Journal of Strategy and Management

Outlining new product development research through bibliometrics: Analyzing
journals, articles and researchers
Nelson A. Andrade-Valbuena, Jose M. Merigo,

Article information:

Users who downloaded this article also downloaded:

(2018),"Twenty years of the Journal of Knowledge Management: a bibliometric analysis", Journal
of Knowledge Management, Vol. 22 Iss 8 pp. 1655-1687 <a href="https://doi.org/10.1108/
JKM-10-2017-0497">https://doi.org/10.1108/JKM-10-2017-0497

(2018),"Fifty years of the European Journal of Marketing: a bibliometric analysis", European Journal
of Marketing, Vol. 52 Iss 1/2 pp. 439-468 https://
doi.org/10.1108/EJM-11-2017-0853

For Authors

If you would like to write for this, or any other Emerald publication, then please use our Emerald
for Authors service information about how to choose which publication to write for and submission
guidelines are available for all. Please visit www.emeraldinsight.com/authors for more information.

About Emerald www.emeraldinsight.com

Emerald is a global publisher linking research and practice to the benefit of society. The company
manages a portfolio of more than 290 journals and over 2,350 books and book series volumes, as
well as providing an extensive range of online products and additional customer resources and
services.

Emerald is both COUNTER 4 and TRANSFER compliant. The organization is a partner of the
Committee on Publication Ethics (COPE) and also works with Portico and the LOCKSS initiative for
digital archive preservation.

Outlining new product development research through bibliometrics
Analyzing journals, articles and researchers

Nelson A. Andrade-Valbuena
School of Economics and Business, Universidad de Chile, Santiago, Chile, and
Jose M. Merigo
*Department of Management Control and Information Systems,
School of Economics and Business, Universidad de Chile, Santiago, Chile*

Abstract

Purpose – New product development (NPD) is a noteworthy field that has attracted the attention of scholars for its relevance for firm success. Based on bibliometric indicators and spatial distance network analysis, the authors outline the general structure overview of NPD research through the last 40 years of scientific production; identify and categorize key articles, authors, journals, institutions, and countries related to NPD research; identify and map the research subareas that have mostly contributed to the construction of NPD intellectual structure. The paper aims to discuss these issues.

Design/methodology/approach – The work uses the Web of Science Core Collection and the visualization of similarities viewer software. The analysis searches for all the documents connected to NPD available in the database. The graphical visualization maps the bibliographic data in terms of bibliographic coupling and co-citation.

Findings – The general NPD citation pattern evidences a construction of knowledge and learning, as evidenced in different subjects, such as biology or physics. Relevant contributions and contributors are highlighted as journals, articles, researchers, countries and institutions in overall NPD research and in its constituent subfields. Five subareas related to the NPD field based on journals and authors network are identified: marketing; operations and production; strategy; industrial engineering and operations; and management.

Originality/value – This paper contributes to the NPD literature by offering a global perspective on the field by using bibliometric data graphical networks, providing insights about the influence of individual actors and its contributions to build bridges between the different subfields of research in NPD.

Keywords Web of science, Bibliometrics, New product development, VOS viewer

Paper type General review

1. Introduction

Over the years, new product development (NPD) has become a key strategic issue for companies because it contributes to the firm's competitiveness and therefore to sustainability, measured in terms of profitability, growth and success (Calantone and Di Benedetto, 2000). The NPD literature explores the entire process of bringing to market tangible or intangible products (Calantone *et al.*, 1995). Due to its relatedness to innovation (Biemans *et al.*, 2010), research in this field has grown rapidly for the last 20 years, leading to efforts to understand tools, techniques and methods that can offer the firm some competitive advantages (Griffin, 1997). These efforts have generated substantial volumes of scientific material and academic information. For instance, a basic topic search in the Web of Science (WoS) database, limiting the request to the phrase "New Product Development" can lead to more than 3,000 academic products.

In recent years, researchers from many different domains and key areas have adopted bibliometric techniques, in order to categorize and rank the scientific material, to provide a general overviews of different fields, such as strategy (Nerur *et al.*, 2016), management (Gallardo-Gallardo *et al.*, 2015; Olavarrieta and Villena, 2012; Podsakoff *et al.*, 2008), entrepreneurship (Landström *et al.*, 2012; Servantie *et al.*, 2016), productions and operations management (Hsieh and Chang, 2009), innovation (Fagerberg *et al.*, 2012; Sakata *et al.*, 2013; Thongpapanl, 2012), sustainability (Franceschini *et al.*, 2016), natural resource accounting (Zhong *et al.*, 2016), decision making (Blanco-Mesa *et al.*, 2017; Yu *et al.*, 2016) and International Business (Sullivan *et al.*, 2011).

Bibliometric techniques inherit the benefits of objectivity from quantitative analysis enabling the construction of a systematic analysis that considers a study's relevance at different levels in any field. By examining authors, papers and journals through a combined analysis of useful objective measures such as citations, the number of publications and other information, bibliometric techniques allow us to categorize research and rank it depending on its weight to the discipline (Valenzuela *et al.*, 2017). Moreover, it can be helpful as a triangulation tool to validate inferences made by experts related to historical evolution and the intellectual structure of any field (Nerur *et al.*, 2008).

A difficulty of analyzing a multidisciplinary subject such as NPD is that it is deliberatively founded by different subfields which compound a dependent intellectual structure. For instance, when considering different models in NPD using contingency variables, a wide source of information from different fields emerge, such as strategy, marketing, operations management, innovation, engineering, etc. (Cooper and Kleinschmidt, 1995; De Brentani and Kleinschmidt, 2004; Carson *et al.*, 2006; Keller, 2001; Calantone *et al.*, 2003; Du *et al.* 2015). This lies on the facts that theoretical frameworks are built on knowledge shared with different subjects of study and disciplines that constitute a dependency relationship with those fields.

Through the use of bibliometric techniques and distance-based visualization of similarities (VOS) analysis, this paper seeks to extend our knowledge of NPD research by identifying the intellectual evolution of the field. The objective is to find key contributors and contributions and its impact from the last 40 years of research, outlining the most prominent and prolific based on the WoS database (WoS). More specifically, our goals are to find the general structure overview of NPD research through the last 40 years of scientific production; categorize key articles, authors, journals, institutions, and countries related to NPD research; identify the research subareas that have mostly contributed to the construction of the intellectual structure in NPD research; map the intellectual structure between the identified research subareas, determining the relationship between them by using VOS based on spatial distance analysis.

To reach these goals, we use a combination of bibliometric measures from the WoS database such as citations and number of papers, to get a general citation structure overview of the field. Second, we calculate some indices like the impact factor index and the H-index (Hirsch, 2005) to trace the historical influence and evolution of NPD research, and to categorize research output from individual scientific achievements. Finally we use a network structure of authors and journals based on the bibliometric mapping and clustering analysis approach utilizing the VOS-viewer software to identify the most prominent journals and authors whose contributions have allowed to build bridges between the different subareas of research.

Regarding goal (1), we find that the distribution of the production of NPD research material over time has followed an upper tendency of research, similar to the one that is showed in the WoS database. Moreover the historical evolution of the calculated impact factor index of all NPD papers published supports the relevance that NPD is gaining among the scientific community. The general NPD citation pattern evidences a construction of knowledge and learning, the result of which can be called leaders of the field, as evidenced in different subjects, such as biology, physics or computing.

With respect to goal (2), we find that the *Journal of Product Innovation Management* is the most prominent journal in the NPD field, followed by the *Strategic Management Journal*, *Journal of Marketing and the Journal of Management Science*. From different perspectives, several authors are of great significance to the NPD literature, such as Gary Lynn, Roger Calantone, Michael Song, Robert Cooper and Abbie Griffin.

Relating to goals (3) and (4), we identify three subareas related to the NPD field based on the journals network: marketing, operations and production, and strategy, which are lead by the *Journal of Industrial Marketing Management*, the *Management Science Journal*, and the *Creativity and Innovation Management* correspondingly. Moreover, based on the authors network we find another two subareas related to NPD that have been frequently supporting NPD research: industrial engineering and operations; and management, which are leaded by Cooper and Eisenhardt correspondingly.

Although bibliographic analysis has produced plenty of different contributors and contributions to relatively similar domains in the field, no published paper has provided a general overview of NPD. Even though the aim of this paper is to provide a general orientation of the most prolific and prominent NPD research, it is important to note that some limitations emerge from the use of WoS as the focus of analysis, as it does not cover the full range of knowledge products that are generated in NPD research, such as conferences and associations. However, several other factors were considered in order to provide a better representation of the NPD field, such as books and conference proceedings.

The paper is organized as follows: Section 2 gives a description of the methodology used. Section 3 presents a general overview of NPD research; shows the most prominent journals and articles in this subject, as well as the most prolific and prominent researchers; and maps the intellectual structure between the identified research subareas based on journals and authors networks. Section 4 presents some conclusions of the paper.

2. Methodology

The bibliometric process was based on data from the WoS, which is currently owned by Clarivate. This choice was made because of the levels of seriousness and prestige that the journals indexed there have among the scientific community, many of which are the main forums of publications of different specialized fields of research commonly related to NPD such as strategy (Nerur *et al.*, 2016). Data search was limited to the WoS core collection, which covers 151 research areas, representing more than 12,000 journals and approximately 50,000,000 articles and other scientific publications at the time this research was conducted (see for example, Bonilla *et al.*, 2015).

