

# A Bibliometric Review of Open Innovation: Setting a Research Agenda

Krithika Randhawa, Ralf Wilden, and Jan Hohberger

*Through an objective, systematic, and comprehensive review of the literature on open innovation (OI), this article identifies gaps in existing research, and provides recommendations on how hitherto unused or underused organizational, management, and marketing theories can be applied to advance the field. This study adopts a novel approach by combining two complementary bibliometric methods of co-citation analysis and text mining of 321 journal articles on OI that enables a robust empirical analysis of the intellectual streams and key concepts underpinning OI. Results reveal that researchers do not sufficiently draw on theoretical perspectives external to the field to examine multiple facets of OI. Research also seems confined to innovation-specific journals with its focus restricted to a select few OI issues, thereby exerting limited influence on the wider business community. This study reveals three distinct areas within OI research: (1) firm-centric aspects of OI, (2) management of OI networks, and (3) role of users and communities in OI. Thus far, studies have predominantly investigated the firm-centric aspects of OI, with a particular focus on the role of knowledge, technology, and R&D from the innovating firm's perspective, while the other two areas remain relatively under-researched. Further gaps in the literature emerge that present avenues for future research, namely to: (1) develop a more comprehensive understanding of OI by including diverse perspectives (users, networks, and communities), (2) direct increased attention to OI strategy formulation and implementation, and (3) enhance focus on customer co-creation and conceptualize “open service innovation.” Marketing (e.g., service-dominant logic), organizational behavior (e.g., communities of practice), and management (e.g., dynamic capabilities) offer suitable theoretical lenses and/or concepts to address these gaps.*

## Practitioner Points

- Firms will benefit from holistic insights on collaborating with users, networks, and communities to guide their open innovation initiatives.
- By integrating marketing perspectives into their R&D efforts, firms can better understand and implement open innovation in services and co-creation with customers.
- In order to balance the creation and capture of value, firms need to tightly link their open innovation initiatives with overall firm strategy.

## Introduction

Organizations increasingly embrace “open innovation” (OI) by opening up their boundaries to seamlessly collaborate and exchange

knowledge with external stakeholders to leverage complementary assets and capabilities, and to accelerate the commercialization of innovation (e.g., Chesbrough, 2003c; West and Gallagher, 2006). Since the publication of Chesbrough's (2003c) seminal book on OI, researchers have been directing considerable attention to the study of OI. Despite significant advancements, OI is evolving into a diverse and fragmented body of knowledge (Gianiodis, Ellis, and Secchi, 2010; Hui-zingh, 2011), with a lack of common understanding of what constitutes OI and its theoretical underpinnings (Dahlander and Gann, 2010; Remneland-Wikhamn and Wikhamn, 2013; West and Bogers, 2014).

The main contribution in this article lies in providing recommendations on how hitherto unused or underused theories and concepts from marketing (e.g., service-dominant logic), organizational behavior (e.g., communities of practice), and management (e.g., dynamic capabilities) can be drawn on to advance OI research. These recommendations address research gaps in OI identified through the novel, systematic, and objective empirical analyses of the structure and content of the field. This study uncovers both the

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theoretical foundations and key themes that underpin the OI paradigm by combining two bibliometric methods of network-based *co-citation analysis* and *text mining* (unstructured ontological discovery) of 321 core articles published on OI. The application of these complementary bibliometric methods enables a more robust, structured, and comprehensive review of this rapidly expanding research domain.

This study uses different co-citation analysis approaches to provide an illustration of the structure and theoretical core of the field, and also to uncover extant schools of scholarship that are used together with OI research. Text mining provides detailed conceptual insights by shifting the level of analysis from authors and their citations to the actual text/words used by the authors, for a content-driven review of the literature. This method differs from co-citation analysis in that it systematically discovers concepts within the OI paradigm, and identifies past, persistent themes as well as emerging themes. The findings thus present a clearer understanding of the intellectual streams and key concepts that constitute OI, and provide a robust foundation to lay out an agenda for future research. The article concludes with recommendations of theories and/or concepts from outside the OI field that can be suitably applied to examine multiple under-researched facets of OI.

#### BIOGRAPHICAL SKETCHES

Krithika Randhawa is a doctoral candidate at the University of Technology Sydney (UTS). She holds an M.B.A. from Macquarie University. Her research focuses on open innovation, with a special interest in the management of community-based innovation and firm-community collaboration. Her previous work based on a global management practices research study at UTS in collaboration with the London School of Economics has been published in *International Journal of Production Economics* and *International Journal of Production Research*.

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## The Evolution of Open Innovation Research

Initially, innovation researchers were mainly interested in the industrial R&D approach and the role of science and technology in economic productivity (Chandler, 1977; Freeman, 1982). Common to these early conceptualizations is the view of innovation as a closed, firm-internal, and sequential process occurring with little interaction with external entities (Cainelli, Evangelista, and Savona, 2004). New technology required for this process was also developed internally (Ahlstrom, 2010; Mowery, 1983) and organizations attained competitive advantage through exclusive ownership and control of intellectual property (Chesbrough, 2003c).

More recently, organizations have begun to adopt a more open approach to innovation by collaborating with external stakeholders through iterative exchange of knowledge, technology, and resources across their boundaries. Researchers recognized that the linear model of innovation cannot adequately explain modern innovation activities (e.g., Powell, Koput, and Smith-Doerr, 1996; Teece, 1986; von Hippel, 1988). Thus, Chesbrough (2003c, p. 24) proposed OI as “a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology.”

According to the OI paradigm, organizational boundaries are permeable rather than closed, and innovation is moved from a location internal to the organization to a relational system that includes its external partners (Bogers and West, 2012; Chesbrough, 2006b). As a result, innovation emerges through purposeful inflows and outflows of knowledge distributed among a network of actors (Chesbrough, 2003a; Enkel, Gassmann, and Chesbrough, 2009; Gassmann and Enkel, 2004). OI business models enable organizations to integrate and commercialize complementary resources and capabilities to capture value and maximize profits from innovation (Chesbrough and Crowther, 2006; Laursen and Salter, 2006).

Following Chesbrough's (2003c) seminal work, the field of OI has attracted explicit attention, as evident from the steady increase in published articles, books, and conferences on this topic. Both interest in the field (number of articles directly related to OI) and its influence (number of articles that cite OI articles) have burgeoned over the last decade. With the rapid expansion of the research domain, literature on OI has become scattered and diverse (Huizingh, 2011; Van De Vrande, Vanhaverbeke, and Gassmann, 2010). Further,

disparate definitions and ambiguous theorizations hamper progress in this field (Gianiodis, Ellis, and Secchi, 2010; West and Bogers, 2014) and hinder the development of an integrated conceptual framework and robust empirical investigations (Dahlander and Gann, 2010; Lichtenthaler, 2011). The notion of OI has also been criticized for simply being “old wine in new bottles” (Trott and Hartmann, 2009).

Scholars have recognized the need to gather a consolidated understanding of the field, and have started to review and synthesize the literature. However, patterns within existing literature can be hard to uncover when a research field is complex, in its early stages of inquiry, and rapidly evolving (Di Stefano, Peteraf, and Verona, 2010). The relative immaturity of OI as a research domain, the multitude of definitions and conceptualizations, and the steep increase in publications in the field add to the task. Yet, literature reviews have contributed valuable insights into different aspects of OI research. For example, West and Bogers (2014) review research on inbound (and coupled) processes of OI to uncover how firms leverage external sources of innovation, and Dahlander and Gann (2010) define and clarify the “openness” construct in OI research. Previous reviews also vary in the methods adopted to analyze the literature. Huizingh (2011) takes a qualitative approach to discuss OI research along the dimensions of context, content, and process, and provides research directions for the field. Remneland-Wikhamn and Wikhamn (2013) empirically classify OI literature into the firm-perspective and ecosystem perspective and relate it to the wider innovation context. In complementing these reviews, this study is the first to combine the two sophisticated and complementary bibliometric methods of co-citation analysis and text mining (unstructured ontological discovery) to develop a more systematic and comprehensive understanding of the structure, concepts, and theoretical foundations of OI. These insights, in turn, provide a robust basis to uncover research gaps and set an agenda to move the field forward.

## Methodology

### *Sample Selection*

To review OI research, this study used Scopus, the largest citation database of peer-reviewed literature, to identify 321 articles (focal articles) published in leading business journals (based on SSCI impact factors) between 2003 and 2013. The journals comprising the focal articles belonged to all business domains, includ-

ing—but not limited to—management, strategy, marketing, and economics.<sup>1</sup> Given that highly influential articles in the field of OI have been published in journals such as *MIT Sloan Management Review* (e.g., Chesbrough, 2003a) and *California Management Review* (e.g., Chesbrough, 2003b), both academic and practitioner-focused outlets were included in the search for focal articles (see also Table 1).

