Radical, Disruptive, Discontinuous and Breakthrough Innovation: More or the same?

KU LEUVEN

FACULTEIT ECONOMIE EN BEDRIJFSWETENSCHAPPEN

Management, Strategy and Innovation (MSI)

# Radical, Disruptive, Discontinuous and Breakthrough Innovation: More or the same?

**Adrian Kovacs, Cristina Marullo, Dennis Verhoeven, Alberto Di Minin and Bart van Looy**

MSI_1904

# Radical, Disruptive, Discontinuous and Breakthrough Innovation:

# More or the same?

Adrian Kovacs[a], Cristina Marullo[b], Dennis Verhoeven[a], Alberto Di Minin[b] and Bart van Looy[a]

[a] KU Leuven, Department of Management, Strategy and Innovation (MSI), Faculty of Business and Economics (FEB), B-3000 Leuven, Belgium

[b] Institute of Management and Department EMBEDS, Sant'Anna School of Advanced Studies, Piazza Martiri della Libertà 33, 56127 Pisa, Italy

## Abstract

The scholarship on innovation has stressed the importance of distinguishing 'exceptional' innovation from 'run-of-the-mill' innovation in both conceptual and empirical terms. Over recent decades, various labels have been coined to denote the exceptional nature of innovation. At the same time, research on this topic has been critiqued for its ambiguity in accurately defining and delineating the phenomena under study and, consequently, putting in jeopardy the development of a cumulative body of understanding. We revisit this concern by systematically reviewing three decades of research advanced under the labels of *radical*, *disruptive*, *breakthrough* and *discontinuous* innovation. We combine two bibliometric techniques – bibliographic coupling and co-citation analysis – to (i) explore the theoretical foundations of these labels and (ii) delineate the thematic orientation of the scholarship pursued under these labels. Our results reveal a dense and growing network of publications that build, in large measure, on the same scientific foundations. In terms of thematic orientation, five overlapping clusters are present, with specific labels scattered across the thematic landscape. These findings suggest that the different labels do not denote clearly distinct bodies of academic scholarship. A subsequent content analysis of the definitions advanced in the most cited papers reveals two discrete underlying dimensions: novelty and impact. Yet, none of the labels characterize innovations across these two dimensions with any consistency. Although this 'lack of rigor' would seem to yield no detrimental effects in terms of growth (of scholarship), we argue that conflating novelty and impact can result in ambiguous results. We conclude, therefore, that consistency in the use (and operationalization) of both dimensions would benefit our (cumulative) understanding of the (complex) phenomena involved.

**Keywords**: radical innovation; disruptive innovation; discontinuous innovation; breakthrough innovation, bibliometric analysis.

**JEL Classification**: O32; Q55

## INTRODUCTION

In the field of innovation and technology management, there is consensus that not all innovations are alike. Whilst the vast majority of innovations involve incremental improvements and/or display a modest impact, a (much smaller) number of innovations are considered 'exceptional' since they depart significantly from previous practices and/or have a more profound impact *(*see, for instance, Schumpeter, 1934; Baumol, 2004; Ahuja and Lampert, 2001; Bower and Christensen, 1995; O'Connor and Rice, 2001). The literature has promoted several labels to denote 'exceptional' innovation, the most prominent of which are *radical* (Chandy and Tellis, 1998; Ettlie, Bridges, and O'Keefe, 1984), *breakthrough* (Barnholt, 1997; Mascitelli, 2000), *discontinuous* (Danneels, Kleinschmidt, and Cooper, 2001; McKee, 1992) and *disruptive* (Christensen, Verlinden and Westerman, 2002; Markides and Anderson, 2006). The availability of multiple labels has resulted in subsequent work treating these constructs as interchangeable and, thus, affording less attention to precise delineation of the terms and their underlying constituents (Linton, 2009). This then lead to concerns about the interpretation of the underlying empirical phenomena, with some scholars asserting that the resulting confusion could well hamper both theory development and the crafting of insights and advice that would be advantageous to practitioners (Garcia and Calantone, 2002; Gatignon, Tushman, Smith and Anderson, 2002).

In this paper, we expressly revisit these concerns – first raised over fifteen years ago, most notably in the work of Garcia and Calantone (2002), and Gatignon et al. (2002) – by engaging in a systematic, bibliometric review of a comprehensive sample of publications appearing in the Web of Science over the last three decades (1985-2016). This sample covers articles that explicitly referred to either *radical*, *breakthrough*, *discontinuous* or *disruptive* innovation and that appeared in the domains of business, management and economics. In a first step, we assess the

distinctiveness (or lack thereof) of the labels in use by analyzing the theoretical foundations and thematic orientation of the said body of literature. We rely on co-citation analysis and bibliographical coupling to study the relatedness between documents based on (dis-)similarities in referencing/citing patterns. We complement the bibliometric analysis with a content analysis of the most highly cited publications in our dataset in order to develop a more thorough understanding of the constituents of the different labels of interest.

Our results show that research on 'exceptional' innovation displays above-average aggregate growth rates, with 'radical' innovation accounting increasingly for the lion's share of publications, particularly over the last decade. The co-citation analysis (of cited references) reveals that the constructs 'radical', 'breakthrough' 'discontinuous' and 'disruptive' innovation rely, to a large extent, on similar 'foundations': for articles that receive at least 10 citations, the overlap between labels in terms of shared references ranges from 51 percent to 90 percent. The analysis based on bibliographical coupling identifies five distinct clusters of thematically related publications, but no exclusive relationship between theme and label is observed. Rather than representing silos of publications that were developed under a specific label, these clusters reflect themes commonly pursued across the labels identified. Taken together, the results of our bibliometric analyses suggest that different labels are not highly distinctive, either in terms of origins or themes covered.

To explore whether the different labels (consistently) cover different underlying concepts, we complement the bibliographical analysis with a content analysis of the definitions advanced in the most highly cited publications (n=100). Here, it becomes apparent that two conceptually distinct dimensions are used to characterize the nature of exceptional innovations: (i) novelty and (ii) impact. While the resulting quadrant could host four distinct terms, we currently observe no situation where the majority of papers related to one label appear in only one quadrant. And while this seems not to jeopardize the growth of scholarship, we conclude that our understanding of the

topic would benefit from greater rigor and accuracy both in terms of defining and in terms of measuring the processes under study.

The remainder of our paper is structured as follows. In the section that follows, we expand on the main concerns expressed earlier, dealing with the simultaneous use of different terms to denote 'exceptional' innovation. In Section 3, we describe how our dataset is constructed and explain the bibliometric methods that we deploy. Subsequently, we present the results obtained by means of bibliographic coupling and co-citation analysis as well as the complementary content analyses in Section 4. We conclude by discussing the academic and practical implications of our findings.

## THE AMBIGUITY OF INNOVATION TERMINOLOGY

The scope of studies that contribute to our understanding of 'exceptional' innovation is broad, delivering a variety of research streams, theoretical perspectives, and concepts (Linton, 2009; Ansari and Krop, 2012). This mirrors the general situation regarding the state of the art in innovation studies: multiple authors have signaled the presence of a variety of terms, the 'blurring' of the boundaries of the research object, and the inconsistent findings that result (Afuah and Bahram, 1995; Gopalakrishnan and Damanpour, 1997; Hauser, Tellis and Griffin, 2006; Suroso and Azis, 2015). The existence of a plethora of terms to denote the range of related concepts has raised concerns about the comparability and generalizability of results across the body of research on exceptionally innovative outcomes. Most notably, the contributions of Garcia and Calantone (2002) and Gatignon et al. (2002) argue convincingly that confusion over the definitions and operationalizations of innovation types can impede academic advancement because it makes comparing, reconciling and accumulating the results that empirical studies report difficult. Scholars will tend to overlook relevant prior research that uses terminology different from their own and/or will assume similarities where none exist. Further, Garcia and Calantone suggest that the

consequences of inconsistency in denoting different types of innovation are not limited to the realm of academia. They claim that the empirical findings in new product development scholarship are confusing and discrepant to the extent that their impact on practice is duly circumscribed:

> *"Because new product researchers have not found consistency in labeling and identifying innovations, we cannot expect practitioners to have learned from our research endeavors. Managers looking for an understanding of how to address the idiosyncratic problems associated with radical innovations will have difficulties finding the holy grail from our research efforts. Managers see more conflict in empirical results than is factually true, natural or even possible in empirical research. Thus, they make choices of which research finding is 'relevant' based on the presentation style, the 'hot topic' of the meeting, or whatever supports their personal motivations or that of their current consultant. One cannot expect managers to embrace confusing conflicting results" (*2002: 111*).*

Their review reveals that no less than fifteen constructs and more than fifty measures (scale items) have been proposed in a sample of just twenty-one publications. In order to create clarity, Garcia and Calantone advance two first-order constructs (micro (firm)/macro (industry) and technology/market), and develop a taxonomy consisting of three overarching types: *radical*, *novel* and *incremental* innovations. They conclude by outlining the most relevant measures to identify each type of innovation and by arguing that greater rigor will promote the accumulation of relevant insights and knowledge within the NPD community (scholars and practitioners alike).

Likewise, Gatignon et. al. (2002) begin their contribution by signaling real confusion within the domain: "fundamental concepts and units of analysis are often confused and/or ambiguous. As such, empirical results are often inconsistent or difficult to reconcile" (o.c., p. 1103). They attribute the presence of ambiguity to three distinct, though related, causes; (i) concepts (attributes) such as competence enhancing/destroying or incremental/radical are not clearly distinguished from the type of innovation (e.g. architectural), (ii) innovation (and its impact) tends to be conceptualized on the product level of analysis, whereas the unit of empirical analysis is often situated on the subsystem level and (iii) innovation research tends to be conducted at a distance from the phenomena of interest. To bring greater discipline to the field, the authors make a distinction

between the locus of innovation (core versus peripheral sub-system), the type of innovation (architectural versus generational) and, finally, its characteristics (incremental versus radical; competence enhancing versus competence destroying). Like Garcia and Calantone, the authors propose and validate scales aimed at measuring the concepts outlined.

While the concerns expressed by Garcia and Calantone (2002) and Gatignon et al. (2002) fifteen years ago were clearly articulated and well founded, we argue that renewed attention to the issue is warranted for two principal reasons. First, the concerns expressed were based on a rather small set of (influential) publications on selected topics[1]. Both contributions provide examples that describe potential issues arising from scholars' reliance on different terminology to distinguish various types of innovation but do not assess their prevalence in the literature as a whole. It is, therefore, appropriate to question whether these concerns apply to the larger body of research in management and economics dealing with exceptional innovations. Second, as both papers were presented more than fifteen years ago, rigor and precision in this field may well have increased since – and very possibly because of – the publication of their findings and recommendations.

In this paper, we assess whether and to what extent conceptual ambiguity still persists concerning the scholarship on 'exceptional' innovation by carefully examining whether different labels rely on different scientific origins, differ in term of focal topics, and adhere to distinct definitions. The answer to this question becomes even more relevant as the scholarship on exceptional innovation has continued to evolve over the past fifteen years. **Figure 1** presents this evolution and benchmarks it to the expansion in the number of total publications in the business, management and economics domains between 2000 and 2016. The scholarship on exceptional

[1] Garcia and Calantone focus on 21 articles that have been published in one specific journal, the Journal of Product Innovation Management up to 2002. Gatignon et al. build their argumentation – and provide examples – by reviewing a limited set of (seminal) contributions to the field.

innovation has higher growth rates than those observed in the combined business, managerial and economics sphere. Between 2000 and 2016, the number of publications on exceptional innovation expanded from 100 to 462, representing a growth of 362 percent, whereas the total number of publications on business, management and economics grew only by 185 percent (from 16,235 in 2000 to 46,254 in 2016).

