the clusters include a reference to performance outcomes. Table 3 shows that the vast majority of studies that analyse innovatory outcomes employ a dependent variable which is either based on patents, new product development or financial performance.

While these measures have enabled much empirical work that contributes to our understanding of innovation, they have limitations that future research may overcome. Moreover, important outcome measures that are particularly wanting for the strategic management of innovation are still prominently missing. The cluster analysis suggests that alternative performance measures such as ‘survival’ (cluster 11) and, particularly, ‘efficiency’ (cluster 4) are used relatively little compared to the occurrence of financial and patent-based measures of performance: Only eight titles contain the term ‘survival’ (2.34%) and only three titles (0.88%) the term ‘efficiency’. Table 3 reveals that dependent variables such as ‘survival’ or ‘productivity’ have been used much less than patent-based or financial measures of performance. This neglect can have problematic consequences.

For instance, the method of using patent counts to gauge a firm’s innovativeness has a number of limitations. Patenting may be driven by tactical motives, such as an improved bargaining position in licensing negotiations, and thus may not be directly related to the firm’s innovatory activities (Blind *et al.* 2006; Cohen *et al.* 2000). Moreover, not all inventions are patentable (Arundel and Kabla 1998; Mansfield 1986). Further, financial or market performance figures can be influenced by sources of variation unrelated to innovatory activities. The use of more direct measures, such as changes in productivity, could help to mitigate these problems. For example, Kusunoki *et al.* (1998) use productivity measures to study the impact of different organisational capabilities on innovation outcomes. The performance of process innovations is particularly hard to measure, since the widely used innovation performance measures were conceptualised for new *product* development (Arundel and Kabla 1998; Belderbos *et al.* 2004; Brouwer and Kleinknecht 1999, emphasis

added).

Not surprisingly then, process innovations have attracted much less attention than product innovations (cf. Table 2). As we have noted further above, this neglect of process innovations seems problematic as process innovations may also exert a strong influence on firm performance. One way to address process innovations could be to employ productivity measures which are closely related to process innovations but underrepresented as dependent variables (cf. Table 3).

Time-related measures also seem to represent a promising opportunity to broaden our knowledge about performance in the context of innovation. On the one hand, even short delays in market entry can substantially decrease the returns from innovations (Vesey 1991) so that innovation speed is one of the most important measures to assess a firm's innovation performance in practice (Kerssens-van Drongelen and Bilderbeek 1999). On the other hand, the ease and speed of competitor imitation is negatively associated with the firm's returns from innovation (Teece 1986). Thus, understanding the antecedents of the time-to-imitation is relevant from a strategic management perspective since a longer time-to-imitation implies a more sustainable competitive advantage. However, variants of the word 'time' (cluster 11) occur only across eight titles (2.34%). The most common variant is 'timing', indicating that most of these titles refer to a timing decision (e.g., entry timing) rather to an amount of time elapsed. Table 3 also illustrates that these time-related measures have been used much less than other performance indicators. To date, very few articles have theorised on innovation speed and time-to-imitation (e.g. Ethiraj *et al.* 2008; Kessler and Chakrabarti 1996; Pacheco-de-Almeida and Zemsky 2007; Pil and Cohen 2006), such that more empirical research on this topic seems promising.

### ***External environment***

Many innovation studies claim generalisability although our analyses suggest that most of the

342 studies we analyse are specific to high-technology industries (see Table 6). Moreover, a synopsis of all clusters suggests that few environmental contingencies beyond country and industry settings have been studied (see Fig. 1). At the very worst, this may mean that many articles that study the strategic management of innovation have identified context-specific subsets of the actual theoretical relationships rather than these relationships themselves. Thus, future research may improve generalisability by considering additional environmental contingencies, and by taking alternative industry and country settings into account.