To arrive at the final sample of focal articles this study adopted a systematic four-step process as described below. The first step was to identify concepts that are relevant to the topic area. Besides “open innovation,” the search also included other concepts that are related to OI including—but not limited to—co-creation, user innovation, collaborative innovation, crowdsourcing, openness, and dynamic capabilities. The intention behind starting with such a broad spectrum of concepts was to ensure that articles that are not explicitly centered on OI but still deal with some aspect of OI are accounted for. Second, based on peer discussions with experienced researchers in the field, this list was reduced to those concepts that are most relevant to OI: “open innovation,” “openness,” “crowdsourcing,” and “co-creation.” For example, the search excluded “dynamic capability” as a search term as, barring very few exceptions (e.g., Waguespack and Fleming, 2009), the majority of dynamic capability research focuses on topics such as business model reorganization and innovation (e.g., Karim, 2009; Zott, Amit, and Massa, 2011) rather than open innovation in specific. In a similar vein, OI and user innovation have been said to be distinct research domains with differing precepts (e.g., Chesbrough and Bogers, 2014; Piller and West, 2014). Given the aim of this article is to aid conceptual clarity for the OI domain, this study consciously excludes articles that do not explicitly discuss the OI concept.

Third, using the selected concepts as search terms, the search returned 450 articles published in business journals with a SSCI impact factor and containing the respective term in their title, abstract, and/or keywords:<sup>2</sup> open innovation (299), openness (72), co-creation (48), and crowdsourcing (31).<sup>3</sup> After accounting for articles that appear in two or more lists, this was reduced to 405

<sup>1</sup>Please contact the authors for a full list of articles and journals included in this study.

<sup>2</sup>For openness and co-creation, the search included “openness” (or “co-creation”) and “innovation” in the criteria, so as to extract only those articles that clearly used these concepts in the context of innovation.

<sup>3</sup>The article lists were longer prior to refining by journals with a SSCI impact factor: open innovation (560), openness (176), co-creation (109), and crowdsourcing (85). The final list excluded journals without impact factor to ensure that the data is of high quality.

**Table 1. Top 15 Journals Publishing the Focal Articles and Their References**

Rank	N	Outlets of focal articles	Rank	N	Outlets of references
1	40	Research Technology Mgt	1	183	Research Policy
2	32	Research Policy	2	151	Technovation
3	31	R & D Mgt	3	123	R & D Mgt
4	30	Int J of Technology Mgt	4	100	Int J of Technology Mgt
5	24	Technovation	5	92	J of Product Innovation Mgt
6	15	Tech Forecasting and Social Change	6	90	Industrial Marketing Mgt
7	12	J of Product Innovation Mgt	7	89	Int J of Innovation Mgt
8	12	Tech Analysis and Strategic Mgt	8	60	European J of Innovation Mgt
9	9	Innovation: Mgt, Policy and Practice	9	60	J of Business Research
10	8	Management Decision	10	56	Tech Forecasting and Social Change
	8	California Mgt Review	11	56	Tech Analysis and Strategic Mgt
12	7	MIT Sloan Mgt Review	12	49	Organization Science
13	6	J of Business Research	13	44	Innovation: Mgt, Policy and Practice
	6	Organization Science	14	43	Industry and Innovation
15	5	Mgt Science	15	42	J of Technology Mgt and Innovation

Note: N = Number of articles.

unique focal articles. Fourth, all three authors independently reviewed the abstracts to determine the relevance of the articles to OI. This review process led to the exclusion of articles that are unrelated to the OI field. For example, some articles on crowdsourcing deal with the use of crowds in a way that does not clearly qualify as an innovation, such as an online information labor market (e.g., Gonen et al., 2013) or as a source of online news and information (e.g., Castillo, Mendoza, and Poblete, 2013). Also, not all articles that deal with collaborative innovation are centered on OI in the way the concept was defined by Chesbrough (2003a, 2003c, 2006a). For example, many co-creation articles predominantly revolve around customers, consumers, and/or services (Alexander et al., 2009; Bolton and Saxena-Iyer, 2009) in a way that has more to do with user innovation, service-dominant logic, or service innovation than OI. This iterative process of reconciling and validating resulted in the final set of 321 focal articles.<sup>4,5</sup>

<sup>4</sup>The authors compared the sample of articles derived based only on the search term “open innovation” with the sample obtained from all four keywords. These two datasets produce comparable results. Due to length restrictions and the similarity of the results, only the results of the full sample are reported.

<sup>5</sup>The sample of 321 focal articles does not include books such as Chesbrough’s (2003c) seminal book. The search consciously excluded books from the core sample of 321 focal articles for three reasons: first, the inclusion of books and book chapters into databases such as Scopus and Web of Science is not consistent and reliable. As a result, bibliometric studies tend to exclude books. Second, unlike journal articles, books do not go through a rigorous editorial review process. Including them may hence impact the quality of the data and results. Third, machine-readable PDF or Word files of the full text content required by the text-mining software are not easily retrievable for books. Although books and book chapters are not part of the initial focal sample, it is important to note that they become part of the co-citation analysis, which is based on references of the focal articles. This process is in line with previous bibliometric studies such as Dahlander and Gann (2010).

Based on the initial sample of 321 focal articles, three additional lists of publications were then created, which are also used for the analysis: (1) 17,286 references (10,259 unique publications) of the 321 focal articles, (2) a list of 4190 publications that cited the 321 focal articles (using the Scopus in-built “cited by” function), and (3) 290,090 references (116,633 unique publications) to these 4190 publications.

### *Co-Citation and Text Mining Methods*

First, to analyze the structure and theoretical foundations of OI this study uses co-citation analysis, which is a popular method applied across different management disciplines; for example, innovation (e.g., Durisin, Calabretta, and Parmeggiani, 2010), international business (e.g., Acedo and Casillas, 2005), and business ethics (e.g., Calabretta, Durisin, and Ogliengo, 2011). Co-citation analysis is based on the idea that citations are manifestations of otherwise often invisible relationships among authors, ideas, and communities (Gmür, 2003; Small, 1973). Thus, co-citation analysis measures the frequency with which two publications are cited together to provide an indicator of the affinity and proximity between them (White and Griffith, 1981), and can be used in conjunction with statistical tools to visualize patterns within a scientific discipline.

Three characteristics of co-citation analysis are pertinent to this study.<sup>6</sup> First, the co-citation analysis was conducted at the publication level, rather than the

<sup>6</sup>The advantages and disadvantages of the various approaches have been discussed in multiple review articles (Gmür, 2003; Osareh, 1996).

author level (Gmür, 2003), as it allows us to relate different contributions by one author to distinct schools of thought. Second, the proximity scores from the co-citation analysis are visualized through two complementary methods to provide a richer and more detailed representation of the connection between publications. In a first step, the analysis uses the proximity scores from the co-citation analysis to create a network graph (using Gephi software). Here, the connections between publications are based on the number of co-citations; the distances between any publications are approximated by the path length; and the size of the publication bubble reflects the number of citations for underlying publications. Then, the analysis uses the “Louvain” grouping algorithm<sup>7</sup> based on the network structure, to identify clusters of related publications. Third, the analysis was performed at the level of the references to examine the theoretical foundations and research streams within OI literature. Different to previous research, however, this study also applies the co-citation logic at the level of the references of the publications that cite the focal articles. This approach allows us to analyze how OI research is diffused within the wider literature.

When conducting co-citation analysis, it is important to note that not all references within a publication are equally important, and citations can be quite unrelated in a given article. While a sufficiently large sample reduces the random “noise” inherent in citation patterns (Schildt, Zahra, and Sillanpää, 2006), references remain proxies for concepts influencing a publication. To overcome these disadvantages and to provide a detailed analysis of the concepts underlying publications, the textual content of the focal articles is analyzed through unstructured ontological discovery.

Text mining is a form of unstructured ontological discovery that provides detailed conceptual insights by shifting the level of analysis from authors and their citations to the actual words used by authors to provide a systematic, unbiased, and content-driven review of the literature (Biesenthal and Wilden, 2014). To do so, this study uses the textual data mining software Leximancer 4.0, a valuable tool for narrative inquiry of a research area (Sowa, 2000; Stubbs, 1996).<sup>8</sup> The underlying assumption is that words are defined by the context within which they occur, and words that co-

occur reflect categories (i.e., concepts) with specific meanings. Leximancer extends beyond simple coding as it bootstraps an expanded list of related terms that signify a concept from the text data. Machine-based concept identification has been found to exhibit close agreement with expert judgment (Campbell et al., 2011; Rooney, 2005). It is considered suitable for sophisticated exploratory research as it exhibits high reliability and reproducibility of concept extractions and thematic clustering, without the problems of expectation biases inherent in manually coded text analysis or expert-based systematic reviews.