Insert Figure 1 about here

## DATA AND METHODS

### Data

We relied on the 'topic search option' in the Web of Science® (WOS) database to retrieve publications that coin the term 'innovation' and contain any references to 'radical', 'breakthrough', 'discontinuous' or 'disruptive' in the titles, keywords or abstract fields of the database. We limited our search to publications in the WOS subject categories 'Management', 'Economics', 'Business' and 'Operations Management and Research Methods'. Furthermore, we confined our search to specific document types – namely, 'Article', 'Editorial', 'Note', 'Letter' and 'Review' – to encompass only published, original and peer-reviewed scholarly papers. We imposed no restrictions with regard to the timing of publication, and all publications that contained relevant keywords running from January 1985 to November 2016 were added to the initial dataset.

Given that authors may not refer to 'radical', 'breakthrough', 'discontinuous' and 'disruptive' in combination with the term 'innovation', such a requirement was not included in our search key. This means that we not only captured publications that refer, for example, to the combination term 'radical innovation' but also publications that contain the terms 'radical' and 'innovation' separately in either the title, abstract or keywords field of the WOS. In addition, we used stemmed versions of these terms to capture the range of variants used. As a result, we were able to capture

publications that, for example, refer to the terms 'radically innovative' and 'innovation discontinuity' in any of the aforementioned WOS fields. We were quite deliberate in opting for a broad approach that captured 'false positives' so that the risk of missing out on 'false negatives' was significantly reduced. Hence, we assume that authors who seek to contribute to the scholarship on 'exceptional' innovation are inclined to refer to variants of the terms 'radical', 'disruptive', 'discontinuous' or 'breakthrough' and the term 'innovation' in a least one of the aforementioned WOS fields[2].

Our search key yielded 2,347 publications for which bibliographical records were downloaded from the WOS. These records contain standardized bibliographic information about the authors, journal sources and – of special importance for this current study – the cited references. We relied on these records to iteratively remove false positives from our dataset. In a first step, we identified 118 publications that had no cited references in common with any other publication in our set. We removed these publications for two reasons: (i) having no references in common with other papers suggests a reduced likelihood of having a focus on the topic of 'exceptional' innovation and (ii) bibliographic coupling and co-citation analysis rely on associating publications based on references (citations). Hence, such association cannot be made for publications that have no cited references in common with any other publication. In a second step, we identified the $10^{th}$ percentile of publications that had the lowest number of cited references in common with other publications in our set, and read through the title, abstract and keywords fields to identify those papers that bore

[2] We considered using other concepts for the search query, such as 'major innovation' or '"really new innovation' (used in Sandberg and Aarikka-Stenroos, 2014, among others). However, search efforts based on such terms highlighted a high degree of overlap between the four dominant labels listed above; only nine *additional* publications were retrieved from the WOS when entering the terms 'major' and 'innovation' in the search key (which turned out to be false positives). This is due to the fact that most of the publications referring to the terms 'major' and 'innovation' also refer to any of the terms 'radical', 'disruptive', 'discontinuous' and/or 'breakthrough' in the title, abstract or keywords sections of the WOS. We observed similar patterns with respect to the terms 'really new innovation' and 'new product innovation'.

no relevance to our study. Three researchers performed this assessment independently, ensuring triangulation and consistency of judgement. Removing irrelevant articles produced a final dataset for further analysis of 2,081 publications.

**Methods**

As stated previously, we apply two bibliometric techniques – bibliographic coupling and co-citation analysis – to analyze the thematic relatedness between publications. The fundamental assumption underlying these techniques is that the degree of overlap between the cited references of a focal pair of publications is representative of the thematic relatedness between these publications. Specifically, the greater the extent to which two focal publications cite the same references, the more likely they are to be concerned with the same topic and, hence, the more related they are. The main difference between bibliographic coupling and co-citation analysis lies in the locus of citation patterns. Bibliographic coupling is a technique used to determine the relatedness among a focal set of publications based on an analysis of the references these publications cite, whereas the co-citation analysis technique determines the relatedness among a focal set of publications based on an analysis of citations received. Whereas bibliographic coupling is mostly applied to reveal (emerging) topics within a field of research, co-citation analysis is more often used to analyze the origins of a research field. Both techniques have a long-standing tradition in the field of bibliometrics for analyzing the development of research fields and communities (see, for instance, Kessler, 1963; Weinberg, 1974; Vladutz and Cook, 1984), and they are often relied on in reviews of managerial and economic research (e.g. Chen, Huang, and Chen 2012; Vogel and Güttel 2013; Kovacs, Van Looy and Cassiman, 2015).

To determine the relatedness between publications, we apply a measure proposed by Van Eck and Waltman (2009) known as the association strength[3]. In essence, the association strength is a measure of the co-occurrence frequency of citations made (in bibliographic coupling) or citations received (in co-citation analysis) for each pair of focal publications; this is achieved by taking into account the total number of linkages in each focal publication and the total number of linkages in the entire set of focal publications. The association strength between a pair of focal publications can therefore be calculated as follows:

$$AS_{ij} = \frac{C_{ij}}{C_i C_j}$$

Whereby *Cij* denotes the number of linkages (i.e. references/citations) shared by publications *i* and *j*, $C_i$ denotes the total number of linkages of publication *i*, and $C_j$ denotes the total number of linkages of publication *j*. In bibliographic coupling, the linkages denote citations given whereas, in co-citation analysis, they denote citations received. Hence, the association strength measure essentially normalizes the number of citations given or citations received that are common to a pair of focal publications for the total number of citations they have given or received and the total number of common citations that the entire set of focal publications has given or received. The higher the value of *AS* for a given pair of focal publications, the greater the relatedness between these publications.

We utilized the VOSviewer software package, developed by Van Eck and Waltman (2010), to calculate the association strength between all pairs of publications and to map and visualize the thematic clusters that resulted. VOSviewer is essentially a unified approach to mapping and clustering bibliographic networks that has been applied in a wide array of studies (i.e., Rafols,

[3] According to Van Eck and Waltman, this probabilistic measure is more suited to normalizing co-occurrence data (in particular, when co-occurrence data are visualized) than well-known set-theoretic measures such as Salton's Index and the Inclusion Index.

Leydesdorff, O'Hare, Wuehrer and Smejkal 2013; Rafols et. al. 2014). In maps generated by VOSviewer, publications are portrayed as nodes where the distance between a pair of nodes represents the association strength between a pair of focal publications. The most connected publications (those that have a high association strength with many other publications) are located near the center of a map, whereas the least connected publications are located on the periphery.

## RESULTS

### The Use of Labels In and Across Publications

A first step in determining whether the labels 'radical', 'breakthrough' 'disruptive', and 'discontinuous' represent distinct or interchangeable concepts is to analyze their use in the set of publications (title and abstract). To this end, **Figure 2** below presents a Venn diagram that visualizes the distribution of label use in our set of 2,081 publications, including various combinations. A first notable observation is that the great majority of the 1,794 publications (or 86.2 percent) refer exclusively to a single label while only 287 publications (or 13.8 percent) refer to multiple labels simultaneously. Of the publications that refer exclusively to a single label, more than half refer to the label 'radical' (958 publications) whereas 314, 308, and 214 publications refer to the labels 'disruptive', 'discontinuous' and 'breakthrough', respectively. Of the publications that refer to multiple labels simultaneously, 258 (or 89.9 percent) refer to two labels, 28 refer to three labels, and only one refers to all four labels. Nearly all two-way combinations (94.6 percent) are combinations of the label 'radical' with other labels, with the combination of 'radical' and 'discontinuous' (referred to in 98 publications) being the most popular.

Insert Figure 2 about here

To examine whether these observations are consistent over time, we plotted the distribution of publications for the four labels over time. From Figure 3, it can be clearly seen that scholarship on

this topic has been growing very significantly, with all labels displaying growth since the beginning of the 1990s. However, it is also clear that the scholarship referring exclusively to the label 'radical' has experienced the most significant growth, especially from 2000 onwards. Whereas the number of 'radical' publications in 1999 was almost equal to the number of 'discontinuous' and 'breakthrough' publications, this figure had risen by 2015 to 2.5, 4, and 6 times the other labels respectively.

Insert Figure 3 about here

Whereas the analysis above indicates that labels are not often used jointly in one and the same publication, a different picture emerges when exploring the use of labels by authors across different publications. **Table 1** presents an overview of the use of labels by authors in our sample who have at least two relevant publications. There are 711 authors with multiple publications in the sample. Interestingly, it can be observed from Table 1 that only 221 (or 31.3 percent) of these authors refer exclusively to a single label – of which 163 use the label 'radical' – while 18, 34 and 6 use the labels 'disruptive', 'discontinuous' and 'breakthrough' exclusively. This means that the vast majority of authors (n =490, or 68.7 percent) use multiple labels across publications.

Insert Table 1 about here

In a subsequent step, we investigate the distinctiveness of the labels in use by addressing the following two questions using bibliographical techniques; (i) to what extent do publications using different labels overlap with respect to the scholarly works they cite? (i.e. are they distinct in terms of origins/theoretical foundations?) and (ii) to what extent do these publications overlap in the topics that they address? (i.e., have they common or different thematic orientations?) We deploy co-citation analysis for the body of cited references in our set of articles to address the first question and use bibliographic coupling to address the second question.

**The Origins of the Scholarship on 'Exceptional' Innovation**

**Map 1** visualizes the origins of the scholarship present in our sample of publications. The colors are intended to reflect the labels used (red = radical, blue = discontinous, green = disruptive, yellow = breakthrough, black = multiple). Since very few of the original legend colors can be clearly discerned in Map 1, one tends to conclude that papers advancing different concepts share similar references. To quantify the number of co-citations among publications advancing different labels more precisely, we calculated the overlap among references cited at least ten times in our sample of publications. Because the number of potential co-citations is not equal for each pair of labels, the co-citations were normalized by calcultating a Jaccard index. In essence, this measure calculates the number of actual co-citations among two sets of publications referring to different labels as a share of potential co-citations, with a greater value indicating a higher overlap between the two sets (with a value of 0 indicating no overlap and a value of 1 indicating perfect overlap among sets).

Insert Map 1 about here

The Jaccard index scores presented in **Table 2** clearly demonstrate that a significant share of the 1,326 references that are cited at least 10 times are co-cited by publications representing different labels. They indicate that at least 50 percent of the cited references of any pair of labels overlap, with the overlap being the highest for pairs that involve the set of publications referring to multiple labels. Amongst pairs of sets involving single labels, co-citations are most prominent between publications representing the labels 'radical' and 'discontinuous' (0.86) followed by 'radical' and 'disruptive' (0.71), 'disruptive' and 'discontinuous' (0.67), and 'radical' and 'breakthrough' (0.63). Jointly, the results based on co-citation analysis signal a significant overlap with respect to the scholarly origins of publications referring to different labels.

Insert Table 2 about here

**The Thematic Orientation of the Scholarship on 'Exceptional' Innovation**

In terms of thematic orientation, we rely on bibliographic coupling in which the association strength measure is derived from citation patterns for each pair in our set of 2,081 publications.

In **Map 2,** we present the obtained clusters of thematically related publications. Nodes represent articles (labelled by the first author and the publication year of the article). While the analysis resulted in the identification of sixteen clusters, we analyze and display only those clusters containing at least ten articles – making five in all.

Insert Map 2 about here

The size of each node corresponds with the number of forward citations received, and the distance between a pair of nodes corresponds to the overlap in their citation patterns (measured by association strength), with a shorter distance signalling a greater overlap. The location of a node in the map represents the connectivity of the node. The location of a node near the center of the map indicates that the underlying publications' citation pattern greatly overlaps with that of many other publications, while location in the periphery indicates that a publication does not have many cited references in common with other publications. Finally, the colors (red, green, blue, yellow and purple respectively) represent thematic clusters. The classification of a publication in a cluster indicates that its citation pattern has a greater overlap with other publications in that cluster than with publications that are classified in other clusters.