First, an improved understanding of environmental contingencies beyond industry and country settings may provide finer-grained theories to guide innovation management research and clearer and more consistent advice for management practice (Tidd 2001, p. 180). The political and institutional environment (e.g., regarding collaboration, antitrust, and regulation policy) offers meaningful opportunities for research and theory development on the relationship between innovation and organisations (Drazin and Schoonhoven 1996, p. 1078). For instance, a firm might benefit from political networking to maximise the performance potential of its product innovation strategy (Li and Atuahene-Gima 2001). Table 4 suggests that such issues have received little attention in extant strategic management literature.

Second, virtually all industries that are referenced throughout the cluster analysis are high-technology or at least medium-high technology industries as defined by the OECD standard (OECD 2007).<sup>10</sup> Table 6 shows that only 12 of the total of 248 empirical contributions focus on low- and medium-low-technology (LMT) industries. This distribution of academic interest is at odds with the fact that in most developing and developed economies, LMT industries provide more than 90% of economic output. They are also likely to contribute more to economic growth than high-technology industries even though a single firm may spend relatively little on R&D (Robertson *et al.* 2009). A particular firm is not necessarily a non-innovator if its profit and loss statement does not show formal R&D expenditures, since in LMT industries innovation depends only to a small extent on formalised internal R&D

activities (Heidenreich 2009; Santamaria *et al.* 2009). Most importantly, the strategic management of innovation in LMT industries, as opposed to high-tech industries, is highly likely to differ. Chen (2009) and Freddi (2009) provide case studies of how the role of resources and the organisation of product and process innovation differ. Moreover, LMT industries largely emphasise process innovation in which they may even outperform their HT counterparts (Kirner *et al.* 2009). Thus, to study the strategic management of innovation in LMT industries may pave the way for novel insights. The gradually emerging stream of phenomenological research on innovation in LMT industries in technology and innovation management journals such as *Research Policy* may provide salient cues that can spur strategic management research in these industries.

## **Conclusion**

The strategic management of innovation has become a central topic within the strategic management field (e.g., Herrmann 2005; Nag *et al.* 2007). Developments in the innovation-related literature over the last two decades and diverse observations by senior scholars consistently indicate that the literature on the strategic management of innovation currently exhibits many inconsistencies, competing theoretical predictions, and persisting knowledge gaps and that many questions pertaining to the strategic management of innovation are still little understood. This situation does not only impede our theoretical understanding of this topic, but also affects practitioners negatively: Despite the increased effort scholars devoted to this topic, the literature seldom provides coherent advice and convincing ‘best practice’ solutions to managers. Managing innovation has become a ‘daunting task’ (Drazin and Schoonhoven 1996, p. 1081), and being offered an overwhelmingly complex literature, but no consistent guidance or insights regarding practical implications that can be derived from this literature is unlikely to simplify this task.

Our paper has addressed these problems by providing the first comprehensive review on the

strategic management of innovation since Lengnick-Hall (1992) and Wolfe (1994). We analysed 342 articles published in seven journals constitutive for the strategic management field over the period 1992–2010. Together, these articles can be considered representative of our present knowledge about the strategic management of innovation. Consistent with recent suggestions that the methodological rigour of reviews of the management literature should be strengthened (e.g., Denyer and Neely 2004; Thorpe *et al.* 2005; Tranfield *et al.* 2003), we undertook a systematic, quantitative review of these articles. We combined different quantitative methods – co-word analysis, cluster analysis, and frequency analysis – to triangulate the findings and thus to validate our claims.

The results of our analyses have pointed to numerous inconsistencies, knowledge gaps, and conflicting theoretical predictions that still impede our understanding of the strategic management of innovation. From these analyses, we charted out promising opportunities for future research that may contribute substantially to the development of the field. Specifically, we identified theoretical inconsistencies and knowledge gaps that future research should resolve with regard to the following topics: the performance implications of inter-firm collaborations; appropriation strategies; the strategic management of process innovations, administrative innovations, and service innovations; deliberate non-innovation; the causal relationship between internal organisation and innovation; the implementation of innovation; the influence of the ownership structure on innovation strategy; the development of resources for innovatory purposes; alternative measures to capture the performance implications of innovation; environmental contingencies beyond country and industry settings; the strategic management of innovation in low- and medium-technology industries.