A basic topic search was made, limiting the request to the phrase "NPD". This specific exploration allowed us to explore the entire process of bringing to market tangible or intangible products as it is known in the engineering and management fields of knowledge, which is the aim of this paper. In September 2016, 3,059 results were found, covering ten different categories of publications: articles (2,760), proceedings papers (175), reviews (125), editorial material (89), book reviews (47), news items (10), meeting abstracts (16), corrections (4), notes (3), reprints (1), letters (3) and correction additions (1). In order to guide the research to the specific production of scientific knowledge in the field as purely as possible, only the first three categories were taken into account for analysis. Accordingly, 2,890 results were included in the data analysis.

The bibliometric process was performed according to the procedures proposed by Merigó *et al.* (2015) and Van Eck and Waltman (2010). Under this objective, this research utilized two different tools to classify the different journals and authors: first, the mentioned H-index, which has gained general acceptance by the scientific community as a valid ratio to measure the impact of scientific outcomes (Hirsch, 2005), is defined as a function of the number of citations and papers published and is calculated as the number of publications

that have received at least the same or more number of citations; and second, the bibliometric mapping and clustering proposed by Van Eck and Waltman (2010), which was applied under the analysis approach of bibliometric mapping and clustering (Merigó *et al.* 2016) utilizing the VOS-viewer software, version 1.6.4 developed by Van Eck and Waltman (2010). This software allows a bibliometric distance-based analysis of the VOS, in which the distance between two items reflects the strength of the relation between them; the shortest distance represents the strongest relationship and vice versa. Moreover, this kind of analysis allows the use of fractional counting, which assigns a fraction of the authorship of each paper based on the number of authors of each publication. Fractional counting means that only a fraction of the authorship of each paper is assigned, depending on the number of authors included in it.

3. Results and analysis
3.1 A General structure overview of NPD research
The distribution of the production of this academic material over time is shown in Figure 1. There is a rise in the number of publications since 1990: all papers published after that year represent approximately 97 percent of all the published material analyzed. Moreover, the proportion of the production of these intellectual sources on NPD has followed the tendency of the WoS database, boosted by the addition of several journals and the inclusion of the NPD subject in the scope of other ones, demonstrating the relevance that NPD is gaining among the scientific community. Since 2000, 147 papers were published in the WoS journals on average each year, and in 2016, 124 were published up to September 2016, when this analysis was conducted.

To evaluate the general NPD citation pattern, the number of citations was classified in different ranks, including the number of papers that each rank references and the percentage of its composition to the total number of papers, as shown in Table I. Note that only two papers reached more than 1,000 citations and almost 13 percent of the papers reached 50 citations or more. This evidences a construction of knowledge and learning, the results of which can be called leaders of the field, as evidenced in different subjects, such as biology, physics or computing. Moreover, an important trait derived from Table I is linked to the H-index (Hirsch, 2005), which has been highly used and accepted as a bibliometric instrument
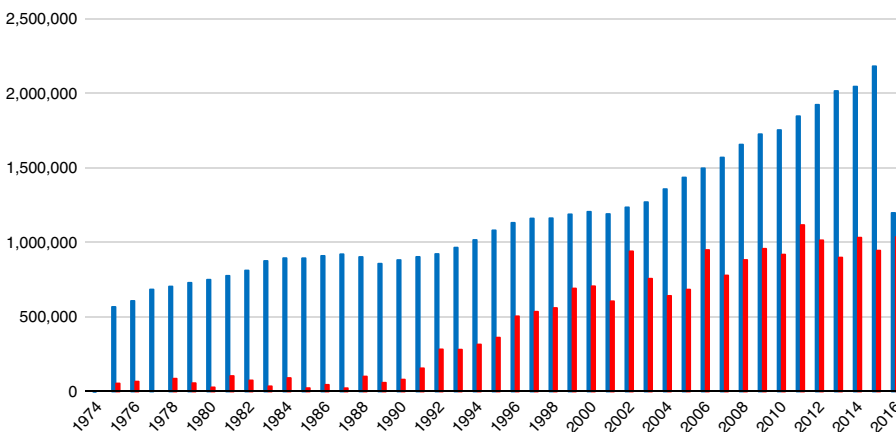
Notes: Blue bars indicate all papers published in each year, and red bars indicate the ratio (NPD-TP/WoS-TP)$\times 10^{11}$ where NPD-TP is the total number of New Product Development papers published and WoS-TP is the total of papers published in WoS

Figure 1.
Total articles + reviews published in WoS per year since 1974

PY	⩾ 1000	⩾ 500	⩾ 250	⩾ 100	⩾ 50	⩾ 25	⩽ 25	TP	% P	% Acum. P.
1975–1980							19	19	0.7	0.7
1981–1985					1	3	24	27	0.9	1.6
1986–1990			2	5	7	12	15	27	0.9	2.5
1991–1995	1	3	7	19	38	57	81	138	4.8	7.3
1996			3	9	16	22	35	57	2.0	9.3
1997			3	10	19	33	29	62	2.1	11.4
1998			2	10	19	32	33	65	2.2	13.7
1999	1	1	2	5	17	32	50	82	2.8	16.5
2000			1	11	22	43	42	85	2.9	19.4
2001		1	3	7	28	38	34	72	2.5	21.9
2002		2	7	20	36	56	60	116	4.0	26.0
2003			8	26	48	48	96		3.3	29.3
2004		1	1	10	30	50	37	87	3.0	32.3
2005		1	5	21	44	54	98		3.4	35.7
2006			11	32	66	76	142		4.9	40.6
2007			5	17	38	84	122		4.2	44.8
2008			3	13	41	105	146		5.1	49.9
2009			1	17	46	119	165		5.7	55.6
2010			1	10	36	125	161		5.6	61.1
2011			2	6	32	174	206		7.1	68.3
2012			1	1	9	186	195		6.7	75.0
2013				1	4	177	181		6.3	81.3
2014				1	2	209	211		7.3	88.6
2015						207	207		7.2	95.7
2016						123	123		4.3	100.0
Total	2	8	32	153	378	744	2,146	2,890	–	–
Percentage	0.1	0.3	1.1	5.3	13.1	25.7	74.3	100.0	–	–

Table I.
New product
development citation
structure in the WoS

Notes: PY, publication year; ⩾ 1000, ⩾ 500, ⩾ 250, ⩾ 100, ⩾ 50, ⩾ 25, is the number of papers that have reached that number of citations; TP is the total number of published papers in that year; % P is the ratio of papers published in the year compared to the total of papers published in NPD; % Acum. P. is the accumulated percentage of papers until that year

that intends to measure the impact of research output from individual scientific achievements (Alonso *et al.*, 2009). Given this order of ideas, and according to Table I, it can be said that almost 85 percent of NPD papers will have an H-index of 25 or less. The NPD research has a 116 H-index, showing that 116 papers in this field received at least 116 citations.

Moreover, the impact factor of all NPD papers published in the last ten years is provided in Table II. It was calculated based on two elements of the Impact Factor Ratio: the numerator is the ratio of citations in the year (t) to papers published in the two previous years ($t-1$) and ($t-2$); the denominator is the number of papers published in

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
NPD–TP	142	122	146	165	161	206	195	181	211	206	124
NPD–TC	2,768	3,228	4,073	4,791	5,523	6,438	7,016	7,171	7,880	9,003	4,817
NPD–TP2	185	240	264	268	311	326	367	401	376	392	348
NPD–TC2	275	334	424	407	474	620	633	703	614	725	417
NPD–IF	1.49	1.39	1.61	1.52	1.52	1.90	1.72	1.75	1.63	1.85	1.20

Table II.
NPD impact factor
during the last
10 years

Notes: NPD-TP, total of Papers published during the n-year; NPD-TC, total of citations received during the n-year; NPD-TC2, total of the *n*-year citations from the ($n-1$) year and ($n-2$) year papers published; NPD-IF impact factor of the *n*-year

year (*t*). As evidenced, there is an upward trend in the Impact factor during the period, as the progressive inclusion of more journals in the field prompted the publication of more papers, as evidenced in the structure of NPD publications in Table I, driving the increase in the significance of previous publications, allowing fewer publications with huge numbers of citations.

3.2 Most prominent journals in NPD
Using the H-index approach, Table III was constructed with the top 50 journals that published papers in the NPD field. The most relevant journal is the *Journal of Product Innovation Management*, whose H-index based on NPD papers (hereafter H-NPD) which is almost double that of the next journal on the list, the Management Science Journal. The relevance of the top journal was expected, as it is a specialized journal in the field and boasts huge numbers compared to the entire population of journals, publishing almost 15 percent of publications in the NPD field. Other very important journals on the field—some newer than others – are *Journal of Engineering and Technology Management*, *Technovation*, *R&D Management*, *Research-Technology Management*, and *International Journal of Technology Management*. Other very relevant interdisciplinary journals that cover NPD directly are the *Management Science Journal*, *International Journal of Operations & Production Management*, *International Journal of Production Economics*, *International Journal of Production Research and the Journal of Production and Operations Management*, *Journal of Engineering Design*, *Production and Operations Management* and *Journal of Business & Industrial Marketing*. Note that the list presents some familiar names that regularly publish papers related to NPD, such as *IEEE Transactions on Engineering Management*, *Expert Systems with Applications* and the *Journal of the Academy of Marketing Science*.