Leximancer applies a Bayesian learning algorithm to identify: (1) the most frequently used concepts within a body of text and, more importantly, (2) the relationships between these concepts. Thus, this approach systematically reveals key concepts within the OI paradigm defined up front by using a small number of seed words from the text (thematic analysis) and how they are linked with each other based on the frequency and co-occurrence of words within their contexts (semantic analysis). It therefore allows examination of concepts (i.e., common text elements) and themes (i.e., groupings of uncovered concepts) (Mathies and Burford, 2011).

The outputs of the Leximancer software are so-called “maps of meaning.” Leximancer first generates a thesaurus of words that are closely related to a concept (dots in Figures 3–5) to define its content. Concepts are more than simple key words—they are collections of words that carry related meaning (Campbell et al., 2011). Relationships between concepts are then identified and aggregated into themes (circles in Figures 3–5).<sup>9</sup> The importance of themes is shown through both the color of the circles (brighter circles are more important) and their size (the circle size indicates how many concepts have been clustered together to form a given theme). The distance between concepts on the “maps of meaning” show how closely the concepts are related. Accordingly, concepts that are strongly related semantically will be mapped closely together (Campbell et al., 2011; Rooney, 2005). Not only does the presence of a concept (i.e., its frequent occurrence in the text) carry meaning, but also its absence. That is, it is potentially indicative of OI research if an important concept does not occur often enough and is not associated with other concepts (Liesch et al., 2011). In sum, Leximancer helps decipher and visualize the structure of complex textual

<sup>7</sup>See Blondel, Guillaume, Lambiotte, and Lefebvre (2008) for a detailed description.

<sup>8</sup>For a more detailed description of the underlying algorithm and the process that Leximancer follows, please see Liesch, Håkanson, McGaughey, Middleton, and Cretchley (2011) and Smith and Humphreys (2006).

<sup>9</sup>Words such as “authors,” “example,” “use,” etc. were deleted from the text so as to not bias the creation of concepts and themes.

**Table 2. Top 15 Most-Cited Focal Articles and Their References**

Rank	Citations	Focal articles	Rank	Citations	References
1	843	Laursen and Salter (2006)	1	180	Chesbrough (2003c)
2	692	Chesbrough (2003a)	2	115	Cohen and Levinthal (1990)
3	339	Huston and Sakkab (2006)	3	97	Laursen and Salter (2006)
4	318	Chesbrough and Crowther (2006)	4	72	Chesbrough (2006a)
5	267	Dahlander and Gann (2010)	5	57	Lichtenthaler (2008)
6	264	Laursen and Salter (2004)		57	Chesbrough and Crowther (2006)
7	248	Enkel, Gassmann, and Chesbrough (2009)		57	March (1991)
8	235	Van De Vrande et al. (2009)	8	56	Chesbrough (2003a)
9	228	Sawhney, Verona, and Prandelli (2005)		56	von Hippel (1988)
	228	Caloghirou, Kastelli, and Tsakanikas (2004)	10	53	Teece (1986)
11	224	Perkmann and Walsh (2007)	11	50	Gassmann (2006)
12	216	West and Gallagher (2006)	12	49	von Hippel (2005)
13	215	Ritter and Gemunden (2003)	13	47	Chesbrough, Vanhaverbeke, and West (2006)
14	201	Dodgson, Gann, and Salter (2006)	14	43	Huston and Sakkab (2006)
15	197	Piller and Walcher (2006)	15	41	Arora, Fosfuri, and Gambardella (2001)
	197	Chesbrough and Appleyard (2007)			

data of the type used in scholarly research. Thus, it appropriately complements citation-based analysis in young fields such as OI where there are a limited number of potentially citable sources and there is a lack of consensus as to what underlies the domain.

## Results

### *Citation and Co-Citation Analysis*

Table 1 shows that the focal OI articles have mainly been published in innovation journals, with *Management Decision* and *California Management Review* being the only non-innovation-centric journals in the Top 10 outlets. The other few management journals (e.g., *Management Science*) used by researchers to disseminate their findings only feature further down the list. Marketing and engineering journals are absent from the Top 15 outlets. This finding is of concern as it indicates that OI research is a rather closed affair, limiting itself from influencing external research fields. The pattern is not too different when looking at the journals of the citing publications, which mainly comprise innovation journals, and only a few management, marketing and engineering journals, although the breadth of fields is slightly wider (e.g., *European Planning Studies*).<sup>10</sup>

Table 2 shows the most influential publications in the field of OI and, by listing the most-cited references of the focal articles, its historical roots. These referen-

ces of the focal articles also form the basis of the network-based co-citation analysis presented in Figure 1. The work of Laursen and Salter (2006) is the most cited focal article followed by the seminal article by Chesbrough (2003a) (Table 2).<sup>11</sup> These are followed by Huston and Sakkab (2006) and Chesbrough and Crowther (2006). Other publications that have been influential in shaping the field of OI cover a variety of topics including R&D collaboration (Perkmann and Walsh, 2007), external knowledge integration (Caloghirou, Kastelli, and Tsakanikas, 2004), open source software (OSS) (Henkel, 2006; West and Gallagher, 2006), idea contests (Piller and Walcher, 2006), OI in SMEs (Van De Vrande et al., 2009), and industrial dynamics of OI (Christensen, Olesen, and Kjær, 2005).

Among the references (that is, the intellectual roots) of the focal articles, Chesbrough (2003c) is most cited (Table 2). It is also clear that the majority of the focal articles cite publications belonging to the OI field. Absorptive capacity (Cohen and Levinthal, 1990), exploration and exploitation (March, 1991), and user innovation (von Hippel, 1988) are the only research domains external to OI that appear in the Top 15 citation statistics. This indicates that OI research draws more heavily from within rather than across fields.

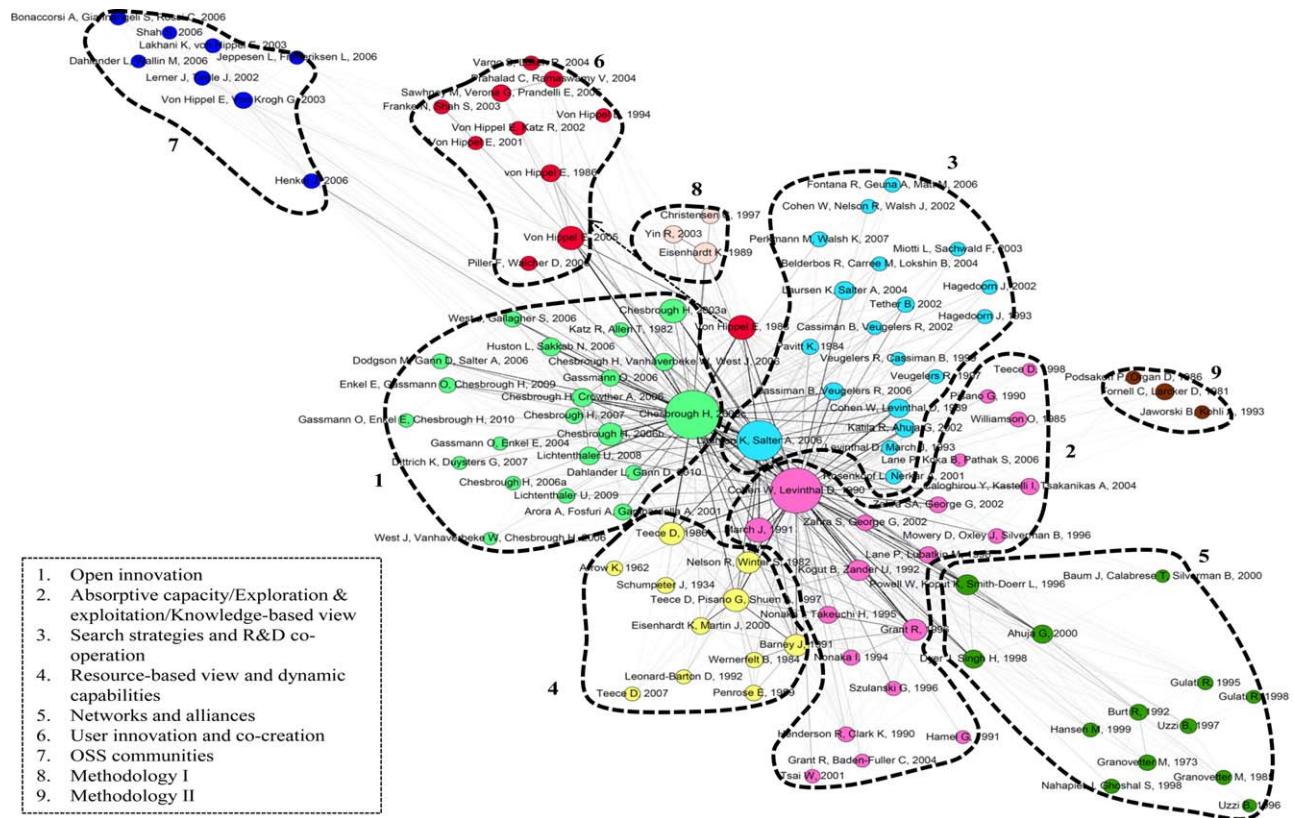
To delve deeper into the intellectual roots of OI, a co-citation network of the references of the focal articles was mapped (Figure 1). The network reiterates the importance of Chesbrough's (2003c) seminal book.