For each of these topics, we provide arguments why it is relevant to close the particular knowledge gap or to resolve the conflicting theoretical predictions and inconsistencies encountered. Proceeding in this way may facilitate the emergence of research efforts that can make a substantial contribution to the development of the field. Further, we refer to

pioneering work that has already addressed a topic that is in need of further investigation. By providing this information, we intend to compensate for a potential disadvantage of the quantitative bibliometric approach vis-à-vis the traditional 'narrative' review approach, namely that less attention is devoted to the content of the individual article which may make it harder for scholars to identify relevant work for their specific research question.

In developing these paths for future research, we also refer extensively to relevant insights generated by innovation research outside the strategic management domain. To date, strategic management scholars have largely ignored such insights from innovation research (e.g., Tahai and Meyer 1999), but cross-fertilizing the strategic management field with findings from other adequate areas can substantially contribute to the development of our knowledge about particular strategic management topics (Furrer *et al.* 2008, p. 16). We therefore believe that our effort to span the boundaries between the areas of strategic management research on the one hand and of innovation research on the other hand and to raise strategic management scholars' awareness of relevant insights in the latter area can prove beneficial for promoting our understanding of the strategic management of innovation.

Our article also makes a methodological contribution. The novel approach to combine co-word analysis, cluster analysis, and frequency analysis yielded useful insights about the strategic management of innovation. We thus agree with the few management scholars who have previously employed bibliometric and lexicographic techniques that these techniques can produce valuable insights (e.g., Furrer *et al.* 2008; Nag *et al.* 2007; Nerur *et al.* 2008). Based on this unanimous assessment, we strongly recommend management scholars to intensify the application of such analytical methods. In particular, we suggest that a combination of different methods such as the one we have deployed in the current paper is particularly promising as it can triangulate the findings and allows scholars to respond to the above call to strengthen the methodological rigour of reviews of the management literature. A higher level of methodological rigour, in turn, increases the validity of their findings.

Besides stimulating the development of our theoretical knowledge about the strategic management of innovation, the opportunities for future research that we have identified should also spur the emergence of insights that can inform executives about management and policy options. Such insights should be highly useful to management practice.

Our study may also serve as a basis to undertake a discursive discussion of how 'innovation' is understood within the strategic management perspective. While we have distinguished between basic types of innovation (cf. Table 2), future research could take a closer look at commonalities and differences in the way strategic management articles define and operationalize innovation. Such an analysis may reveal important properties of innovations that have not yet received adequate research attention and can foster a greater consistency in labelling and measuring particular innovation sub-types such as 'radical', 'really new', and 'discontinuous' product innovations. This greater consistency, in turn, would facilitate the development of our understanding of how different sub-types of innovation should be managed strategically and would also allow us to give more conclusive advice to managers and executives (cf. Garcia and Calantone 2002).

We hope that these recommendations can pave the way for future contributions that can strengthen the theoretical foundations of this research. Ultimately, these endeavours may lead to the development of causal models of the strategic management of innovation, as Lengnick-Hall (1992) had suggested. We join her view by postulating that this claim is of equal, if not greater importance in 2011. While first steps in this direction have been made (e.g., Tidd 2001), considerable work remains to be done.



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Fig. 1 Cluster Analysis of the Title Words of all 342 Articles<sup>a,b,c</sup>

Notes: <sup>a</sup>Based on Ward's method and the Cosine formula to measure the strength of co-word association (see the 'Methods' section).

<sup>b</sup>Words were reduced to their stems in order to consolidate different variants of the same word. To improve readability, we do not report the word stems, but replaced the word stems by their most common 'full' variant (cf. Nag et al. 2007, p. 941).