The dispersion of the blue items and their distances in Figure 2 indicate the closed relationship with four identified clusters related to the NPD field: marketing (yellow items), operations and production (gray items), and strategy (red items). In the first cluster, the *Journal of Product innovation Management*, given its position and size, represents the most prominent and prolific journal in the field of NPD, as evidenced by the H-NPD analysis from Table II.

Again, *R&D Review and Research in Technology Management* are at the center of the cluster analysis. From this perspective, the *Harvard Business Review* is considered very influential in the field. This journal considers multidisciplinary topics such as innovation, technology, entrepreneurship, leadership, and strategy. Another journal that has been relevant to the cluster is the *California Management Review*, thanks to subjects covered, such as intellectual property management, which are highly relevant to the field.

The second cluster is the marketing cluster (Yellow), and its obvious proximity to NPD is evidenced in the overlapping of items, as shown in Figure 2. In this sense, the *Journal of Industrial Marketing Management*, the *Journal of Marketing science*, *Journal of Business Marketing* and the *Journal of Business Research* most closely fit the field of NPD. However, marketing *and the Journal of Marketing*, even though not as close to the NPD cluster as the first mentioned, are extremely valuable to the NPD field, as they cover various subjects closely related to NPD research.

The third cluster is the operations and production cluster (gray). Even though the *MIT Sloan Management Review* is closer to the subject of NPD, other journals, such as the *Management Science Journal*, *Technovation* and the *IEEE Transactions on Engineering Management*, impact NPD research more strongly because of their citations, as seen in Table II. The fourth cluster is management (red cluster), which includes a new journal that is closely related to NPD: *Creativity and Innovation Management*. This cluster evidences a relatively homogenous impact on NPD from at least six journals due to their citations and the number of papers in the subject, such as *The Strategic Management Journal*,

R	Journal	H-NPD	TC-NPD[a]	TP-NPD	%NPD/TP	TP	TC	H	IF	≥250	≥100	≥50	≥25	T50
1	JoPIM	73	17,606	412	34	1,200	38,813	94	2.086	7	43	112	184	11
2	Man. Sc	34	3,785	50	1	5,500	265,334	213	2.741	2	13	25	38	5
3	IMM	29	2,189	96	4	2,523	40,201	78	1.93	0	0	7	37	0
4	IEEE-ToEM	26	1,967	87	6	1,406	24,388	61	1.454	0	2	10	26	1
5	TECH	23	1,548	79	4	1,806	29,325	68	2.243	0	1	5	18	0
6	R&DM	22	1,689	78	6	1,232	18,723	60	1.19	0	5	9	18	0
7	JoETM	21	1,219	51	11	482	6,540	41	1.474	0	2	3	19	1
8	JoM	19	2,823	27	2	1,625	180,039	211	3.885	3	8	14	19	5
9	ESwA	18	804	38	0	10,259	130,773	92	2.981	0	0	3	14	0
10	RTM	17	939	63	2	3,054	8,899	41	1.052	0	1	6	11	0
11	IJPE	16	758	40	1	5,348	90,088	94	2.782	0	0	5	6	0
12	JAMSc	15	822	24	2	968	37,481	97	3.744	0	0	7	12	0
13	IJoTM	15	739	88	5	1,859	10,357	34	0.867	0	0	2	7	0
14	IJO&P	15	542	43	3	1,439	32,066	74	2.252	0	0	1	7	0
15	SMJ	14	4,351	16	1	2,207	234,960	227	3.38	4	9	10	12	5
16	JOM	14	1,705	21	3	683	37,028	105	4	2	6	10	12	2
17	JMR	14	1,602	21	1	1,873	137,219	159	3.109	2	6	7	13	2
18	RP	13	620	23	1	2,627	115,936	155	3.47	0	1	5	7	0
19	JoBV	12	1,159	15	2	985	50,369	110	4.204	1	2	7	9	1
20	JoBR	12	903	34	1	4,495	69,730	99	2.129	0	4	5	8	0
21	IJoPR	12	467	47	1	8,491	112,330	97	1.693	0	0	0	6	0
22	HBR	11	587	13	0	3,754	101,477	141	2.249	1	0	1	5	1
23	JoED	11	266	29	4	767	6,829	30	1.946	0	0	0	3	0
24	OSc	10	2,139	13	1	1,443	128,465	167	3.36	3	3	5	6	3
25	CMR	10	886	11	1	1,331	42,833	100	1.109	0	3	4	6	2
26	C&IE	10	675	23	0	5,672	51,748	75	2.086	0	1	2	4	1
27	POM	10	352	20	2	1,016	18,210	64	1.732	1	1	0	8	0
28	CI	10	277	19	1	2,144	24,702	57	1.685	0	0	1	6	0
29	LRP	10	232	14	1	2,340	23,756	62	2.936	0	0	0	4	0
30	FQP	9	329	15	1	1,929	35,669	74	3.688	0	1	1	2	0
31	IJRM	9	269	14	2	582	13,493	55	1.833	0	0	2	2	0
32	IM&DS	9	186	27	2	1,368	14,320	48	1.278	0	0	0	1	0
33	DSc.	8	616	14	1	1,235	34,238	85	1.418	0	1	6	6	0

(continued)

Table III.
Top 50 most prominent new product development journals

R	Journal	H-NPD	TC-NPD[a]	TP-NPD	%NPD/TP	TP	TC	H	IF	≥250	≥100	≥50	≥25	T50
34	Mk.Sc.	8	456	11	1	1,110	43,507	101	1.647	0	2	2	6	0
35	SCM	8	192	10	2	620	10,061	47	2.731	0	0	1	2	0
36	CE-RA	8	158	27	5	586	4,609	29	1.02	0	0	0	0	0
37	JoB&lMk	8	118	21	4	550	2,871	22	0.973	0	0	2	0	0
38	TFSc&T	7	311	10	1	1,453	64,468	128	5.15	0	1	2	3	0
39	EJOR	7	283	18	0	14,434	300,407	175	2.679	0	0	1	6	0
40	MSMR	7	262	8	1	573	10,372	53	2.114	0	1	2	3	0
41	C&CE	7	219	13	0	6,367	108,697	110	2.581	0	0	1	3	0
42	JoSCM	7	149	9	5	188	3,744	33	4.571	0	0	1	1	0
43	AoMJ	6	877	6	0	2,669	268,742	254	6.233	0	5	5	6	2
44	KBS	6	222	8	0	2,565	25,189	54	3.325	0	0	1	4	0
45	TF&SC	6	184	11	0	3,040	30,945	63	2.678	0	0	2	2	0
46	JoCP	6	158	12	0	5,789	70,153	82	4.959	0	0	1	1	0
47	EJoMk	6	146	17	1	1,358	12,400	45	1.088	0	0	0	2	0
48	AEI	6	118	8	1	596	7,720	37	2	0	0	1	2	0
49	IJoIE	6	116	8	0	1,905	20,776	47	1	0	0	0	2	0
50	TA&SM	6	105	10	0	961	9,532	40	0.845	0	0	0	1	0

Notes: R is the rank; H-NPD is the H-index only with NPD papers; TC-NPD and TP-NPD are the total number of NPD citations and papers, respectively, during 1974–2016; TP and TC are the total number of papers and citations in the period, respectively; %NPD/TP represents the ratio of overall published papers compared to NPD papers; H and IF are the H-index and the impact factor reported by WoS; ≥250, ≥100, ≥50, and ≥25 are the number of NPD papers with more than 250, 100, 50 and 25, respectively; T50 is the number of papers classified in the top 50 list, as shown in Table V. JoPIM, *Journal of Product Innovation Management*; Man. Sc, *Management Science*; IMM, *Industrial Marketing Management*; IEEE-ToEM, *IEEE Transactions on Engineering Management*; TECH, *Technovation*; R&DM, *R&D Management*; JoETM, *Journal of Engineering and Technology Management*; JoM, *Journal of Marketing*; ESwA, *Expert Systems with Applications*; RTM, *Research-Technology Management*; IJPE, *International Journal of Production Economics*; JAMSc, *Journal of the Academy Of Marketing Science*; JIoTM, *International Journal of Technology Management*; IJO&P, *International Journal of Operations & Production Management*; SMJ, *Strategic Management Journal*; JOM, *Journal of Operations Management*; JMR, *Journal of Marketing Research*; RP, *Research Policy*; JoBV, *Journal of Business Venturing*; JoBR, *Journal of Business Research*; IJoPR, *International Journal of Production Research*; HBR, *Harvard Business Review*; JoED, *Journal of Engineering Design*; OSc., *Organization Science*; CMR, *California Management Review*; C&IE, *Computers & Industrial Engineering*; POM, *Production and Operations Management*; CI, *Computers in Industry*; LRP, *Long Range Planning*; FQP, *Food Quality and Preference*; IJRM, *International Journal of Research in Marketing*; IM&DS, *Industrial Management & Data Systems*; DSc., *Decision Sciences*; Mk.Sc., *Marketing Science*; SCM, *Supply Chain Management-An International Journal*; CE-RA, *Concurrent Engineering-Research and Applications*; JoB&lMk, *Journal of Business & Industrial Marketing*; TFSc&T, *Trends in Food Science & Technology*; EJOR, *European Journal of Operational Research*; MSMR, *MIT Sloan Management Review*; C&CE, *Computers & Chemical Engineering*; JoSCM, *JoCP Journal of Supply Chain Management*; AoMJ, *Academy Of Management Journal*; KBS, *Knowledge-Based Systems*; TF&SC, *Technological Forecasting and Social Change*; JoCP, *Journal of Cleaner Production*; EJoMk, *European Journal of Marketing*; AEI, *Advanced Engineering Informatics*; IJoIE, *International Journal of Industrial Ergonomics*; and TA&SM, *Technology Analysis & Strategic Management*. [a]the list is ordered top-down, considering the H-NPD index as the first classification item. The second classification item is the TC-NPD
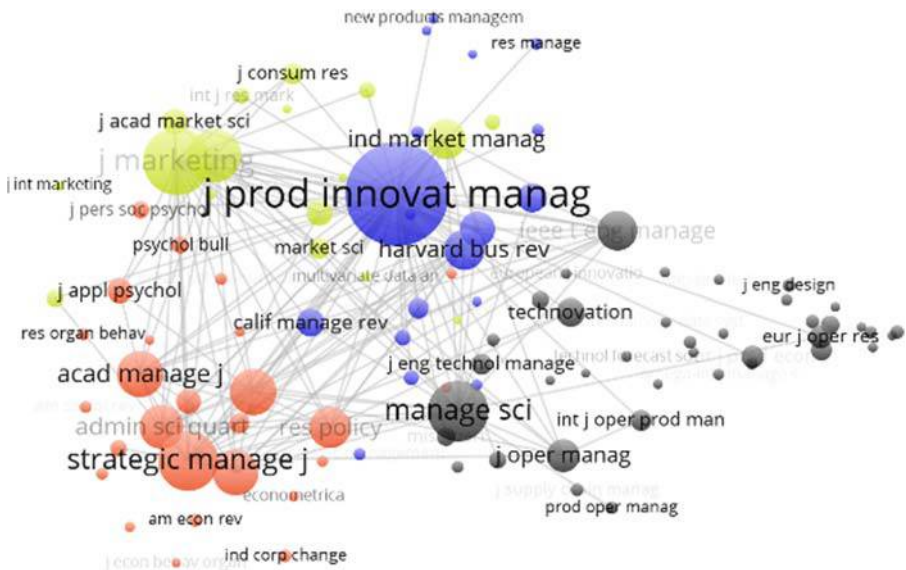
Table III.