The bibliographic network does not display a set of *distinctive* clusters. Most notably, Cluster 1 and Cluster 3 cover the same area, reflecting the fact that articles in these clusters cite similar sources. Furthermore, with regard to the other clusters, considerable overlap is noted. In order to interpret the thematic orientation of the different clusters, we selected and analyzed the 160 articles

that received at least 100 citations. **Table 3** provides an overview of the most cited publications in each cluster focusing on two time periods (before 2000, and after 2000). Based on the content of these papers, we labelled the clusters as 'Cluster 1: *Process Models: From Technological Trajectories to "Systems"*', 'Cluster 2: *New Product Development and Marketing Perspectives*', 'Cluster 3: *Organizing Innovation – Incumbent Firms'*, 'Cluster 4: *Search*, *Collaboration and Organizational Learning*', and 'Cluster 5: *Organizing Innovation – Incumbent Firms, Part 2* (including the role of business models)'. In the following section, we describe these five different clusters in greater detail.

Insert Table 3 about here

***Cluster 1: Process Models: From Technological Trajectories to "Systems".***

The first cluster is the largest in terms of publications, but it also spans a number of different, relatively unrelated themes[4]. The early literature in this cluster deals with **theories of technological change and the related processes of adaptation** in organizations (Tyre and Orlikowski[5], 1994; Orlikowski, 1996) individuals (Abrahamson and Fombrun, 1994; Garud and Rappa, 1994; Zwiebel, 1995), industries (Kortum, 1997; Tiessen, 1997), and societies (Shane, 1992; Ramirez, 1999). Over time, a multi-level perspective has emerged, which reconciles technological transitions (as the result of radical innovation processes) with socio-technical transformations within the framework of system innovations (Geels, 2005; Markard and Truffer, 2008; Garud and Karnoe, 2003). A smaller, but relevant, number of studies in this cluster discuss the (in)flexibility/efficiency

[4] Only 7 cited references are relied on by approximately 5 percent of the papers (in the other clusters, there are more than 40 cited references), reflecting the fact that the foundations on which the cluster is built are rather dispersed.

[5] We are aware that the papers of Tyre and Orlikowski are concerned with the introduction of novel communication technology and do not address 'exceptional innovation' per se. Nevertheless, they are included in the sample since certain key terms, pertinent to this study, are used to denote their content. We decided to retain these papers in the sample as a check on arbitrariness.

tensions in organizational environments as a result of technological change (*discontinuities*), where patterns of stability are replaced by variation and intense selection dynamics. Rooted in evolutionary economics, these studies bridge the organizational theory of research capacity with theories of investment behavior (Henderson, 1993) and the development of dynamic equilibrium models (Smith and Lewis, 2011) to examine patterns of change in the structure of industries, market economies, innovation systems and (types of) firms (Orsenigo, Pammolli and Riccaboni, 2001; Whitley, 2000; Agarwal and Audretsch, 2001; Narula, 2002; Baumol, 2004). In a second subset of articles, technological trajectories are connected to technological knowledge diffusion and entrepreneurial dynamics (Braunerhjelm, Acs, Audretsch and Carlsson, 2010; Siegel and Renko, 2012), network dynamics (Pittaway et al., 2004; Gay, 2005) and firm performance (Rothaermel and Thursby, 2005; Roper, Du and Love, 2008).

***Cluster 2: New product development and marketing perspectives***

A second cluster contains research on exceptional innovations from New Product Development (NPD) and marketing perspectives. Studies grouped in Cluster 2 show a considerable degree of thematic relatedness[6], suggesting that this stream of research represents a coherent body of literature on 'exceptional innovation', building on similar theoretical foundations.

The contributions in the NPD stream of management focus on the processes of development, marketing and launch of 'really new' or 'radically new' products (Veryzer, 1998a; Karakaya and Kobu, 1994; Lee and Na, 1994; Mcintyre, 1988); on the adoption of 'radical' innovations, established by a major technological advance and/or containing a high degree of new knowledge (Dewar and Dutton, 1986; Zhou, Yim and Tse, 2005); and on the impact of market orientation on the performance of 'radically new' products (Atuahene-Gima, 1995; 2005). The NPD literature

[6] 81 scholarly works are cited by approximately 5 percent of publications.

relies extensively on a definition of 'exceptional' innovation (i.e. radical NPD projects) based on the integration between the technological perspective (the exploratory nature of such projects) and the marketing perspective (customer involvement) (Veryzer, 1998b; Danneels and Kleinschmidrt, 2001; O'Connor and Veryzer, 2001). The aforementioned studies by Gatignon et al. (2002) and Garcia and Calantone (2002) – situated in this cluster – represent relevant attempts to clarify these concepts and to develop common ground for the analysis of 'exceptional innovation' within the NPD community.

***Cluster 3: Organizing Innovation in Incumbent Firms***

This cluster includes seminal contributions that, since the early 1990s, have discussed the (in)ability of incumbent firms to respond to the organizational and strategic challenges posed by radical technological change (e.g. Tushman and O'Reilly, 1996; Tripsas, 1997). This body of literature asserts that there is significant variation in the performance of incumbent organizations following technological discontinuities (i.e., *successful* radical technological innovations), which are able to revolutionize entire industries (Tripsas, 1997; Fleming, 2001; Hill & Rothaermel, 2003). Studies in this cluster build on organizational theory in developing insights into the different sources of this variation and into the factors contributing to the success and failure of incumbents. A vast number of publications discuss the complexities that large corporations face in responding to radical technological change, stemming from the small incentives initially involved and the dominance of established routines (Chandy and Tellis, 2000; Tripsas and Gavetti, 2000). Starting in March 1991, a flourishing stream of research on radical innovation has focused on the organizational (internal) solutions that firms can enact to achieve an adequate balance between exploiting existing technological capabilities and exploring new possibilities (Benner and Tushman, 2003). These include organizational forms of an ambidextrous nature (Tushman and O'Reilly, 1996) and the development of managerial practices that can mitigate incumbents' inertia

to respond to radical technological change (Edmondson, Bohmer and Pisano, 2001; Tripsas and Gavetti, 2000; Rothaermel, 2001; Tripsas, 1997; Yeoh and Roth, 1999) or can help them generate 'exceptional innovations' (Lynn, Morone and Paulson, 1996; Shenhar, 2001). It should be noted that Cluster 3 includes the seminal publication by Christensen and Bower (1996). Evidence from analysis of the reference patterns shows that recent literature on disruptive innovation (grouped in Cluster 5) shares the same theoretical foundations of scholarly work in Cluster 3, from which it seemingly emerged.

***Cluster 4: Search, collaboration and organizational learning***

While Cluster 2 and Cluster 3 focus mainly on 'internal solutions' when addressing technological change/radical innovation, Cluster 4 represents a relatively recent body of literature focusing on alliances, (external) collaborations (Bierly and Chakrabarti, 1996; Rosenkopf and Nerkar, 2001) and organizational learning processes (Bruderer and Singh, 1996; Hargadon, 1998; Hatch and Mowery, 1998) that enhance innovative performance. Cluster 4 shows a high degree of thematic relatedness with studies in Cluster 3 investigating the effects of technological search (Fleming, 2001; Ahuja and Lampert, 2001). The examined studies convey on the role of search strategies (Laursen and Salter, 2006; Rosenkopf and Nerkar, 2001) and inter-firm linkages (Ahuja, 2000) on the generation of incremental/radical innovations within incumbent firms. These effects are studied by distinguishing between the type of partner – customer, university, competitor or supplier – involved (Belderbos, Carree, and Lokshin, 2004) and by taking into account the role of cognitive distance between collaborators (Noteboom et al., 2007), the alliance intensity (Rothaermel, 2001) and the effects of collaboration and networks of individuals (Singh and Fleming, 2010). Often starting from a resource-based perspective, this cluster analyzes the role of social capital and network collaborations (Alguezaui and Filieri, 2010; Pérez-Luño et al., 2011 Ahuja, 2000; Zaheer and Bell, 2005) and how interorganizational knowledge transfer (Knudsen,

2007), the development of intellectual capital (Subramanian and Youndt, 2005; Agarwal and Franco, 2004; Forés and Camisón, 2016) and cooperation capabilities (Bengtsson, Raza-Ullah and Vanyushyn, 2016) influence the introduction of 'exceptional' innovation.

***Cluster 5: Organizing Innovation in Incumbent Firms, Part 2.***

The final cluster is the smallest and contains more recent literature on 'exceptional' innovation. Although the earlier contributions on the topic of *disruption* are more centrally positioned in Cluster 3 (Christensen and Rosenbloom 1995; Christensen and Bower 1996), a recent stream of literature further discusses the survival strategies of incumbents under conditions of *disruption*[7]. In this cluster, 'disruption theory' contributions (Christensen, 1997; Christensen, Bohmer and Kenagy, 2000; Yu and Hang, 2010) can be found alongside articles that enrich the notion of disruptive innovation with complementary theories (Danneels, 2004; Markides, 2006; Sood and Tellis, 2011) or apply the theory to different fields (Christensen, Verlinder and Westman, 2002). Finally, a set of papers discusses the conditions for mitigating the disruption threat and aligning organizations to change (O'Connor and De Martino, 2006; Kappel, 2001), including the role that business model dynamics plays in this respect (Christensen, Johnson and Rigby, 2002; Charitou and Markides, 2004; Amit and Zott, 2012; Cavalcante, Kesting, and Ulhøi, 2011; DaSilva, Trkman, Desouza and Lindič, 2013; Ghezzi, Cortimiglia and Frank, 2015; Taran, Boer and Lindgren, 2015).

Insert Map 3 about here

**Map 3** provides a visual representation of the network based on bibliographic coupling with labels instead of publication identifiers. In this figure, the nodes (publications) are described by the labels themselves (e.g. RAD for 'radical'). A number of noteworthy observations can be derived from **Map 3**. Firstly, the bibliographic network of research on 'exceptional' innovation is relatively

[7] All the papers grouped in Cluster 5 were published after 2000.

connected, indicating that most publications have cited references that are common to many other publications. Secondly, the close proximity of different labels indicates that pairs of focal publications in which different labels are used often have a greater overlap in references cited than pairs of focal publications that refer to the same label. From these results, we can determine that, in the body of literature examined, similar labels seem to address different topics and, at the same time, different labels are used to denote similar topics. Finally, each of the five (relatively dense) thematic clusters identified contain publications that represent each of the different labels. This clearly illustrates that none of the identified thematic areas can be associated exclusively with a certain label.

This is further demonstrated in **Table 4**, which tabulates the use of each label in each of the five thematic clusters. It is apparent that, while all of the different labels are present in each cluster, there are noticeable differences in the representation of labels across clusters. Publications making use of the label 'radical' are overrepresented in Cluster 2 and Cluster 4, as more than 61 percent of publications in these clusters refer to the label 'radical' versus 46.7 percent of publications overall. Similarly, publications representing the label 'disruptive' are overrepresented in Cluster 5 whereas those referring to the label 'dicontinuous' are overrepresented in Cluster 3. Lastly, publications referring to the label 'breakthrough' are overrepresented in Cluster 1 whereas publications referring to multiple labels simultaneously are overrepresented in Cluster 3 and Cluster 5. These results suggest that typifying the scholarship on 'exceptional' innovation according to emergent themes might be more meaningful than categorizing them according to different labels.

Insert Table 4 about here

***Content analysis of the definitions advanced under different labels***

The bibliometric analyses clearly suggest considerable levels of overlap between the labels in use, both in terms of intellectual origins and thematic orientation. Despite their clear contribution in terms of rigor, bibliometric methods do not reveal which concepts and definitions underly the various labels. Indeed, these analyses – in theory – do not rule out the possibility that authors using a certain label delineate the topic of their study consistently and that various labels simply reflect fine nuances in terms of underlying concepts. To explore this possibility, we engaged in a content analysis of the definitions as stated in the 100 most cited papers. **Table 5** summarizes the findings obtained, where contributions by use of label are distinguished.