<sup>c</sup>Cluster membership is mutually exclusive; i.e., each word is a member of only one cluster. Yet, that a word is assigned to a particular cluster does not mean that the titles use this word exclusively in the particular context represented by this cluster: While the cluster solution is based on the strength of co-word association, words belonging to different clusters need not have an association strength of zero. The reported frequency counts cover occurrences across all contexts in which the respective word has been used. To illustrate, the term 'innovation' (occurring 96 times) appears also in the title of articles that are not concerned with 'multinational' issues, a term that is in the same cluster as innovation (Cluster 1).

Table 1 Number of Articles and Frequency Analysis by Journal Source and Year<sup>a</sup>

Period	AMR	AMJ	ASQ	JOM	SMJ	MS	OS	Total
1992–	2	2		1	15	2	2	24
1993								
1994–	1	3	2	3	6	4	1	20
1995								
1996–	3	2	6	2	11	7	3	34
1997								

1998–	3		1	1	12	2	5	24
1999								
2000–	1	5	1	1	12	6	8	34
2001								
2002–	1	3		1	16	12	8	41
2003								
2004–	1	1		6	20	6	3	37
2005								
2006–	2	12	1		18	16	7	56
2007								
2008–		7		2	14	22	12	57
2009								
2010		1			11	1	2	15
Total	14	36	11	17	135	78	51	342
% of all	1.11	2.84	1.04	1.93	10.39	3.16	5.47	3.73

articles

in the

journal

<sup>a</sup>AMR = Academy of Management Review; AMJ = Academy of Management Journal; ASQ = Administrative Science Quarterly; JOM = Journal of Management; SMJ = Strategic Management Journal; MS = Management Science; OS = Organization Science

**Table 2 Types of Innovation Studied by All 342 Articles<sup>a</sup>**

Innovation type	Number of times covered
Technical innovation	246

of these:

product innovation	122
service innovation	4
process innovation	11
creative destruction	3
Administrative innovation	25
of these:	
strategic reorientation	9
organisational change/transformation	7
Research and Development	18
Exploration and exploitation	25
Mixed (technical and administrative innovation)	28
Total	342

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<sup>a</sup>Counts on the same level are mutually exclusive; top-level counts are exhaustive.

**Table 3 Dependent Variables Employed by the 223 Articles that Use a Quantitative Measurement Model<sup>a,b</sup>**

Dependent Variable	Number of times used
Intended and emergent initiatives:	
Measures of ambidexterity (exploration and exploitation)	11
Knowledge sourcing	9
Technology sourcing	6
Product-market strategy	8
Internationalisation strategy	2
Inter-firm collaboration:	
Cooperative agreements	6
Agreement characteristics	5

Network characteristics	3
Cooperation timing	1
Problems of alliances	2
Acquisition and divestiture	4
R&D investment/spending	10
Market entry mode	6
Other	6
Internal organisation:	
Multinational organisation	2
Administrative organisation	9
Structural integration	3
Organisational climate	2
Managerial and ownership issues:	
Human Resources practices	3
Resources:	
Intangible resources (e.g. capabilities)	13
Tangible assets	1
Financial resources	1
Human Resources	3
Performance:	
Patenting:	
Patent output	22
Patent quality	9
Technical innovation	7
Product innovation	30

Product quality	8
Service innovation	4
Process innovation	3
Administrative innovation	1
Other criteria:	
Economic/technological significance of innovation	26
Time-to-market/innovation speed/time-to-imitation	10
Other	6
Financial performance	48
Market performance	30
Business survival/firm exit	13
Productivity	8
Growth	2
Alliance performance (including divestiture of alliance)	3
Environment:	
Competitor response to firm initiative	2
Other	2

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<sup>a</sup>The table only comprises those articles that employ a quantitative measurement model. Counts are not mutually exclusive since a particular study may have more than one dependent variable.

<sup>b</sup>The top-level categories in this table correspond to Nag *et al.*'s (2007) definition of strategic management to which we refer in the text.