Source: Based on bibliographic coupling analysis by Kessler (1963) from NPD Journals
(1974–2016)

Academy of Management Journal, *Research Policy*, *Organization Sciences*, the *Academy of Management Review*, and the *Administrative Science Quarterly*. The latter two journals did not classify in the Table II ranking. All the mentioned results are highlighted by the density of item aggrupation in Figure 2, which evidences four hotspots from the four relevant clusters in the field, highlighting the *European Journal of Operations Research*—another important source of development in the NPD field.

In order to provide a better perspective on the quality of each journal, the impact factor of each journal reported by WoS is also provided in Table II.

The main limitation in this kind of analysis is that it could ignore some other relevant sources of information not covered by the WoS, such as books and other relevant journals associated with different professional associations related to NPD. To give a more integrated view on this field of research, relevant information is presented in this article. Table IV presents a list of 20 journals that cover both the NPD research, and other relevant journals in innovation research. Table VI presents relevant books associated with the field.

3.3 Most prominent articles in NPD
One of the most relevant issues related to bibliometrics is to reveal the most popular and influential papers in this field of NPD research. In order to do so, Table V presents the top 50 most cited papers since 1975. In this list, the most popular paper is Leonard-Barton's 1992 article. Three authors have classified four papers in this top 50 list: Griffin, A., and the prolific co-authorship of Handfield and Ragatz. From 83 authors in the list, 67 ranked one paper each, which shows a homogeneous distribution in this sense. Hansen (1999) is another classic and popular article, as it is the most cited paper every year.

Another important source of bibliometric information is books. Unfortunately, the WoS research did not directly produce this information. However, using the "Cited Reference Search," it is possible to obtain the number of received citations from this very important source of knowledge. In this sense, a manual data search was conducted to find and classify

	New product development journals	Innovation journals
1	*International Journal of Product Development (IJPD)*	*Quality Innovation Prosperity/Kvalita Inovácia Prosperita*
2	*New Product Quality and Product Development Teams*	*Journal of Innovation and Entrepreneurship*
3	*Journal of Industrial Engineering and Management*	*International Journal of Innovation and Learning*
4	*Visions Magazine*	*Economics of Innovation and New Technology*
5	*The International Journal of Innovation Management*	*International Journal of Entrepreneurship and Innovation Management*
6	*GPS World*	*Handbook of the Economics of Innovation*
7	*International Society for Professional Innovation Management (ISPIM)*	*Innovation: Management, Policy and Practice*
8	*International journal of new product development & innovation management*	*International Journal of Innovation Management*
9	*Innovation Management and New Product Development*	*International Journal of Innovation and Sustainable Development*
10	*Faster New Product Development*	*International Journal of Technological Learning, Innovation and Development*
11	*Journal of Product & Brand Management*	*Journal of Technology Management and Innovation*
12	*International Journal of Product Development*	*Innovation Journal*
13	*International Journal of Materials and Product Technology*	*Smart Innovation, Systems and Technologies*
14	*Manufacturing Technology*	*Innovation Policy and the Economy*
15	*Journal of Food Products Marketing*	*International Journal of Innovation Science*
16	*International Journal of Product Lifecycle Management*	*Advances in the Study of Entrepreneurship, Innovation, and Economic Growth*
17	*International Journal of Design Sciences and Technology*	*International Journal of Entrepreneurship and Innovation*
18	*Publishing and Production Executive*	*Research on Technological Innovation, Management and Policy*
19	*European Production Engineering*	*Spinnovation*
20	*Global Product Development*	*International Journal of Foresight and Innovation Policy*

Table IV.
List of some New
Product Development
journals not indexed
in the WoS

books relevant to the field. This search technique has many restrictions because, sometimes, the books are not correctly cited, as evidenced by the database. Table VI shows the top 20 books with more than 30 citations produced through this search procedure. Most of these books are classics in the NPD research field. Note that the number of citations for some of these publications is comparable to the journal article citations shown in Table V, highlighting the importance of this information to the NPD research, so a deeper exploration can be worthwhile for further investigations. Note that three authors from the top 50 most cited articles list are also in the top 20 most cited book list: Cooper, R.; Hauser, J., and Kleinschmidt, E. evidencing their prominence in the NPD field.

3.4 Most prolific and prominent researchers in NPD
In order to present an integrated perspective, an analysis of the most cited researchers was conducted. This exploration was complemented with an analysis of the number of papers they published in order to find not only the most influential researchers but also the most active researchers in the NPD field. In this sense, to overcome limitations based only on an analysis of citations and number of papers, a cross-data analysis was made by taking into account the quality of the journal measured by its H-Index and the most cited journals considering NPD research only. Furthermore, a co-citation analysis based on a bibliographic data map is also presented. Table VII presents the top 50 authors in NPD ordered by the H-NPD index.

As we can see, Lynn, G. is the most prolific author on NPD. One of his publications is among the top 50 most prominent articles in NPD, and almost 70 percent of his WoS

R	Journal	NPD-TC	Title	Author(s)	PY	C/Y
1	*SMJ*	1,791	Core capabilities and core rigidities – a paradox in managing new product development	Leonard-barton, D.	1992	74.63
2	*ASQ*	1,728	The search-transfer problem: The role of weak ties in sharing knowledge across organization subunits	Hansen, M.T.	1999	101.65
3	*OrgSc*	780	A pragmatic view of knowledge and boundaries: Boundary objects in new product development	Carlile, P.R.	2002	55.71
4	*SMJ*	736	Social capital, knowledge acquisition, and knowledge exploitation in young technology-based firms	Yli-renko, H., Autio, E. and Sapienza, H.J.	2001	49.07
5	*OrgSc*	652	Demography and design – predictors of new product team performance	Ancona, D.G. and Caldwell, D.F.	1992	27.17
6	*JoPIM*	641	A critical look at technological innovation typology and innovativeness terminology: a literature review	Garcia, R. and Calantone, R.	2002	45.79
7	*JoM*	626	From embedded knowledge to embodied knowledge: New product development as knowledge management	Madhavan, R. and Grover, R.	1998	34.78
8	*SMJ*	530	Exploration and exploitation alliances in biotechnology: A system of new product development	Rothaermel, F.T. and Deeds, D.L.	2004	44.17
9	*JoBV*	506	Strategic alliances and the rate of new product development: An empirical study of entrepreneurial biotechnology firms	Deeds, D.L. and Hill, C.W.L.	1996	25.30
10	*JoPIM*	505	Determinants of new product performance – a review and metaanalysis	Montoya-weiss, M.M. and Calantone, R.	1994	22.95
11	*JoPIM*	485	PDMA research on new product development practices: Updating trends and benchmarking best practices	Griffin, A.	1997	25.53
12	*OrgSc*	454	Knowledge networks: Explaining effective knowledge sharing in multiunit companies	Hansen, M.T.	2002	32.43
13	*JoPIM*	451	Integrating R&D and marketing: A review and analysis of the literature	Griffin, A. and Hauser, JR.	1996	22.55
14	*C&IE*	415	Issues in environmentally conscious manufacturing and product recovery: a survey	Gungor, A. and Gupta, S.M.	1999	24.41
15	*MeatSc.*	380	Consumer perception of meat quality and implications for product development in the meat sector – a review	Grunert, K.G., Bredahl, l. and Brunso, K.	2004	31.67
16	*JoOM*	378	New service development: areas for exploitation and exploration	Menor, L.J., Tatikonda, M.V. and Sampson, S.E.	2002	27.00
17	*JoMR*	373	The impact of organizational memory on new product performance and creativity	Moorman, C. and Miner, A. S.	1997	19.63
18	*JoM*	364	Organizing for effective new product development – the moderating role of product innovativeness	Olson, E.M., Walker, O.C. and Ruekert, R.W.	1995	17.33
19	*JoPIM*	357	Benchmarking the firms critical success factors in new product development	Cooper, R.G. and Kleinschmidt, E.J.	1995	17.00
20	*Man. Sc*	341	A model of new product development – an empirical-test	Zirger, B.J. and Maidique, M.A.	1990	13.12
21	*HBR*	309	The new new product development game	Takeuchi, H. and Nonaka, I.	1986	10.30