<sup>10</sup>The term "open innovation" may not be used in areas such as marketing, where the terms "customer engagement" or "co-creation" may be more common, thus leading to a possible sample bias. However, the fact that little reference to core authors of these fields exist in the (co-)citation results of the focal OI articles is an indication that these related areas of research are indeed developing independent of each other.

<sup>11</sup>Exceeding both these publications is, not surprisingly, the seminal book by Chesbrough (2003c) with 2495 citations. The book is not included in the focal publications (Table 2 left column) but features in the references (Table 2 right column) and also in Figures 1 and 2.







**Figure 2. Dispersion of Open Innovation Concepts**

Note: To increase readability, this study only shows publications with more than 75 citations, a degree range >3, and a co-citation strength >20. Publication size indicates number of citations received, connections between publications are co-citation linkages, and the darkness of connections denotes the number of co-citations (darker = more co-citations). [Color figure can be viewed in the online issue, which is available at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]

Levinthal, 1990; Zahra and George, 2002), exploration and exploitation (March, 1991), and knowledge-based view (e.g., Kogut and Zander, 1992; Nelson and Winter, 1982) form a cluster that OI research is frequently cited with. The work of Cohen and Levinthal (1990), in particular, is closely linked with Chesbrough’s (2003c) seminal work. The OI cluster is also strongly associated with research on external search strategies (Laursen and Salter, 2006; Rosenkopf and Nerkar, 2001) and R&D cooperation (Cassiman and Veugelers, 2002; Perkmann and Walsh, 2007). Specifically, Laursen and Salter (2006) is central and often used together with Chesbrough (2003c). Relative to these two research domains, the literature on resource-based view and dynamic capabilities (e.g., Penrose, 1959; Teece, Pisano and Shuen, 1997; Wernerfelt, 1984) appears less connected to the OI cluster. The resource-based view and dynamic capabilities cluster, in fact, has stronger linkages with the work on absorptive capacity, exploration and exploitation, and knowledge-based view than with core OI research.

Similar to the co-citation network (Figure 1), the OSS communities cluster is separate and less connected to other clusters. Again, although von Hippel’s (1988) seminal work on user innovation is close to the core of the network, later research in the fields of user innovation (Piller and Walcher, 2006; von Hippel, 2005), co-creation (Pralhad and Ramaswamy, 2004; Sawhney, Verona, and Prandelli, 2005), and user-centered OSS communities (e.g., Henkel, 2006; Lakhani and von Hippel, 2003; von Hippel and von Krogh, 2003) are distant and dissociated from OI research. Very few contributions (e.g., West and Gallagher, 2006) seem to be connecting OI researchers with scholars investigating the user and community aspects of OI. Powell, Koput, and Smith-Doerr (1996) bridge the networks and alliances literature with OI research, yet this cluster appears fairly detached within the co-citation network, meaning that there is scope to better integrate networks and alliance theories with OI research. However, note that the network and alliances cluster is more strongly linked with the work on



absorptive capacity, exploration and exploitation, and knowledge-based view. Additionally, the analysis uncovers two methodology-oriented clusters—one focussed on qualitative methods such as case studies (e.g., Eisenhardt, 1989; Yin, 2003) and the other on quantitative methods such as structural equation models (e.g., Fornell and Larcker, 1981).

### *Text Mining*

The (co-)citation analyses revealed that the main focus of OI research remains within the field. Although OI research seems to be connected with other mature fields, it has not yet fully integrated theories from these related research streams. In the following, this study uses text mining to systematically decipher key concepts and themes that existing OI literature has focused on.

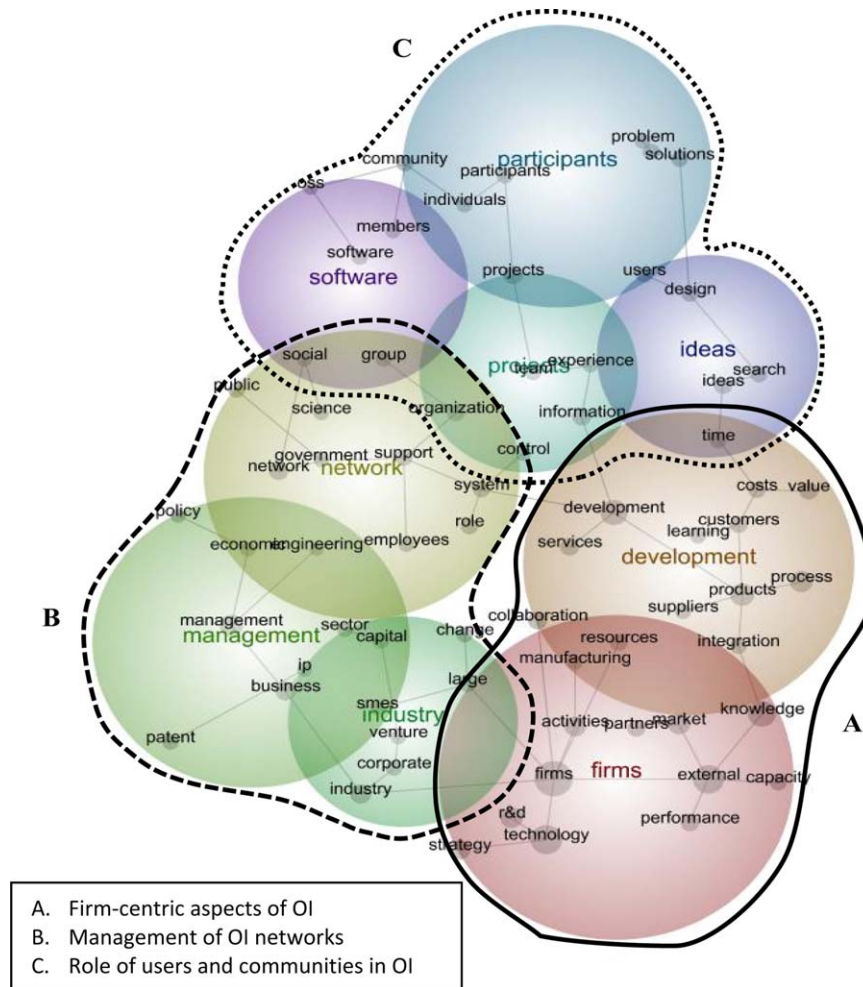
*Focal articles.* First the complete sample of 321 focal OI articles was analyzed (Figure 3). By interpreting the semantically closely related themes (and concepts) and reading contextual text samples (from the focal articles) that form the themes, this study identifies three areas of focus in OI research: (1) firm-centric aspects of OI, (2) management of OI networks, and (3) role of users and communities in OI.

Research on the *firm-centric aspects of OI* has received the most attention (note Area A is in red color). The focus here is on investigating the role of knowledge, technology, and R&D in collaborative development from the perspective of the firm engaging in OI (note the concepts “knowledge,” “technology,” “R&D” belong to the *firms* theme which is closely connected to “collaboration” in the *development* theme). As initial conceptualizations of OI were centered on how firms can expand their boundaries and collaborate with external entities for technology transfer and knowledge exchange (Chesbrough, 2003c, 2006a; Gassmann and Enkel, 2004), research has mainly investigated the organization and implementation of OI at the firm level (e.g., Chiaroni, Chiesa, and Frattini, 2011; Dahlander and Piezunka, 2013; Laursen and Salter, 2006; Van De Vrande, de Jong, Vanhaverbeke, and de Rochemont, 2009). A closer look at text excerpts surrounding these themes and concepts reveals that studies have focused on how firms strategically seek complementary resources through R&D alliances and technology partnerships, and collaboratively develop with suppliers, customers, and partners. Research in this area includes technology sourcing and

integration, as well as development and out-licensing (e.g., Chesbrough and Crowther, 2006; Parida, Westerberg, and Frishammar, 2012). The emphasis here is also on the knowledge exploration and exploitation processes. Many studies draw on the notion of absorptive capacity to investigate how firms can best develop capabilities for search and acquisition of knowledge and technology for OI (e.g., Cassiman and Veugelers, 2006; Hughes and Wareham, 2010).