Insert Table 5 about here

Two observations stand out. First, a significant number of contributions are implicit in terms of delineating or defining the exact nature of the terms advanced. In total, 44 of the most cited papers provide no explicit definition of the 'central construct'. Second, the papers that do advance an explicit delineation of the type of innovation under study tend to rely on two distinct dimensions: (i) novelty and (ii) impact. Novelty is defined as reflecting the degree of non-obviousness of an innovation compared to the state of the art at the time of creation, whereas impact refers to effects that unfold over time. Stated otherwise, novelty can be assessed as soon as an innovation is conceived, whereas the assessment of impact implies a process that could span a considerable time period. As **Table 5** clarifies, there is no consensus on the dimensions that focal labels encompass. Whilst every focal label has a defining underlying dimension – either novelty or impact – that is universally recognized in existing scholarship, there is no consensus on whether a focal label also encompasses the other dimension. The labels 'radical' and 'discontinuous' tend to refer to innovations that have a high degree of novelty whilst the labels 'breakthrough' and 'disruptive' tend to signal innovations that have a high degree of impact. However, for some scholars the labels

'radical' and 'discontinuous' imply innovations that have a high degree of novelty, regardless of their potential impact whereas, for others, these labels equate to innovations that are both novel and have a high degree of impact. In a similar vein, some scholars use the labels 'breakthrough' and 'disruptive' to describe innovations that have a high impact, regardless of whether they are novel, whilst others use these labels to refer to innovations that are both highly novel and have a high impact.

Insert Figure 4 about here

**Figure 4** summarizes this paradigm using a two-dimensional field. The vertical axis represents novelty, the horizontal axis represents impact. Quadrant 1 hosts 'incremental' innovations, which are universally characterized as having low novelty and impact. Quadrant 2 houses innovations that have high novelty and low impact, which are either labeled 'radical' or 'discontinuous' in existing scholarship. Quadrant 3 includes innovations that have low novelty but high impact; these innovations are either deemed 'disruptive' or 'breakthrough' in existing scholarship. Finally, it can be observed in Quadrant 4, which involves innovations that are both highly novel and high impact, that 'anything goes': all four labels are used interchangeably in existing scholarship to denote this particular type of innovation.

### *Discussion and conclusion*

Despite the concerns expressed previously, most notably by Garcia and Calantone (2002) and Gatignon et al. (2002), scholarship on exceptional innovation has experienced considerable growth over the past fifteen years. This growth exceeds the growth of business, economics and management literature in general over the same time period and is mostly accounted for by the increasing number of publications using the label 'radical'. Although the bibliometric analysis

highlights the fact that labels are seldom used jointly in one publication, it is also clear that authors with multiple publications often refer to different labels in different publications. The co-citation analysis of the references cited most by scholarship referring to a certain label shows considerable overlap with the core academic contributions that these bodies of literature on 'exceptional' innovation build on. From this analysis, we can infer that the 'intellectual' origins of different labels are highly related, which in turn might explain their interchangeable use in scholarship on exceptional innovation. In terms of thematic orientation, bibliographic coupling reveals five overlapping clusters, none of which adheres exclusively to a specific label. This implies that the literature on each topic should explore and integrate the findings from articles using each of the labels. It also suggests that a risk of duplication of research efforts may well exist. Moreover, it is apparent that the various labels are scattered across the thematic landscape – indicating that the literature using each label touches upon each topic present in the field as a whole. Diving deeper into the content of one hundred prominent articles, we find that a considerable proportion of articles leave delineation of the construct under study implicit. Moreover, two clearly distinct underlying dimensions – novelty and impact – can be discerned while, at the same time, there is no 1:1 correspondence between labels and (the permutation of) these dimensions. Finally, definitions within each label are inconsistent with respect to the dimension(s) referred to. Taken together, these findings renew the concerns raised over fifteen years ago.

This is clearly an undesirable state of affairs. A first problem concerns the use of multiple labels to denote relatively homogenous topics within this body of literature. The core function of a conceptual label is to group similar pieces of literature and to distinguish them from those that are dissimilar. The labels currently in use do not fulfill this requirement. Consequently, if one was interested in exploring the literature on exceptional innovation – possibly from a particular angle – adhering to one label will not only result in omitting an important proportion of the literature but

will also create a rather broad set of articles. This situation unnecessarily creates confusion with respect to the state of the art in this field and adds to the risk of duplication of research efforts (on similar topics under different labels). Although inefficient, the solution to this problem is rather straightforward. Scholars need to be aware of the fact that various – partly complementary, partly substitutable – labels are in use, and they should, therefore, adapt their study of the literature to it. Additionally, this might call for in-depth literature reviews on topics within this literature to efficiently mitigate confusion about what is (not) studied and what are the key facts uncovered.

Whilst this first problem might be rather benign, a thornier issue relates to the lack of clarity in defining the underlying dimensions. Labels tend to define – if they explicitly do so – the exceptional nature of an invention in terms of its 'radical' novelty and/or (considerable) impact on future developments. However, novelty and impact are clearly distinct dimensions on which innovations can be scaled. Indeed, while some inventions – such as Recombinant DNA, the Polymerase Chain Reaction or, more recently, 3D printing and Quantum computing – can revolutionize their technological domains by introducing completely new ways to serve a purpose (Arthur, 2007), a considerable number of 'novelties' are not (yet) able to fulfill this potential. For instance, technological novelties introduced in the field of nuclear fusion have not (yet) resulted in a significant impact. Moreover, a great deal of highly impactful inventions are mere improvements upon existing technologies (Baumol, 2004). In essence, novelty and impact define a matrix – or plane – with an abundant number of 'off-diagonals' that might be of key importance in understanding the origins and effects of 'exceptional' innovation.

Disregarding these off-diagonals involves the risk of – conceptually and empirically – making Type I and/or Type II errors, and it may result in misleading conclusions. On the one hand, considering novelty without any impact underestimates the risks associated with enacting novelty. This might lead to overly optimistic conclusions about the efficacy of implementing strategies that

are likely to result in novel inventions. For instance, it is often suggested that sourcing knowledge outside what a firm knows – by a logic of (recombinant) novelty – helps to achieve breakthrough success. However, novelty thickens both left and right tails of the impact distribution (Fleming, 2001; Verhoeven et al., 2016). Therefore, disregarding the (failed) novelty dimension will lead to an overestimation of the success of such strategies. On the other hand, analyzing impact – irrespective of novelty creation – is unlikely to yield a satisfactory level of understanding of the nature of the phenomena and the mechanisms driving technological performance. For instance, if one is concerned with novelty (and the creation thereof), knowledge-creation processes come to the forefront (including micro-foundations in terms of cognition and creativity), whereas impact is centered on diffusion dynamics, including the interplay with existing resources, systems and broader socio-technical systems.

Therefore, it seems reasonable to suggest that both dimensions deserve scholarly attention by themselves and – more intriguingly – in interaction with each other. As both dimensions introduce a temporal element[8], this study could inspire scholars to postulate innovation *trajectories* rather than innovation types when developing an insightful, and yet distinctive, set of innovation typologies.

[8] Albeit in a different manner: novelty can almost be conceived as an ex-ante dimension of exceptional innovation whereas impact can only be assessed ex post.

## REFERENCES


Abrahamson, E., and Fombrun, C. J. 1994. Macrocultures: Determinants and Consequences. ***The Academy of Management Review***, *19*(4), 728-755.

Afuah, A. N., and Bahram, N. 1995. The hypercube of innovation. ***Research Policy*****,** *24*(1), 51-76.

Agarwal, R., and Audretsch, D. B. 2001. Does entry size matter? The impact of the life cycle and technology on firm survival. ***The Journal of Industrial Economics,*** *49*(1), 21-43.

Agarwal, R., and Franco, A. M. 2004. Knowledge Transfer Through Inheritance : Spin-Out Generation, Development, and Survival. ***Academy of Management Journal*****,** *47*(4), 501-522.

Ahuja, G. 2000. The duality of collaboration: Inducements and opportunities in the formation of interfirm linkages. ***Strategic Management Journal*****,** *21*(3), 317-343.

Ahuja, G., and Lampert, C. M. 2001. Entrepreneurship in the large corporation: A longitudinal study of how established firms create breakthrough inventions. ***Strategic Management Journal*****,** *22*(6–7), 521-543.

Alguezaui, S., and Filieri, R. 2010. Investigating the role of social capital in innovation: sparse versus dense network. ***Journal of Knowledge Management*****,** *14*(6), 891-909.

Amit, R., and Zott, C. 2012. Creating Value Through Business Model Innovation. ***MIT SLOAN Management Review*****,** *53*(3), 40-50.

Ansari, S., & and Krop, P. 2012. Incumbent performance in the face of a radical innovation: Towards a framework for incumbent challenger dynamics. ***Research Policy*****,** *41*(8), 1357-1374.

Arthur, W. B. (2007). The structure of invention. ***Research policy,*** *36(2)*, 274-287.

Atuahene-Gima, K. 1995. An exploratory analysis of the impact of market orientation on new product performance a contingency approach. ***The Journal of Product Innovation Management*****,** *12*(4), 275-293.

Atuahene-Gima, K. 2005. Resolving the capability-rigidity paradox in new product innovation. ***Journal of Marketing***, *69*(4), 61-83.

Barnholt, E. W. 1997. Fostering business growth with breakthrough innovation. ***Research-Technology Management*****,** *40*(2), 12-16.

Baumol, W. J. 2004. Entrepreneurial Enterprises, Firms and Large Established Other of the Components Growth Machine. ***Small Business Economics*****,** *23*, 9-21.

Belderbos, R., Carree, M., and Lokshin, B. 2004. Cooperative R&D and firm performance. ***Research Policy*****,** *33*(10), 1477-1492.

Bengtsson, M., Raza-Ullah, T., and Vanyushyn, V. 2016. The coopetition paradox and tension: The moderating role of coopetition capability. ***Industrial Marketing Management*****,** *53*, 19-30.

Benner, M. L., and Tushman, M. J. 2003. Exploitation, Exploration, and Process Management: The Productivity Dilemma Revisited. ***The Academy of Management Review*****,** *28*(2), 238-256.

Bierly, P., and Chakrabarti, A. 1996. Generic knowledge strategies in the US pharmaceutical industry. ***Strategic Management Journal*****,** *17*(S2), 123-135.

Bower, J. L., and Christensen, C. M. 1995. Disruptive technologies: catching the wave. ***Long Range Planning*****,** *28*(2), 155.

Braunerhjelm, P., Acs, Z. J., Audretsch, D. B., and Carlsson, B. 2010. The missing link: Knowledge diffusion and entrepreneurship in endogenous growth. ***Small Business Economics*****,** *34*(2), 105-125.

Bruderer, E., and Singh, J. V. 1996. Organizational evolution, learning, and selection: A genetic-algorithm-based model. ***Academy Of Management Journal*****,** *39*(5), 1322-1349.

Cavalcante, S., Kesting, P., and Ulhøi, J. 2011. Business model dynamics and innovation: (re)establishing the missing linkages. ***Management Decision*****,** *49*(8), 1327-1342.

Chandy, R. K., and Tellis, G. J. 1998. Organizing for Radical Product Innovation: The Overlooked Role of Willingness to Cannibalize. ***Journal of Marketing Research*****,** *35*(4), 474.

Chandy, R. K., and Tellis, G. J. 2000. The Incumbent's Curse? Incumbency, Size, and Radical Product Innovation. ***Journal of Marketing*****,** *64*(3), 1-17.

Charitou, C. D., and Markides, C. C. 2003. Responses to disruptive strategic innovation. ***MIT Sloan Management Review*****,** *44*(2), 55-64.

Chen, S.H., Huang, M.H. and Chen, D.Z. 2012. Detecting temporal gaps of technology fronts: A case study of smart grid field. ***Technological Forecasting and Social Change*****,** 79(9):1705:1719.