Table V.
Top 50 most cited papers in NPD during the 1974–2016 period

R	Journal	NPD-TC	Title	Author(s)	PY	C/Y
22	*JoOM*	308	Supplier integration into new product development: coordinating product, process and supply chain design	Petersen, K.J, Handfield, R.B. and Ragatz, G.L.	2005	28.00
23	*JoM*	307	An examination of organizational factors influencing new product success in internal and alliance-based processes	Sivadas, E. and Dwyer, F.R.	2000	19.19
24	*SMJ*	292	Incumbent's advantage through exploiting complementary assets via interfirm cooperation	Rothaermel, F.T.	2001	19.47
25	*JoPIM*	284	Success factors for integrating suppliers into new product development	Ragatz, G.L, Handfield, R.B. and Scannell, T.V.	1997	14.95
26	*JoMR*	274	Cross-functional product development teams, creativity, and the innovativeness of new consumer products	Sethi, R, smith, D.C. and Park, C.W.	2001	18.27
27	*JoPIM*	266	An interim-report on measuring product development success and failure	Griffin, A. and Page, A.L.	1993	11.57
28	*Man. Sc*	265	Shifting innovation to users via toolkits	Von Hippel, E. and Katz, R.	2002	18.93
29	*IJoFM*	263	Application of cereals and cereal components in functional foods: a review	Charalampopoulos, D., Wang, R., Pandiella, S.S. and Webb, C.	2002	18.79
30	*OpR*	251	Material management in decentralized supply chains	Lee, H.L. and Billington, C.	1993	10.91
31	*MISQ*	250	A design theory for systems that support emergent knowledge processes	Markus, M.L., Majchrzak, A. and Gasser, l.	2002	17.86
32	*CMR*	248	Marketing and discontinuous innovation: The probe and learn process	Lynn, G.S., Morone, J.G. and Paulson, A.S.	1996	12.40
33	*Man. Sc*	246	Performance assessment of the lead user idea-generation process for new product development	Lilien, G.L., Morrison, P.D., Searls, K., Sonnack, M. and Von Hippel, E.	2002	17.57
34	*JoPIM*	245	An exploratory analysis of the impact of market orientation on new product performance – a contingency approach	Atuahenegima, K.	1995	11.67
35	*Man. Sc*	243	Patterns of communication among marketing, engineering and manufacturing – a comparison between 2 new product teams	Griffin, A. and Hauser, J.R.	1992	10.13
36	*JoPIM*	243	Discontinuous innovation and the new product development process	Veryzer, R.W.	1998	13.50
37	*ASQ*	235	Organizational improvisation and learning: A field study	Miner, A.S., Bassoff, P. and Moorman, C.	2001	15.67
38	*ISR*	229	From IT leveraging competence to competitive advantage in turbulent environments: The case of new product development	Pavlou, P.A., and E.L Sawy, O.A.	2006	22.90
39	*JoETM*	227	Transferring R&D knowledge: the key factors affecting knowledge transfer success	Cummings, J.L. and Teng, B.S.	2003	17.46
40	*Man. Sc*	226	Integrating operations and marketing perspectives of product innovation: The influence of organizational process factors and capabilities on development performance	Tatikonda, M.V. and Montoya-Weiss, M.M.	2001	15.07

(*continued*)

Table V.

R	Journal	NPD-TC	Title	Author(s)	PY	C/Y
41	*CMR*	224	Involving suppliers in new product development	Handfield, R.B., Ragatz, G.L., Petersen, K.J. and Monczka, R.M.	1999	13.18
42	*SMJ*	223	Knowledge sharing in organizations: Multiple networks, multiple phases	Hansen, M.T., Mors, M.L. and Lovas, B.	2005	20.27
43	*AoMJ*	223	Mass customization – implementing the emerging paradigm for competitive advantage	Kotha, S.	1995	10.62
44	*JoPIM*	220	Environmental uncertainty, organizational integration, and new product development effectiveness: A test of contingency theory	Souder, W.E., Sherman, J.D. and Davies-Cooper, R.	1998	12.22
45	*JoM*	218	The convergence of planning and execution: Improvisation in new product development	Moorman, C. and Miner, A.S.	1998	12.11
46	*AoMJ*	216	Cross-functional project groups in research and new product development: Diversity, communications, job stress, and outcomes	Keller, R.T.	2001	14.40
47	*JoM*	210	National culture and new product development: An integrative review	Nakata, C. and Sivakumar, K.	1996	10.50
48	*IEEE-ToEM*	209	Factors for success in R&D projects and new product innovation: A contextual framework	Balachandra, R. and Friar, J.H.	1997	11.00
49	*JoPIM*	204	Determinants of timeliness in product development	Cooper, R.G. and Kleinschmidt, E.J.	1994	9.27
50	*JoBR*	198	Benefits associated with supplier integration into new product development under conditions of technology uncertainty	Ragatz, G.L., Handfield, R.B. and Petersen, K.J.	2002	14.14

Notes: R, rank; NPD-TC, total citations of the NPD papers published; PY, publication year; C/Y, average number of citations per year during the period. *SMJ, Strategic Management Journal; ASQ, Administrative Science Quarterly; OrgSc, Organization Science; JoPIM, Journal of Product Innovation Management; JoM, Journal of Marketing; JoBV, Journal of Business Venturing; C&IE, Computers & Industrial Engineering; MeatSc., Meat Science; JoOM, Journal of Operations Management; JoMR, Journal of Marketing Research; Man. Sc., Management Science; HBR, Harvard Business Review; IJoFM, International Journal of Food Microbiology; OpR, Operations Research; MISQ, MIS Quarterly; CMR, California Management Review; ISR, Information Systems Research; JoETM, Journal of Engineering and Technology Management; AoMJ, Academy Of Management Journal; IEEE-ToEM, IEEE Transactions on Engineering Management; JoBR, Journal of Business Research*

Table V.

publications concentrate on the field. In this sense, de Brentani, U. is the author most concentrated on NPD (12 out of 14 papers are on NPD). Roger Calantone has reached remarkable numbers when referring to the number of citations. His overall production of publications and the number of citations received per paper makes him a very important contributor to the NPD research. In this sense, Frank Rothaermel has received the highest number of citations per paper (207 citations per paper); considering that he has only four publications on NPD in the WoS, the number of citations demonstrates his remarkable contributions to the field.

In order to monitor the influence of the publications by these authors, a classification based on the number of publications in the top 10 journals constructed on its H-NPD impact is shown in Table VIII. Note that almost all the authors have published in the *Journal of Product Innovation Management*, with Calantone being the most salient author published. It is understandable that several authors, such as Yan, Lee, Buyukozkan, Grunert and Becker, have not published in these journals possibly because their research lines are not directly focused on the core of NPD *per se*, although they have addressed the issue in different research areas, enriching the NPD field.

R	Authors	Book title	Edition(s)	Times cited in WoS
1	Uhrich, K.	*Product Design and Development*	1995, 2000, 2003, 2004, 2008, 2011, 2012	2,283
2	Norman, D.	*The Design of Everyday Things Editorial: Basic Books, New York*	1988, 1990, 2002, 2013	1,642
3	Stone, H.	*Sensory Evaluation Practices*	1985, 1992, 1993, 1995, 1997, 2004, 2012	1,389
4	McDonough, W. and Braungart, M.	*Cradle to Cradle: Remaking the Way We Make Things*	2002	618
5	Urban, G. and Hauser, J.	*Design and Marketing Of New Products*	1993	445
6	Crawford, C. and Benedetto, A.	*New Products Management*	1983, 1987, 1991, 1997, 1999, 2000, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2014	405
7	Cooper, R., Scott, E. and Kleinschmidt, E.	*Portfolio Management for New Products*	1997, 1998, 2001	258
8	Kahn K.B., Kay S. E., Slotegraaf R.J. and Uban S.	*The PDMA Handbook of New Product Development: Third Edition*	1996, 2002, 2004, 2005, 2012, 2013	243
9	Kelley, Tom	*The Art of Innovation: Lessons in Creativity from IDEO, America's Leading Design Firm*	2001	178
10	De Bono, E.	*Lateral Thinking: Creativity Step by Step*	1970, 1973	173
11	Rowe, P	*Design thinking*	2015	149
12	Crampton Smith, G. and Moggridge, B.	*Designing Interactions*	2007	147
13	Ries, E.	*The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses*	2011	139
14	Lidwell, W., Holden, K. and Butler, J	*Universal Principles of Design*	2003	97
15	Gershenfeld, N.	*Fab: The Coming Revolution on Your Desktop–from Personal Computers to Personal Fabrication*	2005	86
16	Reinertsen, D.	*Managing the Design Factory*	1997	60
17	Cooper, R.G.	*Winning at New Products: Creating Value Through Innovation*	2011	51
18	Maeda, J.	*The Laws of Simplicity (Simplicity: Design, Technology, Business, Life)*	2006	40
19	Cooper, R. G. and Edgett, S. J.	*Lean, Rapid and Profitable New Product Development*	2005	30
20	Moore, G.A.	*Dealing with Darwin: How Great Companies Innovate at Every Phase of Their Evolution*	2005	30