**Table 4 Independent Variables Employed by the 223 Articles that Use a Quantitative Measurement Model<sup>a,b</sup>**

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Independent Variable	Number of times used
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Intended and emergent initiatives:

R&D investment/spending	25
Technological pioneering/first-mover strategy	19
Measures of ambidexterity (exploration and exploitation)	17
Knowledge sourcing	10
Technology sourcing	10
Appropriation strategy	1
Manufacturing strategy	4
Product-market strategy	38
Market entry mode	13
Internationalisation strategy	11
Competitive strategy	2
Inter-firm collaboration:	
Cooperative agreements	21
Experience with cooperation	8
Characteristics of alliance or cooperative network	26
Characteristics of partners (e.g. size, innovativeness)	11
Problems of alliances (dependence, partner availability)	2
Number of patents	10
Patent quality	6
New product development strategy	22
Product characteristics	10
Process innovation	6
Process characteristics	4
Economic/technological significance of innovation	19

Time-to-market	2
Acquisition and divestiture	4
Other	30
Internal organisation:	
Organisational design	27
Structural integration	7
Organisational culture	15
Firm size	18
Firm age	6
Managerial and ownership issues:	
Human Resources practices	8
Ownership issues	10
Process management issues	9
Barriers to innovation (other than resource constraints)	6
Resources:	
Prior firm performance	24
Productivity	2
Intangible resources (e.g. knowledge and capabilities)	48
Resource creation	3
Human Resources	23
Financial resources	18
Book value of assets	4
Tangible assets	5
Resource slack	7
Complementary assets	7

Other	2
Environment:	
Time	7
Location	9
Economic and technological factors	3
Political factors	2
Culture	2
Sector/industry affiliation	4
Technological intensity of sector	6
Competition	26
Uncertainty	10
Turnover of industry	6
Speed of technological development of industry	8
Availability of resources in industry	3
Appropriability	2
(Lead) user characteristics	2
Technological threats (technological shock)	3
Technology characteristics	15

<sup>a</sup>The table only comprises those articles that employ a quantitative measurement model. Counts are not mutually exclusive since a particular study may have more than one independent variable.

<sup>b</sup>The top-level categories in this table correspond to Nag *et al.*'s (2007) definition of strategic management to which we refer in the text.

**Table 5 Analytical Methods Used by All 342 Articles<sup>a</sup>**

Method	Number of times used
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Conceptual methods:	
Theory paper	42
Literature review	4
Introduction to special issue	2
Content analysis	3
Meta analysis	1
Mathematical and simulation models:	
Mathematical modeling (including game theoretic modeling)	38
Simultaneous equation model	4
Qualitative methods:	46
Quantitative methods:	
Simple OLS regression	42
Mean difference test	10
Logistic regression	16
Descriptive analysis only <sup>b</sup>	2
Panel regression (includes Poisson, logit, probit, etc.)	68
Confirmatory factor analysis	25
Tobit regression analysis	7
Survival time analysis	24
Time series	4
Event sequence method	1
Hierarchical regression	16
Structural equation model	15
Cluster analysis	3
Analysis of variance (ANOVA, ANCOVA, MANOVA,	9

Variance components analysis)	
Multinomial logistic regression	5
Probit regression	6
Negative binomial regression	11
Moderated regression	3
Heckman regression model	1
Poisson regression	2
Partial least squares regression	2
Simulation model	9
Contingency tables	1
Other	11

<sup>a</sup>Counts are not mutually exclusive because one article may apply more than one method (e.g., OLS regression analysis and a mean difference test).

<sup>b</sup>This category includes articles that use correlation analysis, percentages or indicators, and exploratory factor analysis without subsequent quantitative estimation techniques.