*Management of OI networks* is a theme that has attracted limited research focus (note Area B is in green color). Management of industry networks through corporate ventures and spinouts, and IP and patents for businesses (e.g., Seldon, 2011; Vanhaverbeke, Van de Vrande, and Chesbrough, 2008) has received some attention (note *industry* is a theme that is closely related to *management*, with “corporate,” “venture,” “IP,” “patents,” and “business” as key concepts). The focus on institutional networks addressing the role of the public sector, national and regional systems of innovation, and government policy-making on OI outcomes (e.g., Bodas Freitas, Geuna, and Rossi, 2013; Lee, Hwang, and Choi, 2012) is relatively less (note “public” and “policy” are only peripheral concepts within the green *network* and *management* themes). Discussion on strategy seems restricted to R&D and technology-related strategies at the firm level (note “strategy” is a peripheral concept connected only to “technology” and “R&D” within the *firms* theme); for example, the implementation of strategic alliances and partnerships in firms (e.g., Chiaromonte, 2006; Han et al., 2012). Very few studies have paid attention to wider strategic management issues associated with OI networks such as the creation of sustainable business models (e.g., Chesbrough and Schwartz, 2007; Chesbrough, 2007), and capture of value through appropriability regimes and governance mechanisms (e.g., Afuah and Bogers, 2016; Bogers and West, 2012) (note “strategy” is not directly linked to any concept within the *management* or *network* themes). Research focus on social relationships ensuing between partners in OI networks (e.g., Huggins, 2010) also appears to be limited (note “social” is only a peripheral concept within the *network* theme).

The *role of users and communities in OI* as a research theme has received relatively little attention (note Area C is in blue color), despite being regarded as topical (Baldwin and von Hippel, 2011; Bogers and West, 2012). Although there is significant discussion on collaborative development with value chain partners such as suppliers and customers (note



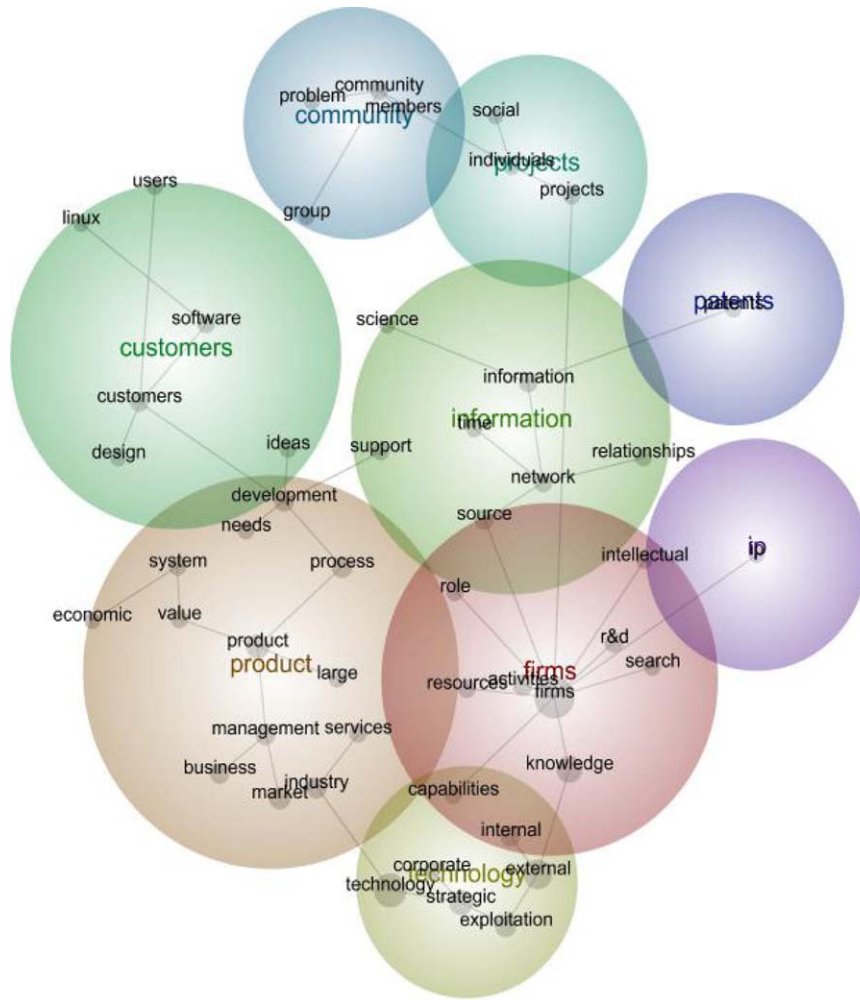
**Figure 3. Focal Articles**

[Color figure can be viewed in the online issue, which is available at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]

“collaboration,” “suppliers,” and “customers” are core concepts within the *development* theme), much less attention has been paid to individual users as innovators, barring few studies looking at the incorporation of user ideas in new product design and development (e.g., Fuller et al., 2009) (note “users” is only a peripheral concept within the *ideas* theme). There is also little focus on the role of communities (and their members) as participants in OI, with only some researchers (e.g., Ebner, Leimeister, and Krcmar, 2009; Füller, Matzler, and Hoppe, 2008) focusing on this topic (note “community” and “members” are peripheral concepts within the *participants* theme). The limited interest in community-based innovation is mainly restricted to the context of OSS projects (e.g., Dahlander and Wallin, 2006; Lakhani and von Hippel, 2003) (note “community” is linked with “OSS” in the *software* theme). A closer analysis of the text in this

context shows that researchers have focussed on profit appropriation and benefit accrual despite “free-revealing” of ideas and information in OSS projects through, for instance, a private-collective model (von Hippel and von Krogh, 2006) or selective-revealing strategies (Henkel, 2006).

*Differences between early and current research.* In the next step, the focal articles were separated into two time periods: 2003–2008 (55 articles) and 2009–2013 (266 articles) to investigate how the concepts and themes of more contemporary articles have evolved from the early foundational articles, and thus how the focus of OI research has diversified. In the earlier time period (Figure 4), OI research had a strong focus on *firm-centric aspects of OI* (note the red color). Technology is also an important theme revealing that attention has been paid to how firms leverage



**Figure 4. Time Period 2003–2008 (55 articles)**

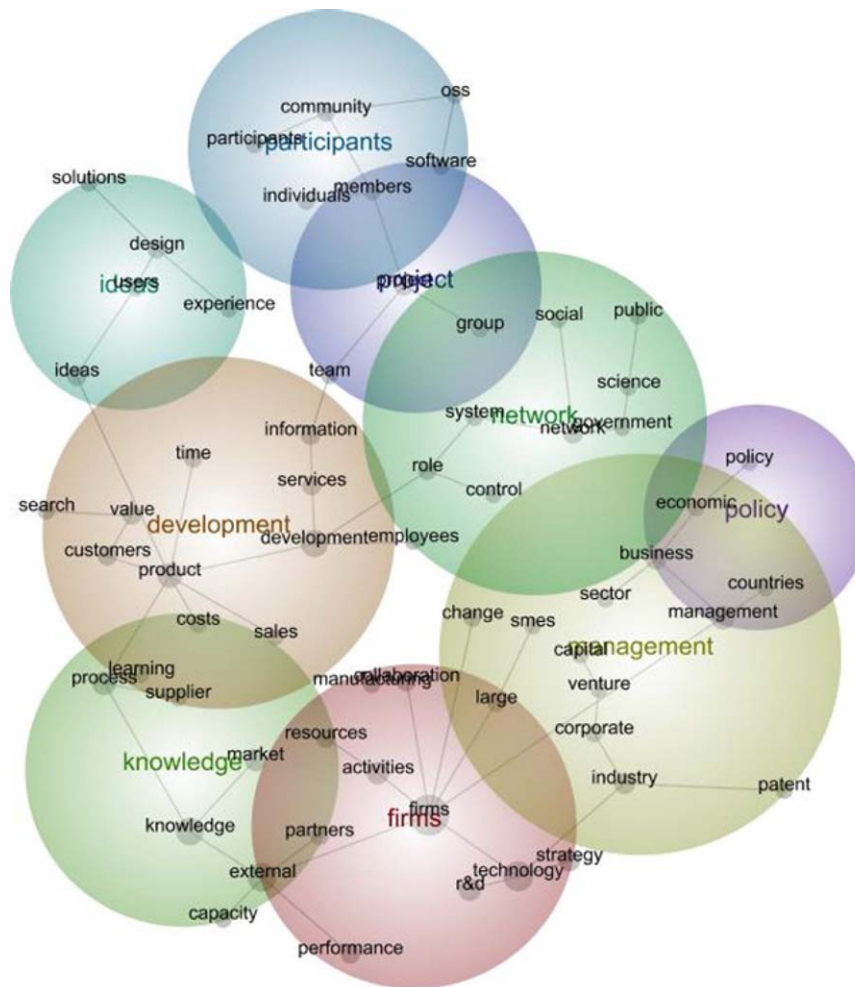
Note: Dots represent concepts that are collections of words which carry related meaning, and circles represent themes that are an aggregation of pertinent concepts. The *importance* of themes is shown through both the color of the circles (brighter circles = more important) and their size (larger size = more concepts have been clustered together to form a given theme). The *distance* between concepts denotes how closely the concepts are related. [Color figure can be viewed in the online issue, which is available at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]