Table VI.
Some books in new product development with more than 50 citations in WoS

With the aim of getting a better overview, a list of the ten authors with the highest number of publications in the top 8 most cited journals in NPD is presented in Table IX. Calantone and Cooper have the most complete profiles in these journals, present in four journal lists. Cooper is at the top of the list for *Research-Technology Management* and the *International Journal of Technology Management*, and Calantone is the top publisher in

R	Author	TC-NPD	TP-NPD	H NPD[a]	Country	Last institution registered	H	TP	TC	TP10	TC10	T50
1	Lynn, G.S.	856	23	15	USA	Stevens Inst Technol	18	33	1,630	15	354	1
2	Calantone, R.	2,236	16	14	USA	Michigan State Univ	39	155	6,692	76	1,362	2
3	Song, M.	545	15	13	USA	Univ Missouri	16	21	862	16	547	0
4	Song, X.M.	1,324	13	13	USA	Michigan State Univ	19	21	1,628	1	2	0
5	Droge, C.	647	14	12	USA	Michigan State Univ	31	69	3,223	27	707	0
6	Chen, C.H.	283	16	11	Singapore	Nanyang Technol Univ	20	85	1,358	54	817	0
7	Cooper, R.G.	1,134	13	11	Canada	McMaster Univ	42	79	6,233	10	421	2
8	Barczak, G.	737	12	11	USA	Northeastern Univ	16	29	918	19	397	1
9	Attuahene-Gima, K.	1,105	12	10	Peoples R China	City Univ Hong Kong	22	35	2,729	10	492	1
10	McDonough, E.F.	662	11	10	USA	Northeastern Univ	14	29	835	8	71	0
11	Goffin, K.	313	15	9	England	Cranfield Sch Management	11	26	359	20	234	0
12	Chin, K.S.	247	15	9	Peoples R China	City Univ Hong Kong	26	129	2,180	90	1,549	1
13	Souder, W.E.	634	13	9	USA	Univ Alabama	20	33	1,332	33	1,332	0
14	Schmidt, JB	722	12	9	USA	Univ Oklahoma	11	17	801	6	68	0
15	de Brentani, U.	549	12	9	Canada	Concordia Univ	9	14	551	11	156	0
16	Yan, W.	236	12	9	Singapore	Nanyang Technol Univ	18	78	925	46	509	0
17	Salomo, S.	312	11	9	Denmark	DTU Tech Univ Denmark	12	23	501	22	448	0
18	Ozer, M.	240	15	8	Peoples R China	City Univ Hong Kong	10	22	234	15	89	0
19	Akgun, A.E.	374	12	8	Turkey	Gebze Inst Technol	16	38	905	30	520	0
20	Gerwin, D.	395	10	8	Canada	Carleton Univ	9	17	865	4	17	0
21	Fuller, J.	445	8	8	Austria	Univ Innsbruck	13	25	760	25	760	0
22	Swink, M.	422	8	8	USA	Michigan State Univ	21	34	1,513	24	1,065	0
23	Ernst, H.	356	11	7	Germany	WHU Otto Beisheim	13	22	487	21	480	0
24	Lee, A.H.I.	173	11	7	Peoples R China	Chung Hua Univ	17	65	1,049	65	1,049	0
25	Choy, K.L.	279	9	7	Peoples R China	Hong Kong Polytech Univ	20	81	1,306	66	832	0
26	Deeds, D.	1,161	8	7	USA	Georgia Inst Technol	9	11	1,568	1	172	2
27	Kessler, EH	404	7	7	USA	Pace Univ	10	14	819	3	23	0
28	Kwong, C.K.	116	12	6	Peoples R China	Hong Kong Polytech Univ	19	110	1,331	79	703	0
29	Muffatto, M.	216	9	6	Italy	Univ Padua	8	16	277	3	4	0
30	Barclay, I	119	8	6	England	Liverpool John Moores Univ	8	19	490	1	1	0
31	Dayan, M.	119	8	6	United Arab Emirates	United Arab Emirates Univ	8	15	164	15	164	0
32	Huang, G.Q.	101	7	6	Peoples R China	Univ Hong Kong	27	158	2,268	121	1,404	0
33	Buyukozkan, G.	217	6	6	Turkey	Galatasaray Univ	23	67	1,872	57	1,445	0

Table VII.
Top 50 of the most prolific and prominent researchers on new product development

R	Author	TC-NPD	TP-NPD	H NPD[a]	Country	Last institution registered	H	TP	TC	TP10	TC10	T50
34	Marion, T.J.	50	9	5	USA	Northeastern Univ	5	14	60	14	60	0
35	Millson, MR	252	6	5	USA	Calif State Univ	5	8	253	5	21	0
36	Bonner, J.M.	383	5	5	USA	Univ Wisconsin	10	18	517	9	123	0
37	Nijssen, E.J.	185	5	5	The Netherlands	Univ Nijmegen	12	23	531	1	0	0
38	Chen, LH	122	5	5	Peoples R China	Natl Cheng Kung Univ	35	276	2,278	145	970	0
39	Wang, Y.M.	75	5	5	Peoples R China	Fuzhou Univ.	35	101	3,420	92	2,772	4
40	Griffin, A.	195	11	4	USA	Univ Utah	8	28	353	27	349	0
41	Meyer, M.H.	296	8	4	USA	Northeastern Univ	13	30	795	11	26	0
42	Bstieler, L.	177	7	4	USA	Univ New Hampshire	5	11	207	10	142	1
43	Grunert, K.G.	242	5	4	Denmark	Aarhus Univ	32	132	3,147	97	1,280	0
44	Ettlie, JE.	156	5	4	USA	Rochester Inst Technol	9	15	297	11	219	0
45	Becker, M.C.	86	5	4	Italy	Univ Salerno	5	6	100	4	38	0
46	Rothaermel, F.T.	828	4	4	USA	Georgia Inst Technol	16	22	2,403	16	1,328	2
47	Tatikonda, MV.	579	4	4	USA	Univ N Carolina	5	5	616	5	616	2
48	Langerak, F.	217	4	4	Netherlands	Erasmus Univ.	12	18	527	8	171	0
49	Perks, H.	110	3	3	England	Univ Manchester	7	9	193	7	108	0
50	Chen, H.H.	41	2	2	Peoples R China	Tsing Hua Univ	3	3	64	3	64	0

Notes: R is rank; H-NPD is the H-index only with NPD papers; TC-NPD and TP-NPD is the total number of NPD citations and papers, respectively, during the 1974–2016 period; TP, TC are the Total number of Papers and Citations in the whole period; H is the H-index comprehending all the papers from the author in WoS during the 1974–2016 period; TP10 and TC10 are the total of papers and total of citations of all the author's papers published in WoS in last ten years; T50 is the number of papers classified in the top 50 list shown in Table V.[a]The list is ordered top-down, considering the H-NPD index as the first classification item; the second classification item is the TC-NPD; the third classification item is the TP-NPD

Table VII.

Table VIII.
Total of papers published by the top 10 journals in Table II

R	Top 50 authors	JOPIM	MSc	IMM	IEEE-TOEM	TechN	R&D M	JOETM	JoM	ESWA	RTM	Total
1	Lynn, G.S.	9		4	6						3	22
2	Calantone, R.	32			1		1					34
3	Song, M.	8		2	1		1					12
4	Song, X.M.	9		1	1		1		2			13
5	Droge, C.	13		1								14
6	Chen, CH			4						1		5
7	Cooper, RG	2			1		1				10	14
8	Barczak, G.	11		3	2		4				1	21
9	Attuahene-Gima, K.	6	1	3			1					11
10	McDonough, E.F.	7			2		1					10
11	Goffin, K.	3					2				5	10
12	Chin, K.S.				2					7		9
13	Souder, W.E.	13										13
14	Schmidt, J.B.	5										5
15	de Brentani, U.	7										7
16	Yan, W.											0
17	Salomo, S.	6										6
18	Ozer, M.	2		4	1						1	8
19	Akgun, A.E.	2		1	1	2	2	4				12
20	Gerwin, D.		2		3			1				6
21	Fuller, J.	2		1		1						4
22	Swink, M.	1				1					1	3
23	Ernst, H.	2			1				3			6
24	Lee, A.H.I.											0
25	Choy, K.L.									2		2
26	Deeds, D.	2										2
27	Kessler, E.H.	1			1	1	1	1				5
28	Kwong, C.K.				1					2		3
29	Muffatto, M.	1				1	1					3
30	Barclay, I.						2					2
31	Dayan, M.	1		1	2		1					5
32	Huang, G.Q.											0
33	Buyukozkan, G.											0

(continued)

R	Top 50 authors	JOPIM	MSc	IMM	IEEE-TOEM	TechN	R&D M	JOETM	JoM	ESWA	RTM	Total
34	Marion, T.J.	6									1	7
35	Millson, MR	2		1		1	1				1	6
36	Bonner, J.M.	2		2								4
37	Nijssen, E.J.	2		1			1					4
38	Chen, L.H.				1							1
39	Wang, Y.M.									1		1
40	Griffin, A.	7	1	15								23
41	Meyer, M.H.	2	2								1	5
42	Bstieler, L.	3				1						4
43	Grunert, K.G.											0
44	Ettlie, J.E.	4										4
45	Becker, M.C.											0
46	Rothaermel, F.T.				1							1
47	Tatikonda, M.V.	2	1		1							4
48	Langerak, F.	7		1	1			1				10
49	Perks, H.	2		2								4
50	Chen, H.H.					1				2		3
	Total	175	7	43	23	9	20	8	5	15	21	326

Notes: *JOPIM, Journal Of Product Innovation Management; MSc, Management Science; IMM, Industrial Marketing Management; IEEE-TOEM, IEEE Transactions On Engineering Management; TechN, Technovation; R&D M, R & D Management; JOETM, Journal of Engineering and Technology Management; JoM, Journal of Management; ESWA, Expert Systems with Applications; RTM, Research-Technology Management*

Table VIII.