Christensen, C. M. 1997. The Innovator's Dilemma: when new technologies cause great firms to fail. *Harvard Business Review Press*

Christensen, C. M., and Bower, J. L. 1996. Customer power, strategic investment, and the failure of leading firms. ***Strategic Management Journal***, *17*(3), 197-218

Christensen, C. M., Bohmer, R., and Kenagy, J. 2000. Will disruptive innovations cure health care?. ***Harvard Business Review***, *78*(5), 102-112.

Christensen, C. M., Johnson, M. W., and Rigby, D. K. 2002. Foundations for growth: How to identify and build disruptive new businesses. ***MIT Sloan Management Review***, *43*(3), 22.

Christensen, C. M., and Rosenbloom, R. S. 1995. Explaining the attacker's advantage: Technological pradigms, organizational dynamics, and the value network. ***Research Policy***, *24*, 233-257.

Christensen, C. M., Verlinden, M., and Westerman, G. 2002. Disruption, disintegration and the dissipation of differentiability. ***Industrial and Corporate Change***, *11*(5), 955-993.

Danneels, E. (2004). Disruptive technology reconsidered: A critique and research agenda. ***Journal of Product Innovation Management***, *21*(4), 246-258.

Danneels, E., Kleinschmidt, E. J., and Cooper, R. G. 2001. Product Innovativeness From the Firm's Perspective : Its Dimensions and Their Impact on Project Selection and Performance. ***Journal of Product Innovation Management***, *18*(6), 357-373.

DaSilva, C. M., Trkman, P., Desouza, K., and Lindič, J. 2013. Disruptive technologies: a business model perspective on cloud computing. ***Technology Analysis & Strategic Management***, *25*(10), 1161-1173.

Dewar, R. D., and Dutton, J. E. 1986. The Adoption of Radical and Incremental Innovations: An Empirical Analysis. ***Management Science***, *32*(11), 1422-1433.

Edmondson, A. C., Bohmer, R. M., and Pisano, G. P. 2001. Disrupted routines: Team learning and new technology implementation in hospitals. ***Administrative Science Quarterly*****,** *46*(4), 685-716.

Ettlie, J. E., Bridges, W. P., and O'Keefe, R. D. 1984. Organization Strategy and Structural Differences for Radical Versus Incremental Innovation. ***Management Science***, *30*(6), 682-695.

Fleming, L. 2001. Recombinant uncertainty in technological search. ***Management Science***,

*47*(1), 117-132.
Forés, B., and Camisón, C. 2016. Does incremental and radical innovation performance depend on different types of knowledge accumulation capabilities and organizational size? ***Journal of Business Research***, *69*(2), 831-848.
Gay, B., and Dousset, B. 2005. Innovation and network structural dynamics: Study of the alliance network of a major sector of the biotechnology industry. ***Research Policy***, *34*(10), 1457-1475.
Garcia, R., and Calantone, R. J. 2002. A critical look at technological innovation typology and innovativeness terminology: a literature review. ***Journal of Product Innovation Management***, *19*, 110-132.
Garud, R., and Karnoe, P. 2003. Bricolage vs. breakthrough: distributed and embedded ageny in technology entrepreneurship. ***Research Policy***, *32*(2), 277-300.
Garud, R., and Rappa, M. A. 1994. A Socio-Cognitive Model of Technology Evolution : The Case of Cochlear Implants. ***Organization Science***, *5*(3), 344-362.
Gatignon, H., Tushman, M. L., Smith, W., and Anderson, P. 2002. A Structural Approach to Assessing Innovation: Construct Development of Innovation Locus, Type, and Characteristics. ***Management Science***, *48*(9), 1103-1122.
Geels, F. W. 2005. Processes and patterns in transitions and system innovations: Refining the co-evolutionary multi-level perspective. ***Technological Forecasting and Social Change***, *72*(6 Spec. Iss.), 681-696.
Ghezzi, A., Cortimiglia, M. N., and Frank, A. G. 2015. Strategy and business model design in dynamic telecommunications industries: A study on Italian mobile network operators. ***Technological Forecasting and Social Change***, *90*(PA), 346-354.
Gopalakrishnan, S., and Damanpour, F. 1997. A Review of Innovation Research in Economics, Sociology and Technology Management. ***Omega, International Journal Management Science***, *25*(1), 15-28.
Hargadon, A. B. 1998. Firms as knowledge brokers: Lessons in pursuing continuous innovation. ***California Management Review***, *40*(3), 209-227.
Hatch, N. W., and Mowery, D. C. 1998. Process innovation and learning by doing in semiconductor manufacturing. ***Management Science***, *44*(11-part-1), 1461-1477.
Hauser, J. R., Tellis, G. J., and Griffin, A. 2006. Research on innovation: A review and agenda for Marketing Science. ***Marketing Science***, *25*(6), 687-717.
Henderson, R. 1993. Underinvestment and Incompetence as Responses to Radical Innovation: Evidence from the Photolithographic Alignment Equipment Industry. ***The RAND Journal of Economics***, *24*(2), 248-270.
Hill, C. W., and Rothaermel, F. T. 2003. The performance of incumbent firms in the face of radical technological innovation. ***Academy of Management Review***, *28*(2), 257-274.
Karakaya, F., and Kobu, B. 1994. New Product Development Process: An Investigation of Success and Failure in High-Technology and Non-High-Technology Firms. ***Journal of Business Venturing***, *9*, 49-66.
Kappel, T. A. 2001. Perspectives on roadmaps: how organizations talk about the future. ***Journal of Product Innovation Management***, *18*(1), 39-50.
Kessler, M.M. 1963. Bibiliographic coupling between scientific papers. ***American Documentation***, *14*(1):10+.
Knudsen, M. P. 2007. The Relative Importance of Interfirm Relationships and Knowledge Transfer for New Product Development Success. ***The Journal of Product Innovation Management,*** *24*(May 2002), 117-138.

Kortum, S. S. 1997. Research, Patenting, and Technological Change. ***Econometrica***, *65*(6), 1389-1419.
Kovacs, A., Van Looy, B., and Cassiman, B. 2015. Exploring the scope of open innovation: a bibliometric review of a decade of research. ***Scientometrics***, *104*(3), 951-983
Laursen, K., and Salter, A. 2006. Open for innovation: the role of openness in explaining innovation performance among UK manufacturing firms. ***Strategic Management Journal*****,** *27*(2), 131-150.
Lee, M., and Na, D. 1994. Determinants of technical success in product development when innovative radicalness is considered. ***The Journal of Product Innovation Management***, *11*(1), 62-68.
Linton, J. D. 2009. De-babelizing the language of innovation. ***Technovation***, *29*(11), 729-737.
Lynn, G. S., Morone, J. G., and Paulson, A. S. 1996. Marketing and discontinuous innovation: the probe and learn process. ***California Management Review***, *38*(3), 8-37.
March, J. G. 1991. Exploration and exploitation in organizational learning. ***Organization Science***, *2*(1), 71-87.
Markard, J., and Truffer, B. 2008. Technological innovation systems and the multi-level perspective: Towards an integrated framework. ***Research Policy***, *37*(4), 596-615.
Markides, C. 2006. Disruptive innovation: In need of better theory. ***Journal Of Product Innovation Management***, *23*(1), 19-25
Markides, C. C., and Anderson, J. 2006. Creativity is not enough: ICT-enabled strategic innovation. ***European Journal of Innovation Management*****,** *9*(2), 129-148.
Mascitelli, R. 2000. From experience: harnessing tacit knowledge to achieve breakthrough innovation. ***Journal of Product Innovation Management*****,** *17*(3), 179-193.
Mcintyre, S. 1988. Market Adaptation as a Process in the Product Life-Cycle of Radical Innovations and High Technology Products. ***Journal of Product Innovation Management*****,** *5*(2), 140-149.
McKee, D. 1992. An Organizational Learning Approach to Product Innovation. ***Journal of Product Innovation Management*****,** *9*(3), 232-245.
Narula, R. 2002. Innovation systems and 'inertia'in R&D location: Norwegian firms and the role of systemic lock-in. ***Research Policy***, *31*(5), 795-816.
Nooteboom, B., Vanhaverbeke, W., Duysters, G., Gilsing, V., and Van den Oord, A. 2007. Optimal cognitive distance and absorptive capacity. ***Research Policy***, *36*(7), 1016-1034.
O'Connor, G. C., and DeMartino, R. 2006. Organizing for radical innovation: An exploratory study of the structural aspects of RI management systems in large established firms. ***Journal of Product Innovation Management***, *23*(6), 475-497.
O'Connor, G. C., and Rice, M. P. 2001. Opportunity recognition and breakthrough innovation in large established firms. ***California Management Review***, *43*(2), 95-116.
O'Connor, G. C., and Veryzer, R. W. 2001. The nature of market visioning for technology-based radical innovation. ***Journal of Product Innovation Management*** *18*(4), 231-246.
Orlikowski, W. J. (1996). Improvising Organizational Transformation Over Time: A Situated Change Perspective. ***Information Systems Research***, *7*(1), 63-92.
Orsenigo, L., Pammolli, F., and Riccaboni, M. 2001. Technological change and network dynamics: lessons from the pharmaceutical industry. ***Research Policy***, *30*(3), 485-508.
Pérez-Luño, A., Cabello Medina, C., Carmona Lavado, A., and Cuevas Rodríguez, G. 2011. How social capital and knowledge affect innovation. ***Journal of Business Research***, *64*(12), 1369-1376.
Pittaway, L., Robertson, M., Munir, K., Denyer, D., and Neely, A. 2004. Networking and

innovation: a systematic review of the evidence 200. ***International Journal of Management Reviews***, *5-6*(3-4), 137-168.
Rafols, I., Hopkins, M. M., Hoekman, J., Siepel, J., O'Hare, A., Perianes-Rodríguez, A., and Nightingale, P. 2014. Big Pharma, little science? A bibliometric perspective on Big Pharma's R&D decline. ***Technological Forecasting and Social Change***, *81*, 22-38.
Rafols, I., Leydesdorff, L., O'Hare, A., Nightingale, P., and Stirling, A. 2012. How journal rankings can suppress interdisciplinary research: A comparison between Innovation Studies and Business & Management. ***Research Policy***, *41*(7), 1262-1282.
Ramirez, R. 1999. Value Co-Production : Intellectual Origins and Implications for Practice and Research. ***Strategic Management Journal***, *20*(1), 49-65.
Roper, S., Du, J., and Love, J. H. 2008. Modelling the innovation value chain. ***Research Policy*** *37*(6-7), 961-977.
Rothaermel, F. T. 2001. Incumbent's advantage through exploiting complementary assets via interfirm cooperation. ***Strategic Management Journal***, *22*(6–7), 687–699.
Rothaermel, F. T., and Thursby, M. 2005. University-incubator firm knowledge flows: assessing their impact on incubator firm performance. ***Research Policy***, *34*(3), 305-320.
Rosenkopf, L., and Nerkar, A. 2001. Beyond local search: boundary-spanning, exploration, and impact in the optical disk industry. ***Strategic Management Journal***, *22*(4), 287-306.
Sandberg, B., and Aarikka-Stenroos, L. 2014. What makes it so difficult? A systematic review on barriers to radical innovation. ***Industrial Marketing Management***, *43*(8), 1293-1305.
Shane, A. 1992. Why do some societies invent more than others? ***Journal of Business Venturing***, *7*, 29-46.
Shenhar, A. J. 2001. One Size Does Not Fit All Projects: Exploring Classical Contingency Domains. ***Management Science***, *47*(3), 394-414.
Schumpeter, J. A. 1934. The Theory of Economic Development (1911).
Siegel, Jd. S., and Renko, M. 2012. The role of market and technological knowledge in recognizing entrepreneurial opportunities. ***Management Decision***, *50*(5), 797-816.
Singh, J., and Fleming, L. 2010. Lone inventors as sources of breakthroughs: Myth or reality?. ***Management Science***, *56*(1), 41-56.
Smith, W. K., and Lewis, M. W. 2011. Toward A Theory Of Paradox: A Dynamic Equilibrium Model Of Organizing. ***Academy of Management Review***, 36(2), 381-403.
Sood, A., and Tellis, G. J. 2011. Demystifying Disruption: A New Model for Understanding and Predicting Disruptive Technologies. ***Marketing Science***, *30*(2), 339-354.
Subramaniam, M., and Youndt, M. A. 2005. The influence of intellectual capital on the types of innovative capabilities. ***Academy of Management Journal***, *48*(3), 450-463.
Suroso, E., and Azis, Y. 2015. Defining Mainstreams Of Innovation: A Literature Review. In H. A. Buchory and M. F. Cahyandito (Eds.), ***Proceedings of the International Conference on Economics and Banking*** (Vol. 5, pp. 387-398). Paris: Atlantis Press.
Taran, Y., Boer, H., & Lindgren, P. 2015. A business model innovation typology. ***Decision Sciences***, *46*(2), 301-331.
Tiessen, J. H. 1997. Individualism, collectivism and entrepreneurship: A framework for international comparative research. ***Journal of Business Venturing,*** *12*(5), 367-384.
Tripsas, M. 1997. Unraveling the process of creative destruction: Complementary assets and incumbent survival in the typesetter industry. ***Strategic Management Journal***, *18*(S1), 119-142.
Tripsas, M., and Gavetti, G. 2000. Capabilities, cognition, and inertia: Evidence from digital imaging. ***Strategic Management Journal***, *21*(10-11), 1147-1161.