technology sourcing and licensing as a strategic means of facilitating inflow and outflow of knowledge (e.g., Chesbrough, Vanhaverbeke, and West, 2006; Gassmann and Enkel, 2004). A firm-centric perspective has been applied to study the role of internal and external resources and capabilities in exploring and exploiting knowledge and technology (e.g., Dittrich and Duysters, 2007; Lichtenthaler, 2007). This research area also focusses on R&D alliances, innovation markets, networks, IP, and patenting for implementing OI (e.g., Vanhaverbeke, Van de Vrande, and Chesbrough, 2008; West and Gallagher, 2006).

While there is some focus on the role of information, knowledge (and other resource) exploitation, and transfer across networks, there appears to be no attention paid to

organizational learning (note the absence of “learning” as a concept). There is some focus on involving customers for new product ideas, design, and development (e.g., Piller and Walcher, 2006), yet users as innovators have received relatively less attention (note “users” is only a concept while *customer* is a theme). Community-based innovation had not yet emerged as a mainstream practice, and only few studies have investigated the role of communities in OI projects and the ensuing social relationships between community members.

Of the total 321 articles in the sample, 266 articles (83%) belonged to the later time period (2009–2013), confirming that research on OI has burgeoned over the last five years. Figure 5 shows that recent research retains a firm-centric perspective in investigating the



**Figure 5. Time Period 2009–2013 (266 articles)**

Note: Dots represent concepts that are collections of words which carry related meaning, and circles represent themes that are an aggregation of pertinent concepts. The *importance* of themes is shown through both the color of the circles (brighter circles = more important) and their size (larger size = more concepts have been clustered together to form a given theme). The *distance* between concepts denotes how closely the concepts are related. [Color figure can be viewed in the online issue, which is available at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]

technology and R&D aspects of OI (e.g., Veugelers, Bury, and Viaene, 2010), but with explicit attention to the related knowledge exchange processes (note that *knowledge* is a new theme). Absorptive capacity is used as a lens to investigate how firms can best search and integrate external knowledge for OI (e.g., Lichtenthaler and Lichtenthaler, 2009; Spithoven, Clarysse, and Knockaert, 2011). There is an emphasis on collaboration of firms with value chain stakeholders (suppliers, customers, partners) as a means of leveraging external knowledge, technology, and resources for new product development (e.g., Clausen, 2013; Obal and Lancioni, 2013). Discussion on firm capabilities for OI, however, seems to have waned (note “capabilities” no longer appears as a concept).

*Management* emerges as a new theme, indicating an increased attention to managing OI through, for example, corporate venturing, strategic alliances, patent, and IP portfolio management (e.g., Li and Kozhikode, 2009; Rohrbeck, 2010). With *network* appearing as a new theme, OI research seems to be expanding from the firm- to the network-level (e.g., Rampersad, Quester, and Troshani, 2010) to focus more on how the systemic processes (e.g., Crespín-Mazet, Goglio-Primard, and Scheid, 2013; Michelfelder and Kratzer, 2013) and social relationships (e.g., Huggins, 2010) across OI networks can be managed. Moreover, the role of institutional networks, public sector, national and regional systems of innovation and government policy making is also emerging into a pertinent topic

in OI (note the appearance of *policy* as a theme and “government” and “public” as concepts) (Agarwal et al., 2014; Bodas Freitas, Geuna, and Rossi, 2013; Lee, Hwang, and Choi, 2012). A key difference between the two time periods is the declining focus in later research on co-ideation and co-design with customers for OI (note *customer* is no longer a core theme comprising “ideas” and “design” as concepts). Customer co-creation and service-related aspects of OI are not prominent topics in recent research.

Discussion on strategy is still limited to the firm-level implementation of R&D alliances and technology partnerships, while the strategic development and management of open business models is not yet focussed on. Accordingly, the cost implications of integrated development with suppliers and customers and the performance effects of OI (e.g., Kim and Park, 2010) emerge as research topics (note that “cost” and “performance” appear as new concepts). Nevertheless, focus on the measurement of value capture through OI remains limited (West and Bogers, 2014). With “learning” occurring as a concept, the emergent attention to organizational learning processes involved in OI is evident (e.g., Chate-nier et al., 2009), albeit with potential to improve.

Discussion on incorporating user ideas for design and development of new products and services is relatively more prominent in recent research (note that *ideas* is a new theme with “users” and “design” as central concepts), yet there is scope to improve (note the blue color). Studies on OI communities and the role of participant interactions and behavior (e.g., Fichter, 2009) remain sparse. The little research in this space is also mainly limited to the context of OSS projects (e.g., Stam, 2009), revealing a lack of focus on other user communities and how to manage firm-hosted communities.

## Discussion

Based on the text mining results this study identifies three distinct areas in OI research to-date: *firm-centric aspects of OI*; *management of OI networks*; and *role of users and communities in OI*. These areas align well with the research clusters identified through co-citation analysis. Table 3 provides a snapshot of the key findings from text mining and co-citation analysis, and also shows how the two sets of results complement each other.

Findings from text-mining clearly indicate that researchers have paid predominant attention to the *firm-centric aspects of OI*, with a particular focus on knowledge, technology, and R&D from the viewpoint of the

innovating firm (note on Table 3 that these concepts have strong research emphasis). OI was initially conceptualized as a way for firms to open up their boundaries to leverage inflows and outflows of knowledge, so as to internally boost and externally exploit innovation (Chesbrough, 2003c; Chesbrough, Vanhaverbeke, and West, 2006; Gassmann and Enkel, 2004). Researchers have since tended to adopt a firm-driven approach to investigate how the focal firm adopts OI, conditions that enable this adoption, and how OI impacts performance (e.g., Dahlander and Piezunka, 2013; Van De Vrande, de Jong, Vanhaverbeke, and de Rochemont, 2009). Table 3 further presents how the co-citation results tie in with relevant themes and concepts in this area. OI studies have mainly used knowledge theories namely absorptive capacity, and exploration and exploitation as theoretical lenses to understand knowledge and technology acquisition of the focal firm. Further, the literature on search strategies and R&D co-operation have served to investigate the focal firm’s external search and collaborative development mechanisms for OI. As discussed earlier, the resource-based view and dynamic capabilities have been drawn on only to a limited extent also from a firm-centric perspective (Lichtenthaler and Lichtenthaler, 2009) mainly to investigate how the focal firm can develop resources and capabilities for knowledge exchange and technology transfer (note on Table 3 that the research emphasis on “capabilities” has fallen significantly in the recent time period; see also the discussion on Figures 1 and 2).

The other two areas identified through text mining remain relatively under-researched. Accordingly, there is lack of focus on investigating aspects related to *OI networks*, and in understanding the role of *users and communities* as external sources of innovation. In sync with these findings, the co-citation results also reveal a weak integration of theories and concepts on networks and alliances, user innovation and co-creation, and OSS communities into mainstream OI research (Table 3). Furthermore, OI research seems confined to innovation-specific journals, thereby exerting limited influence on other fields. Combining these insights, the remainder of this section derives key research gaps which serve as directions for future investigation.