R	JOPIM Author	IMM TP	IMM Author	IEEE-TOEM TP	IEEE-TOEM Author	TechN TP	TechN Author	IJTM TP	IJTM Author	MSc TP	MSc Author	R & D M TP	R & D M Author	RTM TP	RTM Author
R	Barczak, G.	15	Ozer, M.	4	Bierly, P.E.	3	Takayama, M.	3	Cooper, R.	3	Kavadias, S.	6	Calantone, R.J.	9	Cooper, R.G.
1	Calantone, R.J.	15	Griffin, A.	3	Griffin, A.	3	Watanabe, C.	3	Corso, M.	2	Eliashberg, J.	3	Wilemon, D.	8	Edgett, S.J.
2	Griffin, A.	14	Barczak, G.	2	Lynn, G.S.	3	Wong, V.	3	Deszca, G.	2	Gerwin, D.	3	Akgun, A.E.	5	Goffin, K.
3	De Brentani, U.	11	Bonner, J.M.	2	Mu, J.F.	3	Armstrong, P.	2	Ishii, K.	2	Krishnan, V.	3	Barclay, I.	5	Kleinschmidt, E.J.
4	Souder, W.E.	10	Di Benedetto, C.A.	2	Akgun, A.E.	2	Cooper, R.	2	Kurokawa, S.	2	Mihm, J.	3	Bierly, P.E.	3	Wilemon, D.
5	Hultink, E.J.	9	Durmusoglu, S.S.	2	Calantone, R.	2	Cormican, K.	2	Lynn, G.S.	2	Von Hippel, E.	3	Cooper, R.	3	Gupta, A.K.
6	Song, M.	8	Eng, T.Y.	2	Chai, K.H.	2	Eng, T.Y.	2	Mcwilliams, B.	2	Bhattacharya, S.	2	Frattini, F.	2	Koners, U.
7	Droge, C.	8	Fredericks, E.	2	Chen, C.J.	2	Fuller, J.	2	Munro, H.	2	Chao, R.o.	2	Herstatt, C.	2	LYNN, G.S.
8	Salomo, S.	8	Harmancioglu, N.	2	Di Benedetto, A.	2	Griffy-Brown, C.	2	Noori, H.	2	Kekre, S.	2	Keskin, H.	2	Munson, J.M.
9	Schmidt, J.B.	8	Iyer, G.R.	2	Filippini, R.	2	Gunasekaran, A.	2	Sandmeier, P.	2	Loch, C.H.	2	Kumar, V.	2	Spivey, W.A.
10	Calantone, R.	7	Lancioni, R.A.	2	Hultink, E.J.	2	Ilori, M.O.	2	Souder, W.E.	2	Morrison, P.D.	2	Parkinson, S.T.	2	Szwejczewski, M.

Notes: TP-NPD is the total number of NPD papers during the 1974–2016 period; JOPIM, *Journal of Product Innovation Management*; IMM, *Industrial Marketing Management*; IEEE-TOEM, *IEEE Transactions on Engineering Management*; TechN, *Technovation*; IJTM, *International Journal of Technology Management*; MSc, *Management Science*; R&D M, *R & D Management*; RTM, *Research-Technology Management*

Table IX.
Authors with the highest number of publications in the top 8 most cited NPD journals (1974–2016)

the *Journal of R&D Management*. Another two very prolific researchers in the NPD area are Griffin and Lynn, who are ranked in three different journals each. A remarkable number of papers published in the NPD research area come from Barczak; even when her name does not appear in the other journals list in Table IX, she is among the top 8 most important researchers in the development of knowledge in the field, as seen in Table VII.

In order to provide a more integrated view, a bibliographic data map co-citation analysis based on fractional counting was conducted, taking into account first authors only. The co-citation analysis relates the frequency that two authors are cited together, and it is useful to reveal the structure, diffusion and influence of a knowledge field (Servantie *et al.*, 2016). As seen in Figure 3, the analysis revealed three main areas related to NPD that have been frequently cited: management (green cluster); strategy (red cluster); and industrial engineering and operations (purple cluster). Note that, when these areas are cited, there is no evident mixture of citations, except with counted authors, that are very similar in the limits of the three areas; nonetheless, each area can be clearly delimited. The clearest co-cited author in NPD is Cooper, who is also the most salient co-cited author in industrial engineering and operations (purple cluster). Griffin is another prominent author co-cited in this cluster, but her work is also often co-cited in the strategy cluster. With respect to the management cluster, Song is the most cited author, followed by Gupta, Sowder and Calantone. Finally, in the Strategy cluster, several classic names frequently cited by NPD authors emerge, such as Eisenhardt, Chesbrough, Porter, and Teese. Even when its work is not directly focused on NPD, its impact on this research field is undiscussed.
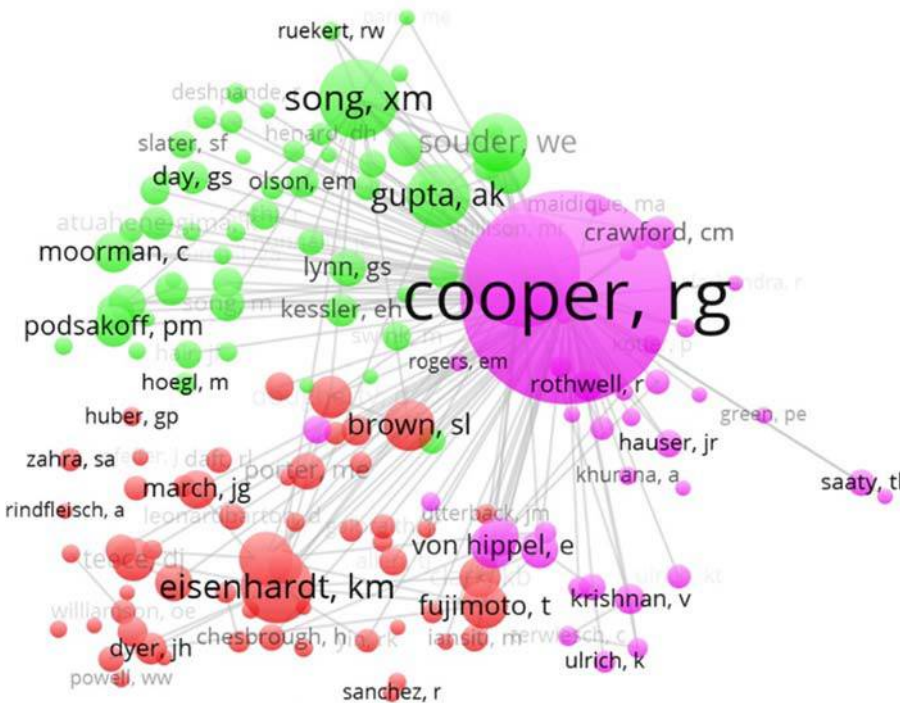

Figure 3.
Bibliographic data map (size variation-network visualization)

Source: Based on co-citation analysis by Small (1973) from NPD authors (1974–2016)

4. Conclusions

Bibliometric methods have been used to present a general outline of NPD research. We attempted to reach this goal identifying the intellectual evolution of the field through the use of bibliometric techniques and distance-based analysis, by taking different levels of analysis (articles, authors, journals, institutions and countries) and its impact from the last 40 years of NPD research based on the WoS database.

Our results evidence an increase in the production of research on NPD, as well as its impact, demonstrating the relevance that NPD is gaining among the scientific community. This increase could also be attributed to the inclusion of several journals in the field over the years, which has prompted the publication of more papers.

The most relevant journal is the *Journal of Product Innovation Management*. The relevance of this journal was expected, as it is a specialized journal in the field and has huge numbers compared to the entire journal population. Other very important journals focused on the field—some newer than others—are *Journal of Engineering and Technology Management*, *Technovation*, *R&D Management*, *Research-Technology Management*, and *International Journal of Technology Management*. The most popular paper is Leonard-Barton's 1992 article. Hansen (1999) is another classic and popular article, as it is the most cited paper annually. With respect to authors, the most prolific researcher is Lynn G., almost 70 percent of his publications in WoS are concentrated on the field. Calantone R. has also remarkable numbers as a very important contributor to NPD research. From different perspectives, several authors are of significance to the NPD literature such as Gary Lynn, Michael Song, Robert Cooper and Abbie Griffin.