Tushman, M. L., and O'Reilly, C. A. 1996. Ambidextrous organizations: Managing evolutionary and revolutionary change. ***California Management Review***, *38*(4), 8-30.
Tyre, M. J., and Orlikowski, W. J. 1994. Windows of Opportunity: Temporal Patterns of Technological Adaptation in Organizations. ***Organization Science***, *5*(1), 98-118.
Van Eck, N. J., and Waltman, L. 2009. How to normalize coocurrence data? An analysis of some well-known similarity measures. ***Journal of the American Society for Information Science and Technology****, 60*(8), 1635-1651.
Van Eck, N.J. and Waltman, L. 2010. Software survey: VOSviewer, a computer program for bibliometric mapping. ***Scientometrics***, *84*(2):523-538.
Veryzer, R. W. 1998a. Discontinuous Innovation and the new product development process. ***Journal of Product Innovation Management***, *15*(97), 304-321.
Veryzer, R. W. 1998b. Key Factors Affecting Customer Evaluation of Discontinuous New Products. ***Journal of Product Innovation Management.***
Vogel. R. and Guttel, W.H. 2013. The dynamic capability view in strategic management: A bibliometric Review. ***International Journal of Management Reviews***, ***15***(4):426-446.
Weinberg, B.H. 1974. Bibliographic coupling – Review. ***Information Storage and Retrieval***, ***10***(5-6):189-196.
Whitley, R. 2000. The institutional structuring of innovation strategies: business systems, firm types and patterns of technical change in different market economies. ***Organization Studies***, *21*(5), 855-886.
Wuehrer, G. A., and Smejkal, A. E. 2013. The knowledge domain of the academy of international business studies (AIB) conferences: A longitudinal scientometric perspective for the years 2006-2011. ***Scientometrics****, 95*(2), 541-561.
Vladutz, G. and Cook, J. 1984. Bibliographic coupling and subject relatedness. ***Proceedings of the American Society for Information Science***, ***21***:204-207.
Yeoh, P. L., and Roth, K. 1999. An empirical analysis of sustained advantage in the US pharmaceutical industry: Impact of firm resources and capabilities. ***Strategic Management Journal***, *20*(7), 637-653.
Yu, D., and Hang, C. C. 2010. A Reflective Review of Disruptive Innovation Theory. ***International Journal of Management Reviews***, *12*(4), 435-452.
Zaheer, A., and Bell, G. G. 2005. Benefiting from network position: firm capabilities, structural holes, and performance. ***Strategic Management Journal***, *26*(9), 809-825.
Zhou, K. Z., Yim, C. K., and Tse, D. K. 2005. The effects of strategic orientations on technology- and market-based breakthrough innovations. ***Journal of Marketing***, *69*(2), 42-60.
Zwiebel, J. (1995). Corporate Conservatism and Relative Compensation. ***Journal of Political Economy***, *103*(1), 1-25.

**APPENDIX**

**List of Tables**

**Table 1. An Overview of the Use of Labels and Combinations Thereof by Authors with Multiple Publications**

| | RAD_ONLY | DRU_ONLY | CON_ONLY | BRE_ONLY | MULTI |
|---|---|---|---|---|---|
| **RAD_ONLY** | 163 | 92 | 115 | 90 | 160 |
| **DRU_ONLY** | | 18 | 30 | 35 | 59 |
| **CON_ONLY** | | | 34 | 38 | 62 |
| **BRE_ONLY** | | | | 6 | 51 |
| **MULTI** | | | | | 21 |

**Table 2. Overlaps Among References Cited at Least 10 Times Overall (Jaccard-Index Scores)**

| | RAD_ONLY | DRU_ONLY | CON_ONLY | BRE_ONLY | MULTI |
|---|---|---|---|---|---|
| **RAD_ONLY** | X | 0,71 | 0,86 | 0,63 | 0,90 |
| **DRU_ONLY** | | x | 0,67 | 0,51 | 0,67 |
| **CON_ONLY** | | | x | 0,59 | 0,80 |
| **BRE_ONLY** | | | | x | 0,60 |
| **MULTI** | | | | | x |

**Table 3. The Top 10 Most-Cited Publications in each Cluster (before 2000 – after 2000)**

| PUBLICATIONS | CITATIONS | LABEL |
|---|---|---|
| **Cluster 1** | | |
| Orlikowski, W.J, (1996*), Improvising Organizational Transformation Over Time: A Situated Change Perspective*, Information Systems Research, 7(1), 63-92. | *499* | *CON* |
| Henderson, R., (1993*), Underinvestment and Incompetence as Responses to Radical Innovation - Evidence from the Photolithographic Alignment Equipment Industry*, RAND Journal of Economics, 24(2), 248-270. | *317* | *RAD* |
| Tyre, M.J. and Orlikowski, W.J., *Windows of Opportunity - Temporal Patterns of Technological Adaptation in Organizations*, Organization Science, 5(1), 98-118. | *314* | *CON* |
| Kortum, S.S., (1997), *Research, Patenting, and Technological Change*, Econometrica, 65(6), 1389-1419. | *247* | *BRE* |
| Ramirez, R., (1999), *Value Co-Production: Intellectual Origins and Implications for Practice and Research*, Strategic Management Journal, 20(1), 49-65. | *234* | *BRE* |
| Garud, R. and Karnoe, P., (2003), *Bricolage Versus Breakthrough: Distributed and Embedded Agency in Technology Entrepreneurship*, Research Policy, 32(2), 277-300. | *403* | *BRE* |
| Pittaway, L et. al., (2004), *Networking and Innovation: A Systematic Review of the Evidence*, International Journal of Management Reviews, 42526, 137-168. | *309* | *DRU* |
| Huy, Q.N., (2002), *Emotional Balancing of Organizational Continuity and Radical Change: The Contribution of Middle Managers*, Administrative Science Quarterly, 47(1), 31-69. | *267* | *RAD* |
| Smith, W.K. and Lewis, M.W., (2011), *Toward a Theory of Paradox: A Dynamic Equilibrium Model of Organizing*, Academy of Management Review, 36(2), 381-403. | *264* | *RAD* |
| Markard, J. and Truffer, B., (2008), *Technological Innovation Systems and the Multi-level Perspective: Towards an Integrated Framework*, Research Policy, 37(4), 596-615. | *210* | *RAD* |
| **Cluster 2** | | |
| Dewar, R.D. and Dutton, J.E., (1986), *The Adoption of Radical and Incremental Innovations - An Empirical Analysis*, Management Science, 32(11), 1422-1433. | *687* | *RAD* |
| Moorman, C. and Miner, A.S., (1997), *The Impact of Organizational Memory on New Product Performance and Creativity*, Journal of Marketing Research, 34(1), 91-106. | *385* | *CON* |

| | | |
|---|---|---|
| West, M.A., and Anderson, N.R., (1996), *Innovation in Top Management Teams*, Journal of Applied Psychology, 81(6), 680-693. | *314* | *RAD* |
| Slater, S.F. and Narver, J.C., (1998), *Customer-led and Market-oriented: Let's Not Confuse the Two*, Strategic Management Journal, 19(10), 1001-1006. | *306* | *CON* |
| Veryzer, R.W., (1998), *Discontinuous Innovation and the New Product Development Process*, Journal of Product Innovation Management, 15(4), 304-321. | *254* | *MULTI* |
| Garcia, R., and Calantone, R., (2002), *A Critical Look at Technological Innovation Typology and Innovativeness Terminology: A Literature Review*, Journal of Product Innovation Management, 19(2), 110-132. | *669* | *MULTI* |
| Zhou, K.Z. et. al., (2005), *The Effects of Strategic Orientations on Technology- and Market-based Breakthrough Innovations*, Journal of Marketing, 69(2), 42-60. | *363* | *BRE* |
| Atuahene-Gima, K., (2005), *Resolving the Capability-Rigidity Paradox in New Product Innovation*, Journal of Marketing, 69(4), 61-83. | *322* | *RAD* |
| Hauser, J.R. et. al., (2006), *Research on Innovation: A Review and Agenda for Marketing Science*, Marketing Science 25(6), 687-717. | *279* | *RAD* |
| Danneels, E. and Kleinschmidt, E.J., (2001*), Product Innovativeness from the Firm's Perspective: Its Dimensions and their Relation with Project Selection and Performance*, Journal of Product Innovation Management, 18(6), 357-373. | *253* | *CON* |
| **Cluster 3** | | |
| Tushman, M.L. and O'Reilly, C.A., (1996), *Ambidextrous Organizations: Managing Evolutionary and Revolutionary Change*, California Management Review, 38(4). | *833* | *MULTI* |
| Christensen, C.M and Bower, J.L., (1996), *Customer Power, Strategic Investment, and the Failure of Leading Firms*, Strategic Management Journal, 17(3), 197-218. | *756* | *RAD* |
| Orlikowski, W.J., (1993), *Case Tools as Organizational-Change - Investigating Incremental and Radical Changes in Systems Development*, MIS Quarterly, 17(3), 309-340. | *397* | *RAD* |
| Chandy, R.K. and Tellis, G.J., (1998), *Organizing for Radical Product Innovation: The Overlooked Role of Willingness to Cannibalize*, Journal of Marketing Research, 35(4), 474-487. | *367* | *RAD* |
| Tripsas, M., (1997), *Unraveling the Process of Creative Destruction: Complementary Assets and Incumbent Survival in the Typesetter Industry*, Strategic Management Journal, 18, 119-142. | *332* | *RAD* |
| Benner, M.J., and Tushman, M.L., (2003), *Exploitation, Exploration, and Process Management: The Productivity Dilemma Revisited*, Academy of Management Review, 28(2), 238-256. | *934* | *CON* |
| Tripsas, M. and Gavetti, G., (2000), *Capabilities, Cognition, and Inertia: Evidence from Digital Imaging*, Strategic Management Journal, 21(42684), 1147-1161. | *596* | *RAD* |
| Ahuja, G. and Lampert, C.M., (2001*), Entrepreneurship in the Large Corporation: A Longitudinal Study of how Established Firms Create Breakthrough Inventions*, Strategic Management Journal, 22(42557), 521-543. | *567* | *MULTI* |
| Fleming, L., (2001), *Recombinant Uncertainty in Technological Search*, Management Science, 47(1), 117-132. | *499* | *MULTI* |
| Edmondson, A.C. et. al., (2001), *Disrupted Routines: Team Learning and New Technology Implementation in Hospitals*, Administrative Science Quarterly, 46(4), 685-716. | *491* | *DRU* |
| **Cluster 4** | | |
| Bierly, P. and Chakrabarti, A., (1996), *Generic Knowledge Strategies in the US Pharmaceutical Industry*, Strategic Management Journal, 17, 123-135. | *314* | *RAD* |
| Hargadon, A.B., (1998), *Firms as Knowledge Brokers: Lessons in Pursuing Continuous Innovation* | *202* | *BRE* |
| Hatch, N.W. and Mowery, D.C., (1998*), Process Innovation and Learning by Doing in Semiconductor Manufacturing*, Management Science, 44(11), 1461-1477. | *118* | *DRU* |
| McKee, D., (1992), *An Organizational Learning Approach to Product Innovation*, Journal of Product Innovation Management, 9(3), 232-245. | *118* | *CON* |
| Bruderer, E. and Singh, J.V., (1996), *Organizational Evolution, Learning, and Selection: A Genetic Algorithm-based Model*, Academy of Management Journal, 39(5), 1322-1349. | *74* | *CON* |
| Laursen, K. and Salter, A., (2006), *Open for Innovation: The Role of Openness in Explaining Innovation Performance among UK Manufacturing Firms*, Strategic Management Journal, 27(2), 131-150. | *1063* | *CON* |
| Rosenkopf, L. and Nerkar, A., (2001), *Beyond Local Search: Boundary-Spanning, Exploration, and Impact in the Optical Disk Industry*, Strategic Management Journal, 22(4), 287-306. | *699* | *RAD* |
| Subramaniam, M. and Youndt, M.A., (2005), *The Influence of Intellectual Capital on the Types of Innovative Capabilities* | *655* | *RAD* |
| Ahuja, G., (2000), *The Duality of Collaboration: Inducements and Opportunities in the Formation of Interfirm Linkages*, Strategic Management Journal, 21(3), 317-343. | *509* | *MULTI* |