## Avenues for Future Research

Although scholars have suggested that OI is an umbrella concept with diverse intellectual roots (e.g., Dahlander and Gann, 2010; Huizingh, 2011; Remneland-Wikhamn





**Table 4. Research Gaps and Future Research Directions**

	Research Gap	Potential Research Questions	Theories / Concepts that Can Be Applied
1	Develop a more comprehensive understanding of OI by including diverse perspectives <i>The network perspective</i>	How can collaborative learning processes be managed across open innovation networks? What is the role of network structure and strength of social ties between network entities in open innovation outcomes? What relational capabilities and governance mechanisms drive value creation and capture in open innovation networks?	Network learning (e.g., Powell et al., 1996; Ahuja, 2000) Alliance learning (e.g., Kale and Singh, 2007) Social network theory (e.g., Burt, 1992; Uzzi, 1997) Alliance-portfolio management (e.g., Aggarwal & Hsu, 2009; Wang and Rajagopalan, 2015)
	<i>The user perspective</i>	How do users co-construct identities through their engagement in the open innovation process? How can user identity formation act as an intrinsic motivator for users to co-innovate with firms? What is the role of users' motivation in shaping their participation behavior in open innovation activities?	Identity theory (e.g., McAdams, 1996, 2006; Brown, 2006; Watson, 2009; Kleine III, Keine, and Kernan., 1993; Mittal, 2006) User innovation concepts (e.g., von Hippel, 1986, 1988, 2005; Piller and Walcher, 2006)
	<i>The community perspective</i>	How do open innovation communities relate to the canonical procedures and rules of engagement laid by the host firm? What kind of self-governing practices emerge through relational participant interactions in open innovation communities? How do communal dynamics feed back into organizational practices of open innovation?	Communities of practice (e.g., Brown & Duguid, 1991; Lave and Wenger, 1991; Wenger, 1998) Social practice theory (e.g., Reckwitz, 2002; Schatzki, Knorr-Cetina, and von Savigny, 2001; Gherardi, 2008)
2	Direct increased attention to open strategy formulation and implementation	How can firms align open business models with the outcomes of value creation and value capture? What are the collective processes of developing open strategy across open innovation networks? What organizational capabilities are required for the sustained implementation of open strategy?	Business model innovation (e.g., Zott & Amit, 2010) Strategic innovation and value capture (e.g., Afuah, 2009; Afuah and Tucci, 2013) Strategy-as-practice (e.g., Whittington, 1996; Jarzabkowski and Spee, 2009) Dynamic capabilities (e.g., Eisenhardt and Martin, 2000; Teece et al., 1997)
3	Enhance service focus and conceptualize “open service innovation”	How can firms leverage customer resources to co-create value across various stages of open service innovation? How can service value networks be structured to enable open service innovation? What kind of collaborative processes are involved between the firm and customers in open service innovation?	Service dominant logic (e.g., Vargo and Lusch, 2004; Lusch and Vargo, 2006) Service (eco-)system (e.g., Vargo and Akaka, 2012) Co-creation (e.g., Prahalad and Ramasamy, 2004; Sawhney et al., 2005) Service innovation concepts (e.g., Miles, 1993; Magnusson, Matthing, and Kristensson, 2003)

and Wikhamn, 2013), the results clearly show that extant OI research has mainly drawn from within the field with its focus restricted to specific OI topics. Apart from select knowledge-based theories, that is, absorptive capacity and exploration and exploitation, OI researchers have not yet sufficiently applied other theoretical perspectives used in management, marketing, and organizational behavior. Doing so can help address a broader spectrum of OI issues to generate a more holistic and robust understanding of OI, and thus advance the research domain. Accordingly, this discussion presents three fertile research avenues along with potential research questions corresponding to these, and suggests relevant organizational, management, and marketing theories and/or concepts that may be applied to explore these questions (Table 4). Although beyond the scope of this article, such integration of ideas also paves the way for OI concepts to enrich research in these external domains, in turn enabling OI to have a more significant impact on the wider business community.

#### *Develop a More Comprehensive Understanding of OI from Diverse Perspectives*

As discussed, the results suggest that OI research has predominantly adopted a firm-centric perspective. However, to enable a holistic examination of OI, there is a need for analyses from various perspectives and to integrate alternate theories from outside the OI field.

*The network perspective.* Studies on OI networks predominantly addresses how a focal firm can leverage external partners, with an emphasis on the role of information, knowledge, technology, and (other resource) exploitation and transfer across the value network (e.g., Chesbrough and Schwartz, 2007; Huggins, 2010). Relatively fewer studies explore topics related to the management of OI networks (Table 3; see also Figure 3). Accordingly, limited research brings a network-wide focus, where the entire network forms the level of analysis, to address how collaborative, systemic aspects of OI can be managed (e.g., Rampersad, Quester, and Troshani, 2010). There also seems to be little integration of (social) network and alliance theories into OI research (note that the cluster of network and alliance scholars is distant within the co-citation network in Figures 1 and 2, and the concept “social” appears within a theme in blue and is not strongly connected to other concepts/themes in Figure 3). Yet, the literature on networks and strategic alli-

ances can help explore key under-researched areas on the management of OI networks. Network learning (Powell et al., 1996), alliance learning (Kale and Singh, 2007) and individual inventor collaboration (Almeida, Hohberger, and Parada, 2011; Hohberger, Almeida, and Parada, 2015) offer useful lenses to examine the collaborative learning processes across OI networks, which hitherto have received limited attention in OI research (see Figure 4 and 5). Integration of (social) network theories (e.g., Burt, 1992; Powell, 1990; Uzzi, 1997) into OI research can shed light on the role of network structure, size, and density in OI (e.g., Afuah, 2013; Schilling and Fang, 2014), and the embeddedness of learning and innovation in social ties, trust, and reciprocity within the OI network (e.g., Muthusamy and White, 2005). The literature on alliance-portfolio management can be drawn on to understand how relational capabilities (e.g., Sarkar, Aulakh, and Madhok, 2009) and governance mechanisms (e.g., Aggarwal and Hsu, 2009; Lee and Cavusgil, 2006) can be leveraged to balance value creation and value capture in OI networks (e.g., Afuah and Bogers, 2016; Wang and Rajagopalan, 2015). Finally, studies on international alliances (e.g., Hohberger, 2014; Narula and Duysters, 2004) can be useful in examining the benefits and challenges of international OI networks.

*The user perspective.* Findings from the textual analysis indicate that little attention has been paid to users as innovators in OI research (Table 3; see also Figure 3). The results of the co-citation analysis show that although user innovation scholars appear close to the core of the co-citation network, very few scholars (e.g., West and Gallagher, 2006) seem to have made the conscious effort to connect OI research with aspects of user innovation, indicating that this research stream has not been fully integrated with mainstream OI research (see Figures 1 and 2). Although interest in this area seems to have increased over the last five years (see Figure 5), there is scope for more research on the role of users as innovators and the management of the ensuing B2C relationships between the innovating firm and its users. This is consistent with the suggestions of key user innovation scholars (e.g., Baldwin and von Hippel, 2011). It is important to shift the level of analysis from the firm to the individual user, in order to understand user identities, motivation, and behavior while co-innovating with firms, and to gain insights into the processes of OI from the user perspective

(e.g., Füller et al., 2009). Innovation scholars (e.g., Bogers, Afuah, and Bastian, 2010) have called for a better integration of user innovation concepts with OI literature. Furthermore, alternate theoretical perspectives can also be adopted to better understand how users can be leveraged and managed as external sources of innovation. For example, theories of identity that have been successfully applied in management and organizational behavior (e.g., Brown, 2006; McAdams, 2006; Watson, 2009) and marketing (consumer behavior) fields (e.g., Bhattacharya and Sen, 2003; Kleine III, Kleine, and Kernan, 1993; Mittal, 2006) can serve as a useful lens to explore the formation of user identity and motivation while engaging in OI activities. Such insights will enable firms to better engage and incentivize user innovators in the OI process.