The network analysis based on journals allowed us to identify three subareas related to the NPD field based on the journals network: marketing, operations and production, and strategy, which are leaded by *Industrial Marketing Management*, *Management Science*, and *Creativity and Innovation Management*.

Based on the authors network it is possible at some extent to depict, the social construction of a discipline that takes place at individual level, as noted by Nerur *et al.* (2008). This led us to find another two subareas related to NPD that have been frequently supporting NPD research at a social construction level: industrial engineering and operations; and management, which are leaded by Cooper and Eisenhardt correspondingly.

Even when the aim of this paper is to provide a comprehensive picture on the most prolific and prominent NPD research, it is important to note that some limitations emerge from the same characteristics of the methodology addressed here. For instance, the assignation of authorship when calculating the H-NPD Index was made by considering full authorship for each paper. Even when this issue was considered by applying different bibliometric approaches, such as co-authorship, bibliographic coupling and fractional authorship, the results should still be taken with caution. Another restriction in the presented information is that it does not include other information that could lead to different results, such as indexes that are different from the H-index or information gathered from another source of information accepted by scholars, such as specialized associations or conferences. Nevertheless, some other relevant sources of information not covered by the WoS, such as books and a few relevant journals associated with different professional associations related to NPD were also taken into account in order to provide a better representation of the field.

References

Alonso, S., Cabrerizo, F.J., Herrera-Viedma, E. and Herrera, F. (2009), "H-Index: a review focused in its variants, computation and standardization for different scientific fields", *Journal of Informetrics*, Vol. 3 No. 4, pp. 273-289.

Biemans, W., Griffin, A. and Moenaert, R. (2010), "In search of the classics: a study of the impact of JPIM papers from 1984 to 2003", *Journal of Product Innovation Management*, Vol. 27 No. 4, pp. 461-484.

Blanco-Mesa, F., Merigó, J.M. and Gil-Lafuente, A.M. (2017), "Fuzzy decision making: a bibliometric based review", *Journal of Intelligent & Fuzzy Systems*, Vol. 32, pp. 2033-2050.

Bonilla, C.A., Merigó, J.M. and Torres-Abad, C. (2015), "Economics in Latin America: a bibliometric analysis", *Scientometrics*, Vol. 105 No. 2, pp. 1239-1252.

Calantone, R., Garcia, R. and Dröge, C. (2003), "The effects of environmental turbulence on new product development strategy planning", *Journal of Product Innovation Management*, Vol. 20 No. 2, pp. 90-103.

Calantone, R.J. and Di Benedetto, C.A. (2000), "Performance and time to market: accelerating cycle time with overlapping stages", *IEEE Transactions on Engineering Management*, Vol. 47 No. 2, pp. 232-244.

Calantone, R.J., Vickery, S.K. and Dröge, C. (1995), "Business performance and strategic new product development activities: an empirical investigation", *Journal of Product Innovation Management*, Vol. 12 No. 3, pp. 214-223.

Carson, S.J., Madhok, A. and Wu, T. (2006), "Uncertainty, opportunism, and governance: the effects of volatility and ambiguity on formal and relational contracting", *Academy of Management Journal*, Vol. 49 No. 5, pp. 1058-1077.

Cooper, R.G. and Kleinschmidt, E.J. (1995), "Benchmarking the firm's critical success factors in new product development", *Journal of Product Innovation Management*, Vol. 12 No. 5, pp. 374-391.

De Brentani, U. and Kleinschmidt, E.J. (2004), "Corporate culture and commitment: impact on performance of international new product development programs", *Journal of Product Innovation Management*, Vol. 21 No. 5, pp. 309-333.

Du, H., Li, B., Brown, M.A., Mao, G., Rameezdeen, R. and Chen, H. (2015), "Expanding and shifting trends in carbon market research: a quantitative bibliometric study", *Journal of Cleaner Production*, Vol. 103, pp. 104-111.

Fagerberg, J., Fosaas, M. and Sapprasert, K. (2012), "Innovation: exploring the knowledge base", *Research Policy*, Vol. 41 No. 7, pp. 1132-1153.

Franceschini, S., Faria, L.G. and Jurowetzki, R. (2016), "Unveiling scientific communities about sustainability and innovation. A bibliometric journey around sustainable terms", *Journal of Cleaner Production*, Vol. 127, pp. 72-83.

Gallardo-Gallardo, E., Nijs, S., Dries, N. and Gallo, P. (2015), "Towards an understanding of talent management as a phenomenon-driven field using bibliometric and content analysis", *Human Resource Management Review*, Vol. 25 No. 3, pp. 264-279.

Griffin, A. (1997), "PDMA research on new product development practices: updating trends and benchmarking best practices", *Journal of Product Innovation Management*, Vol. 14 No. 6, pp. 429-458.

Hansen, M.T. (1999), "The search-transfer problem: the role of weak ties in sharing knowledge across organization subunits", *Administrative Science Quarterly*, Vol. 44 No. 1, pp. 82-11.

Hirsch, J.E. (2005), "An index to quantify an individual's scientific research output", *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 102 No. 46, pp. 16569-16572.

Hsieh, P.N. and Chang, P.L. (2009), "An assessment of world-wide research productivity in production and operations management", *International Journal of Production Economics*, Vol. 120 No. 2, pp. 540-551.

Keller, R.T. (2001), "Cross-functional project groups in research and new product development: diversity, communications, job stress, and outcomes", *Academy of Management Journal*, Vol. 44 No. 3, pp. 547-555.

Kessler, M.M. (1963), "Bibliographic coupling between scientific papers", *Journal of the Association for Information Science and Technology*, Vol. 14 No. 1, pp. 10-25.

Landström, H., Harirchi, G. and Aström, F. (2012), "Entrepreneurship: exploring the knowledge base", *Research Policy*, Vol. 41 No. 7, pp. 1154-1181.

Merigó, J.M., Gil-Lafuente, A.M. and Yager, R.R. (2015), "An overview of fuzzy research with bibliometric indicators", *Applied Soft Computing*, Vol. 27, pp. 420-433.

Merigó, J.M., Cancino, C.A., Coronado, F. and Urbano, D. (2016), "Academic research in innovation: a country analysis", *Scientometrics*, Vol. 108 No. 2, pp. 559-593.

Nerur, S., Rasheed, A.A. and Pandey, A. (2016), "Citation footprints on the sands of time: an analysis of idea migrations in strategic management", *Strategic Management Journal*, Vol. 37 No. 6, pp. 1065-1084.

Nerur, S.P., Rasheed, A.A. and Natarajan, V. (2008), "The intellectual structure of the strategic management field: An author co-citation analysis", *Strategic Management Journal*, Vol. 29 No. 3, pp. 319-336.

Olavarrieta, S. and Villena, M.G. (2012), "Innovation and business research in latin America: an overview", *Journal of Business Research*, Vol. 67 No. 4, pp. 489-497.

Podsakoff, P.M., MacKenzie, S.B., Podsakoff, N.P. and Bachrach, D.G. (2008), "Scholarly influence in the field of management: a bibliometric analysis of the determinants of university and author impact in the management literature in the past quarter century", *Journal of Management*, Vol. 34 No. 4, pp. 641-720.

Sakata, I., Sasaki, H., Akiyama, M., Sawatani, Y., Shibata, N. and Kajikawa, Y. (2013), "Bibliometric analysis of service innovation research: identifying knowledge domain and global network of knowledge", *Technological Forecasting and Social Change*, Vol. 80 No. 6, pp. 1085-1093.

Servantie, V., Cabrol, M., Guieu, G. and Boissin, J.P. (2016), "Is international entrepreneurship a field? A bibliometric analysis of the literature (1989–2015)", *Journal of International Entrepreneurship*, Vol. 14 No. 2, pp. 168-212.

Small, H. (1973), "Co-citation in the scientific literature: a new measure of the relationship between two documents", *Journal of the Association for Information Science and Technology*, Vol. 24 No. 4, pp. 265-269.

Sullivan, D., Nerur, S.P. and Balijepally, V. (2011), "Source or storer? IB's performance in a knowledge network", *Journal of International Business Studies*, Vol. 42 No. 3, pp. 446-457.

Thongpapanl, N.T. (2012), "The changing landscape of technology and innovation management: an updated ranking of journals in the field", *Technovation*, Vol. 32 No. 5, pp. 257-271.

Valenzuela, L., Merigó, J.M., Johnston, W., Nicolás, C. and Jaramillo, J.F. (2017), "Thirty years of the journal of business & industrial marketing: a bibliometric analysis", *Journal of Business & Industrial Marketing*, Vol. 32 No. 1, pp. 1-18.

Van Eck, N.J. and Waltman, L. (2010), "Software survey: VOS viewer, a computer program for bibliometric mapping", *Scientometrics*, Vol. 84 No. 2, pp. 523-538.

Yu, D., Li, D.F., Merigó, J.M. and Fang, L. (2016), "Mapping development of linguistic decision making studies", *Journal of Intelligent & Fuzzy Systems*, Vol. 30 No. 5, pp. 2727-2736.

Zhong, S., Geng, Y., Liu, W., Gao, C. and Chen, W. (2016), "A bibliometric review on natural resource accounting during 1995–2014", *Journal of Cleaner Production*, Vol. 139, pp. 122-132.

Corresponding author

Nelson A. Andrade-Valbuena can be contacted at: nandradev@fen.uchile.cl