**Table 6 Industries Analysed by 223 Quantitative and 25 Qualitative Articles<sup>a</sup>**

Industry	Number of times used
<u>Studies of industries classified according to their technological intensity:</u>	
High-technology industries:	
21: Manufacture of basic pharmaceutical products and pharmaceutical preparations	17
26: Manufacture of computer, electronic and optical products	44
72: Scientific research and development (here:	16

biotechnology\*)

Various high-tech industries (as classified by the authors of the respective articles)\* 7

Medium-high-technology industries:

20: Manufacture of chemicals and chemical products 6

27: Manufacture of electrical equipment 1

28: Manufacture of machinery and equipment n.e.c. 2

29: Manufacture of motor vehicles, trailers and semi-trailers 5

Medium-low-technology industries:

23: Manufacture of other non-metallic mineral products 1

25: Manufacture of fabricated products, except machinery and equipment 2

30: Manufacture of other transport equipment 3

Low-technology industries:

31: Manufacture of furniture 1

32: Other manufacturing 5

Studies of other industries\*:

Transportation and storage:

51: Air transport 3

Accommodation and food service activities:

56: Food and beverage service activities 2

Information and communication

58: Publishing activities 9

60: Programming and broadcasting activities 2

61: Telecommunications	6
Financial and insurance activities:	
64: Financial service activities, except insurance and pension funding	9
65: Insurance, reinsurance and pension funding, except compulsory social security	2
66: Activities auxiliary to financial services and insurance activities	1
Professional, scientific and technical activities:	
69: Legal and accounting activities	1
74: Other professional, scientific and technical activities	6
<u>Studies across industries or without industry specification:</u>	
Cross-industry	92
Industry-classification not applicable	2
Not specified	3
Total	248

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<sup>a</sup>Counts are mutually exclusive. The index accompanying each industry is this industry's two-digit NACE 2008 classification (Eurostat 2008). Industries marked with an asterisk (\*) cannot be assigned to the OECD Science, Technology and Industry Scoreboard 2007 classification (OECD 2007). The final selection of articles in this table was determined by subtracting any literature reviews, introductions to special issues, articles containing meta-analyses, theoretical, mathematical and simulation models from the total article count of 342.

<sup>1</sup>As in Podsakoff *et al.* (2005), citation data for this study was obtained from the Institute for Scientific Information (ISI).

<sup>2</sup>A dendrogram to this cluster solution is available from the corresponding author upon request.

<sup>3</sup>Some concepts are listed in both Table 3 and Table 4 as a particular concept might be considered as an antecedent in one model and as the outcome in another.

<sup>4</sup>A descriptive contentual appraisal of the cluster analysis is available from the corresponding author upon request.

<sup>5</sup>As each title typically consists of more than one word, the percentage measures of the individual words do not add up to 100%.

<sup>6</sup>Since we limited our review to articles that focus on an organizational level of analysis, the sixth definitional element ('of firms') is already implicit in our selection of relevant articles. The subsequent structure, therefore, comprises only six elements.

<sup>7</sup>To this end, we reproduced Tables 3 and 4 considering only those articles that use a longitudinal quantitative method. These focused tables are available from the corresponding author upon request.

<sup>8</sup>This skewed distribution might explain why the term 'longitudinal' is used in only three titles despite the fact that our sample comprises a considerable share of longitudinal analyses: There are some topics in which this kind of analysis is relatively common, so that a reference to this method does little to distinguish this article from other articles on this topic.

<sup>9</sup>This claim may be partially qualified by the fact that innovation sometimes implies resource creation. For instance, a firm that is granted a patent has typically been successful at generating new knowledge (e.g., Hall *et al.* 2005). Thus, studies that deal with the question of how firms can produce innovations and patents may address resource creation (if inadvertently). However, this implicit resource creation is likely to pertain to certain resources (particularly knowledge) only and the extent to which resource creation is implied by innovation can vary substantially across innovative outcomes. Therefore, we still believe that too little attention has been devoted to creation of resources for innovatory purposes. This

assessment is consistent with Bowman and Collier's (2006) finding that little attention has been devoted to resource creation in general.

<sup>10</sup>The OECD classifies high-technology industries as those where the ratio of R&D expenditure to sales is greater than 5% and medium-high-technology industries as those with an R&D expenditure-to-sales ratio between 3 and 5%.

## **Supporting Information**

Additional Supporting Information may be found in the online version of this article:

**Appendix S1.** Overview of the 342 articles subjected to the literature review and their cluster affiliations

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