*The community perspective.* The text mining results show that there is limited discussion on the role of communities in OI (Table 3; see also Figure 3). Consistent with this, the co-citation networks also reveal a weak integration of work on community-based innovation into mainstream OI research (see Figures 1 and 2). Emerging interest in this space is also mainly centered on OSS communities (see Figure 5) (e.g., Dahlander and Wallin, 2006; von Hippel and von Krogh, 2003). There is scope to further investigate how to engage other user communities and manage firm-hosted communities (e.g., Ebner, Leimeister, and Krcmar, 2009; Füller, Matzler, and Hoppe, 2008) to sustain community-based innovation outcomes. In line with West and Lakhani (2008) and Fichter (2009), there is a need for defining more clearly what an OI community is, identifying community-level constructs, and looking at communities (rather than firm/network) as the unit/level of analysis. Investigating OI from the perspective of non-firm actors such as communities serves to extend the hitherto firm-centric approach to OI research. This requires researchers to go beyond the traditional focus on dyadic interactions between firms to study the one-to-many relationships between firms and community members. For example, studies can examine how self-governing practices of the community engage with the canonical procedures and rules laid down by the host firm. Investigating the many-to-many C2C relationships and how these shape knowledge exchange and social dynamics in OI communities also form topical areas for future research. In this context, studies can look at how collective self-governing practices such as communal norms and rituals emerge

from iterative participant interactions. Sociological and organizational behavior theories such as “communities of practice” (Brown and Duguid, 1991; Wenger, 1998) and social practice theory (Gherardi, 2008; Schatzki, Knorr-Cetina, and von Savigny, 2001) may be drawn on to explore these relational aspects of community innovation (West and Lakhani, 2008).

### *Direct Increased Attention to OI Strategy Formulation and Implementation*

The analysis reveals that strategy discussion in OI research is largely limited to the firm-level implementation of R&D and technology strategies, with only a few studies focussing on wider concerns in OI strategy such as the creation of sustainable business models and the measurement of value capture (Table 3; note that in Figures 3 and 5 “strategy” is connected only with the concepts “R&D” and “technology,” and is completely dissociated from the concepts “business” and “value”). Co-citation results also show that core OI research is not closely linked with Chesbrough’s (2007) work on open business models (Figure 1). This is in sync with the findings of West and Bogers (2014) that research on business models of OI is still nascent, and has hitherto focused more on value creation rather than value capture. This insight is particularly important given Chesbrough’s (2003a) emphasis on the centrality of both business models and value capture to the concept of OI. To address this gap, OI research can draw from broader innovation and strategy literature on business model innovation (e.g., Zott and Amit, 2010), strategic innovation (e.g., Afuah, 2009), and value capture through innovation (e.g., Afuah and Tucci, 2013; Kang and Afuah, 2010).

Moreover, Chesbrough and Appleyard (2007) have introduced the concept of open strategy, pointing to the need for a new approach to business strategy that balances the creation and capture of value from open business models. As a next step, there is an opportunity for studies to develop open strategy as a framework to explore the strategic aspects of OI produced through network- (or community-) centric business models. The notion of open strategy can help examine how firms can better develop and deploy strategies that account for such collaborative business models, and yet capture value through appropriability regimes and governance mechanisms (Afuah and Bogers, 2016; Bogers and West, 2012). In this context, OI research can benefit from drawing on strategy-as-practice

(Whittington, 1996), developed as a social theory in strategic management (e.g., Jarzabkowski and Spee, 2009; Vaara and Whittington, 2012), to unpack the complex, collective processes of formulating open strategy across OI networks and communities.

Further, to successfully implement open strategy, organizations need to develop relevant capabilities at the individual, firm, and corporate levels. The dynamic capabilities perspective (Eisenhardt and Martin, 2000; Teece, Pisano and Shuen, 1997; Wilden, Devinney, and Dowling, 2016), currently applied only to a limited extent in OI research (see Table 3), is useful to explore how firms can sense, seize, and reconfigure complementary resources and relational capabilities across open business models so as to capture value through OI, especially when faced with environmental turbulence (Wilden and Gudergan, 2015). Moreover, the very process of transitioning from traditional to open business models calls for adjustments to a firm's idiosyncratic resource base; which, in turn, requires the development and deployment of dynamic capabilities (Dougherty and Dunne, 2011; Zott, Amit, and Massa, 2011). Finally, the growing work on managerial cognition and microfoundations of dynamic capabilities can help us understand how managers make open strategy-related decisions (Hodgkinson and Healey, 2011; Narayanan, Zane, and Kemmerer, 2011).

#### *Enhance Focus on Customer Co-creation and Conceptualize “Open Service Innovation”*

Customer co-creation and service-related aspects of OI has received limited research attention, despite being regarded as highly pertinent to today's networked and service-led environment (Randhawa and Scerri, 2015). While collaborating with customers for new product ideas, design, and development was a core theme of research in early OI research, the focus on customers appears to have waned in more recent research (Table 3; see also Figures 4 and 5). Moreover, OI in services is not a particularly dominant topic of research in either time period, calling for more focus in this area. This echoes the recent notion of “open service innovation” (Chesbrough, 2011a, 2011b), which reinforces that even manufacturers within an increasingly commoditized marketplace need to apply a service-oriented logic to innovation by collaborating with customers throughout the innovation process, other than partnering with other value network entities. In this context, there is scope to draw on service marketing

theories, and in particular to incorporate the concept of co-creation and the emerging service-dominant logic (Lusch and Vargo, 2006; Vargo and Lusch, 2004), to aid the conceptualization and theorization of open service innovation. For example, the service-dominant logic can be applied to understand how firms can leverage inputs from their customers to co-produce offerings and co-create value at all stages of open service innovation. Insights from service-(eco)system research (e.g., Vargo and Akaka, 2012) are useful to address the structural complexities associated with the distributed, multi-entity service value networks through which open service innovation emerges. The co-creation literature (e.g., Ramaswamy, 2009) can help shed light on the interactive, collaborative processes between the firm and customers in open service innovation. Integrating concepts from service innovation literature (e.g., Magnusson, Matthing, and Kristensson, 2003; Miles, 1993) into OI research can also support the proposed service focus in B2C and C2C contexts.

#### **Conclusion and Implications**

This study combined co-citation analysis and text mining of published OI articles to present a novel, systematic, and comprehensive review of the field. The results suggest that OI research is predominantly inward-looking and does not sufficiently draw from other external fields. Research also is largely confined to innovation-specific journals with a focus only on a select few OI issues, thereby exerting limited influence on the wider business community. Studies to date have predominantly focused on the firm-centric aspects of OI, investigating knowledge, technology, and R&D from the firm's vantage point. Incorporating network, user, and community perspectives present key avenues for future research to gain a more holistic understanding of OI. Other areas to which to direct attention include: investigating OI strategy formulation and implementation with a focus on open business models, open strategy, and associated value capture through OI; and understanding OI in the context of services through emphasis on customer co-creation and conceptualizing “open service innovation.” To address these gaps, organizational behavior (e.g., communities of practice), management (e.g., dynamic capabilities), and marketing (e.g., service-dominant logic) offer suitable theoretical lenses and/or concepts for OI researchers. Such an integration of OI with other intellectual

streams will aid researchers to more comprehensively capture the richness of the OI phenomenon. Although outside the scope of this study, this suggested amalgamation will also allow the OI concept to permeate into other research domains. This will help to address theoretical and empirical challenges in fields outside of OI, and thereby increase the impact of OI on the broader business community.

The resulting broader perspective on OI will ultimately benefit managerial decision-making. For example, integrating service-dominant logic into OI research will inform managers on how to better establish organizational conditions for value co-creation, such as an open service innovation orientation and culture, which treat external partners as integrated, active, and value creating. Insights from service-dominant logic will also provide managers with guidelines to better design OI processes for better collaboration across the entire value chain including customers, suppliers, and other partners. Furthermore, adopting a community of practice perspective will shed light on how managers can foster communities as external sources of innovation by addressing the social, interactive practices that underpin intra-community and firm-community relationships. Managers can draw on these insights to orchestrate community engagement and governance practices toward better firm-community collaboration, and thus spur the creation and capture of value through community-based OI. Finally, incorporating dynamic capability thinking into an OI framework will help managers to better identify market opportunities for OI and effect organization-wide business model reconfigurations to capture value from these opportunities. Implementing open business models requires high organizational responsiveness and broad market understanding particularly in highly dynamic environments.

Inevitably, this study is subject to limitations. Through the use of a systematic research methodology, this study reduced the bias often associated with traditional literature reviews and expert surveys. Nevertheless, the findings are influenced by the scope and nature of the underlying research design and methods. First, the restriction to certain keywords and/or journals while building the sample may have had an impact on the results. To minimize sampling bias, this study employed a rigorous sample selection procedure by choosing multiple keywords and a wide range of journals and articles belonging to all business domains. Second, the empirical results are a representation of existing research (published and in-press articles), and

exclude ongoing and not-yet-published debates (e.g., working articles and conference proceedings). Finally, as is the case with any bibliometric analysis, the results are the outcome of the algorithm employed by the analytic software. Hence a detailed methods description is provided for the reader. Additionally, to guide and strengthen the interpretation of the software-produced outputs, the research team read the contextual text excerpts and abstracts of the related articles/citations, thereby supplementing the objective examination of the literature with qualitative and interpretative analysis.

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