| | | |
|---|---|---|
| Zaheer, A. and Bell, G.G., (2005), *Benefiting from Network Position: Firm Capabilities, Structural Holes and Performance*, Strategic Management Journal, 26(9), 809-825. | *380* | *RAD* |
| **Cluster 5** | | |
| Gilbert, C.G., (2005), *Unbundling the Structure of Inertia: Resource Versus Routine Rigidity*, Academy of Management Journal, 48(5), 741-763. | *257* | *CON* |
| Christensen, C.M. et. al., (2000), *Will Disruptive Innovations Cure Health Care?* Harvard Business Review, 78(5), 102. | *193* | *DRU* |
| Danneels, E., (2004), *Disruptive Technology Reconsidered: A Critique and Research Agenda*, Journal of Product Innovation Management, 21(4), 246-258. | *186* | *MULTI* |
| Markides, C., (2006*), Disruptive Innovation: In Need of Better Theory*, Journal of Product Innovation Management, 23(1), 19-25. | *132* | *DRU* |
| Kappel, T.A., (2001), *Perspectives on Roadmaps: How Organizations Talk about the Future*, Journal of Product Innovation Management, 18(1), 39-50. | *119* | *DRU* |
| Song, C. and Di Benedetto, A., (2008), *Supplier's Involvement and Success of Radical New Product Development in New Ventures*, Journal of Operations Management, 26(1), 1-22. | *115* | *RAD* |
| Whitley, R., (2006), *Project-based Firms: New Organizational Form or Variations on a Theme?* Industrial and Corporate Change, 15(1), 77-99. | *105* | *RAD* |
| Wirtz, B.W.et. al., (2010), *Strategic Development of Business Models Implications of The Web 2.0 for Creating Value on the Internet*, Long Range Planning, 43(), 272-290, | *95* | *MULTI* |
| Christensen, C.M. et. al., (2002*), Disruption, Disintegration and the Dissipation of Differentiability*, Industrial and Corporate Change, 11(5), 955-993. | *86* | *DRU* |
| O'Connor, G.C. and Demartino, R., (2006), *Organizing for Radical Innovation: An Exploratory Study of the Structural Aspects of Ri Management Systems in Large Established Firms*, Journal of Product Innovation Management, 23(6), 475-497. | *82* | *RAD* |

**Table 4. The Distribution of Publications Representing the Use of Different Labels Across Thematic Clusters**

| | CLUSTER 1 | CLUSTER 2- | CLUSTER 3 | CLUSTER 4 | CLUSTER 5 | OVERALL |
|---|---|---|---|---|---|---|
| **RAD_ONLY** | 45,5% | 61,5% | 26,4% | 61,3% | 26,7% | 46,7% |
| **DRU_ONLY** | 18,3% | 5,9% | 6,2% | 10,3% | 36,6% | 14,6% |
| **CON_ONLY** | 13,2% | 8,8% | 40,6% | 12,6% | 9,9% | 15,5% |
| **BRE_ONLY** | 14,7% | 8,1% | 3,3% | 9,9% | 2,6% | 9,3% |
| **MULTI** | 8,2% | 15,7% | 23,6% | 5,9% | 24,1% | 13,9% |

**Table 5. Conceptualization of 'Exceptional Innovation' in the Top 100 Most-cited Publications on 'Exceptional Innovation'**

| LABEL | NOVELTY | IMPACT | NOVELTY AND IMPACT | UNDEFINED |
|---|---|---|---|---|
| ***RADICAL*** | **[16]** Ahuja and Lampert (2001); Belderbos et al. (2004); Castaldi et al. (2015); Christensen and Roosenbloom (1995); Fleming (2001); Goktan and Miles (2011); Harvey (2014); Laursen and Salter (2006); Madjar et al. (2011); Parida et al. (2012); Pittaway et al. (2004); Rosenkopf and Nerkar (2001); Singh and Fleming (2010); Tellis et al. (2009); Verganti (2008); Verhoeven et al. (2016) | **[2]** Andriopoulos and Lewis (2009); Markard and Truffer (2008) | **[22]** Ahuja (2000); Atuahene-Gima (2005); Baker and Sinkula (2009); Benner and Tushman (2003); Bouncken and Kraus (2013); Bouncken et al. (2016); Chandy and Tellis (1998); Chandy and Tellis (2000); Fores and Camison (2016); Gatignon et al. (2002); Kammerlander and Ganter (2015); Kim et al. (2012); Menguc et al. (2014); Nieto et al. (2015); Ordanini and Parasuraman (2011); Ritala and Hurmelinna-Laukkanen (2013); Rubera and Kirca (2012); Schneider et al. (2010); Subramaniam and Youndt (2005); Tripsas and Gavetti (2000); Tushman and O'Reilly (1996); Zhou and Li (2012) | **[22]** Agarwal (2004); Baker (2016); Bengtsson et al. (2016); Cavalcante et al. (2011); Cheng et al. (2013); Cui and Wu (2016); Danneels (2008); Erevelles et al. (2016); Hauser et al. (2006); He and Wang (2016); Henry et al. (2016); Huy (2002); Nicolini (2011); Nooteboom et al. (2007); Pagell and Shevchenko (2014); Schweisfurth and Herstatt (2016); Slater et al. (2014); Smith and Lewis (2011); Turner et al. (2013); Vona and Consoli (2015); Yoo et al. (2012); Zaheer and Bell (2005) |
| ***DISRUPTIVE*** | **[0]** | **[3]** Christensen and Bower (1996); Cohen and Winn (2007); Sandstrom (2016) | **[2]** Kammerlander and Ganter (2015); Kivima and Kern (2016) | **[13]** Amit and Zott (2012); Bala and Venkatesh (2016); Carvalho et al. (2013); Edmondson et al. (2001); Gawer and Cusumano (2014); Lee et al. (2013); Martin (2016); Matos and Hall (2007); Mellor et al. (2014); Rayna and Striukova (2016); Wang et al. (2015); Wirtz et al. (2010); Zhang et al. (2016) |
| ***DISCONTINUOUS*** | **[1]** Sandstrom (2016) | **[0]** | **[4]** Gilbert (2005); Kammerlander and Ganter (2015); Konig et al. (2013); Veryzer (1998) | **[5]** Christman et al. (2015); Garud and Rappa (1994); Ghezzi et al. (2015); Huenteler et al. (2016); Makri et al. (2010); Moorman and Miner (1997); Orlikowski (1996); Pellegrinelli et al. (2015); Rothaermel and Hess (2007); Slater and Narver (1998); Tyre and Orlikowski (1994); West and Bogers (2014); Wirtz et al. (2010); Yoo et al. (2012) |
| ***BREAKTHROUGH*** | **[0]** | **[4]** Castaldi et al. (2015); Fleming (2001); Harvey (2014); Singh and Fleming (2010) | **[2]** Bouncken and Kraus (2013); Zhou et al. (2005) | **[4]** Braunerhjelm et al. (2010); Garud and Karnoe (2003); Ramirez (1999); Vona and Consoli (2015) |

List of Figures and Maps

**Figure 1. Distribution of WOS Publications on 'Exceptional Innovation' vs. All Business and Management Publications Over Time**

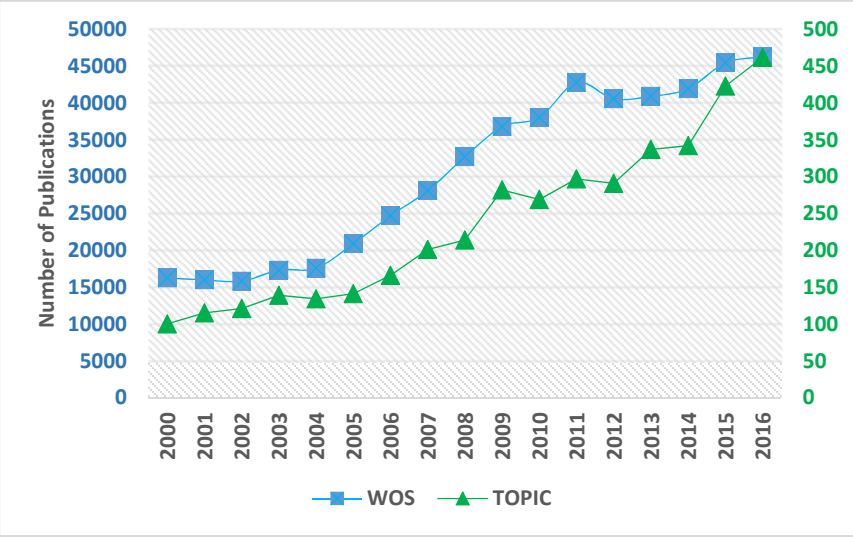



**Figure 2. Venn Diagram Displaying the Distribution of 2,081 Publications over the Four Labels and Combinations Thereof**

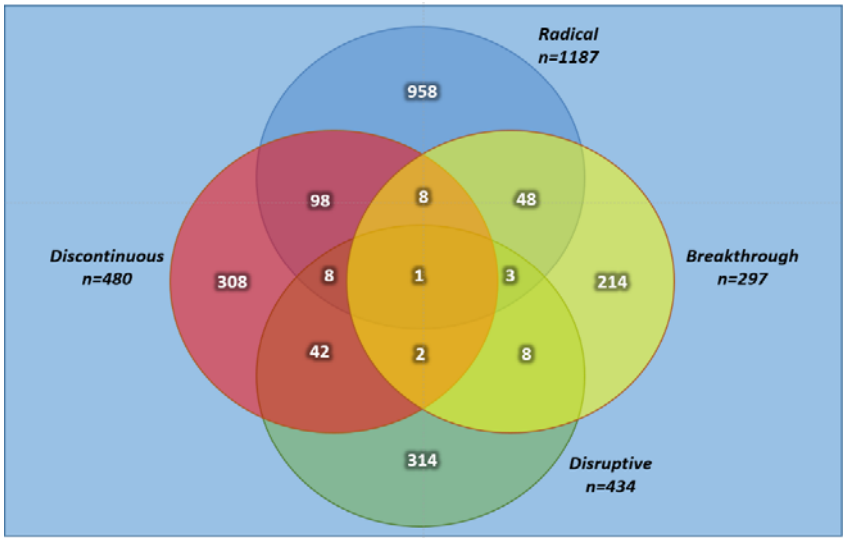



**Figure 3. Distribution of the Number of Publications Per Label Over Time**

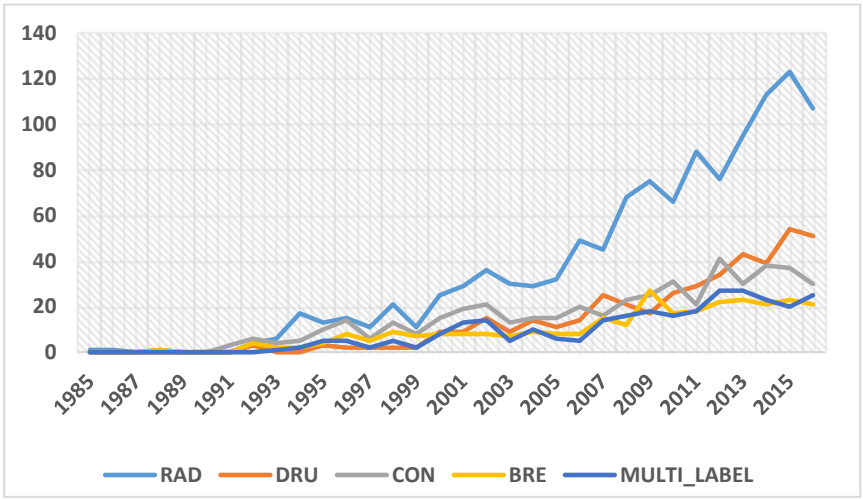
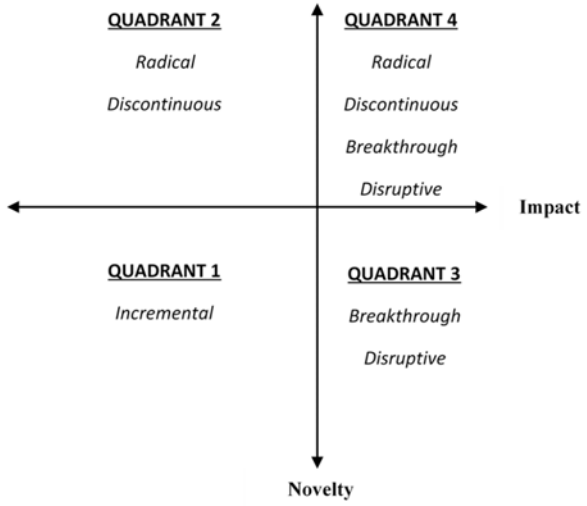
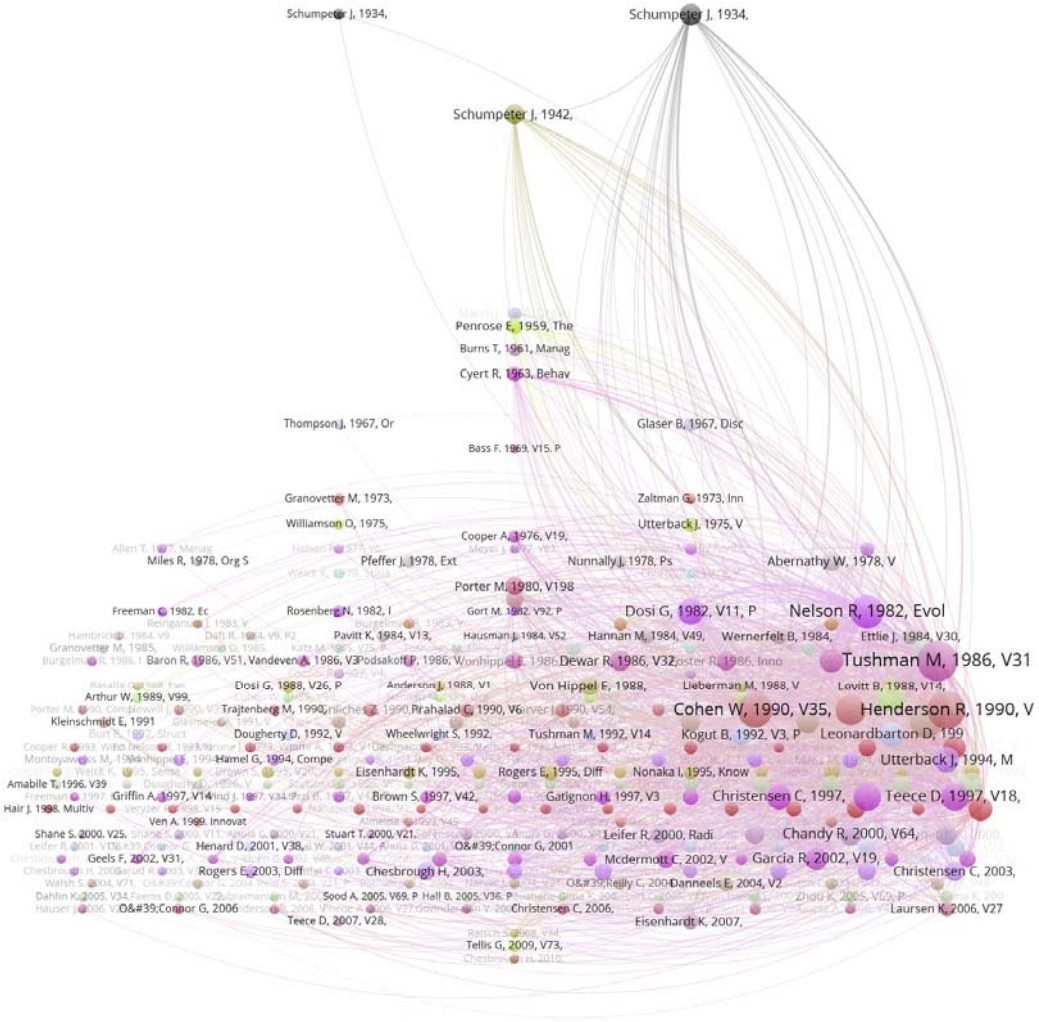


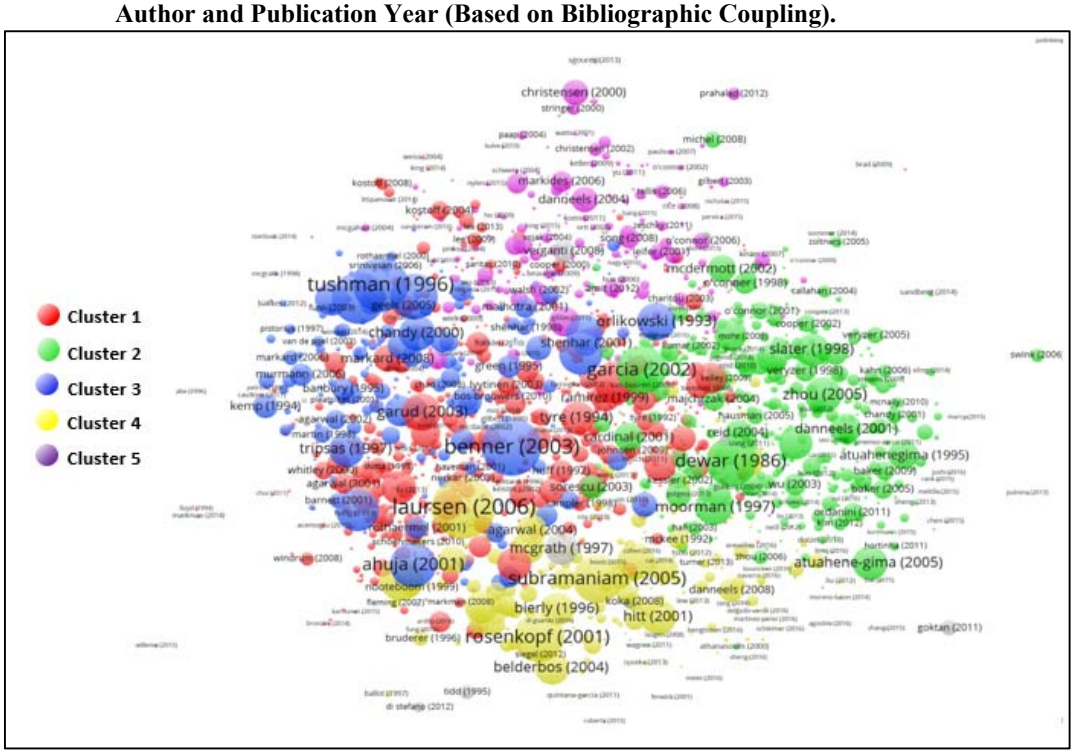

**Figure 4. Underlying Dimensions of 'Exceptional Innovation'**



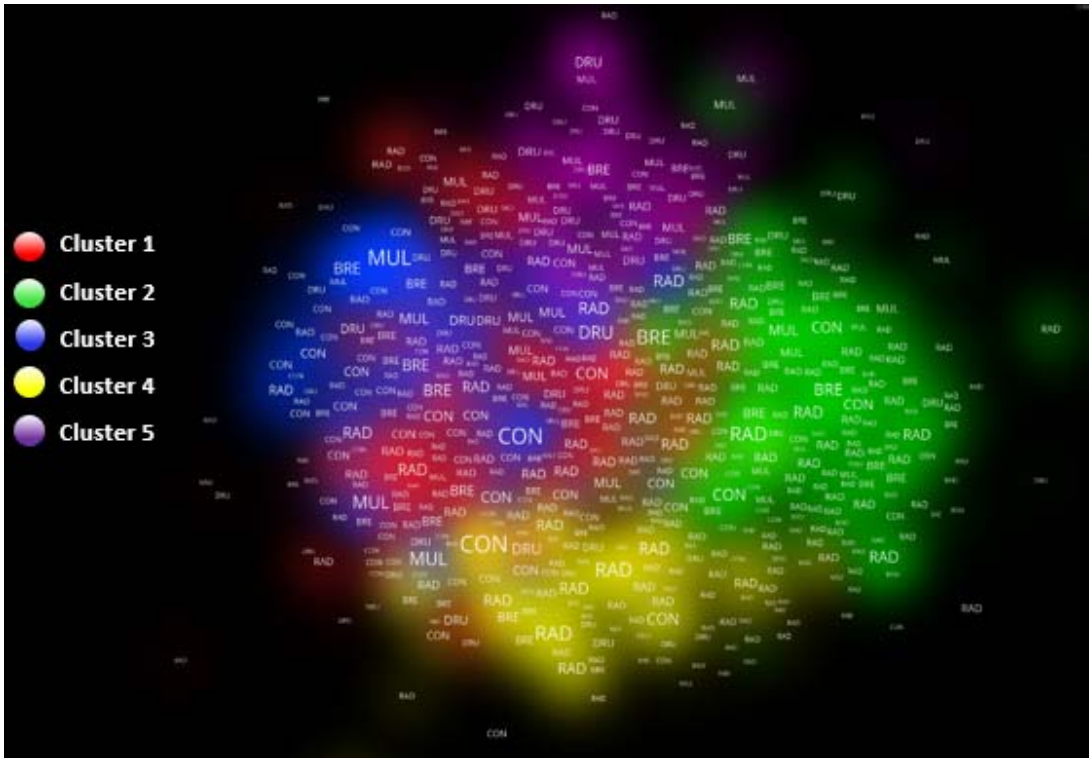
**Map 1. The Origins of Scholarship on 'Exceptional Innovation'**



**Map 2. A Visualization of Clusters of Thematically Related Publications Displaying First Author and Publication Year (Based on Bibliographic Coupling).**




**Map 3. A Visualization of Clusters of Thematically Related Publications Within the Network of Publications Referring to Different Labels (Based on Bibliographic Coupling)**



MANAGEMENT, STRATEGY AND INNOVATION (MSI)
Naamsestraat 69 bus 3535
3000 LEUVEN, Belgium
tel. + 32 16 32 67 00
msi@econ.kuleuven.be
https://feb.kuleuven.be/research/MSI/