Bibliometric analysis of worldwide scientific literature in Project Management Techniques and Tools over the past 50 years: 1967-2017

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Abstract:

The Project Management (PM) is being seen as a core activity in business, science, education or any field in which the realization of a set of interrelated tasks has to be achieve over a fixed period and within certain cost and other limitations. PM aims to apply knowledge, skills and techniques and tools to deploy and implement projects effectively and efficiently. PM is a strategic competency for organizations; the professionals involved in this area of knowledge are seeking to develop a culture of result orientation, of effective decision-making and of collaboration through the use of PM Techniques and Tools. In this respect, bibliometric reviews and analysis are developed to evaluate the performance and evolution of the authors and publications that are directly related to the Techniques and Tools of PM. It can also enable the recognition of new and trustworthy Techniques and Tools relevant to the Project Manager.

Keywords: Project Management; Project Management Tools; Project Management Techniques; PM Techniques and Tools; Bibliometric Analysis.

1. Introduction

The Project Management Techniques and Tools are precisely what make managing projects efficient and more effective. These can be described as the ways that we gather information, communicate, and generally get things done. With this in mind, it is interesting to analyze the link between the Techniques and Tools and the knowledge areas of the PM to understand the full impact of these in the Project Management Process: Initialing, Planning, Executing, Monitoring and Controlling and Closing.

In this way, the main objective of the present article is to analyze the link between of the Techniques and Tools of Project Management and the PMBOK 6 Knowledge Areas (Project Integration Management, Project Scope Management, Project Schedule Management, Project Cost Management, Project Quality Management, Project Resource Management, Project Communication Management, Project Risk Management, Project Procurement Management and Project Stakeholder Management) using bibliometric tools. To do that, we target to quantify the main indicators related to bibliometric performance: published publications, received citations, most cited articles, most cited authors, data on geographic distribution of publications, among others. Lastly, using a bibliometric analysis software based on a bibliometric network, we will review the connections.

Bibliometrics can be defined as a set of methods and tools for evaluating and analyzing academic publication and citation in order to explore its impact on a specific field and how it contributes to the progress of science in the main areas of research [1, 2].

2. Methodology and Dataset

Based on a prior review of the state of the art, we focused the analysis according to the terms included in the PMBOK® Guide 6th Edition released on September 2017. In addition to carry out the bibliometric performance and network visualization map analysis, the publications related to the Techniques and Tools of PM have been collected.

The data pertaining to Techniques and Tools of PM were retrieved from Web of Science™ Core Collection using the following advance query: *TS=("Project Management Tool" OR "Project Management Tools" OR "Project Management Technique" OR "Project Management Techniques" OR "Project Tool" OR "Project Tools" OR "Project Technique" OR "Project Techniques")*. In addition, the knowledge base was further refined and limited to Articles, Proceedings and Reviews published in English.

This advance query retrieved a total of 548 publications, of which 405 are directly related to use of the Techniques and Tools of PM. To accomplish this, we downloaded all the publications and reviewed each abstract.

3. Performance Bilbiometric Analysis of the Project Management Techniques and Tools

To understand how the Techniques and Tools of PM have evolved in terms of publication, citations and impact, we evaluated their performance through analysis of the following bibliometric indicators: published publications, received citations, most cited articles, most cited authors, data on geographic distribution of publications and h-index [3, 4].
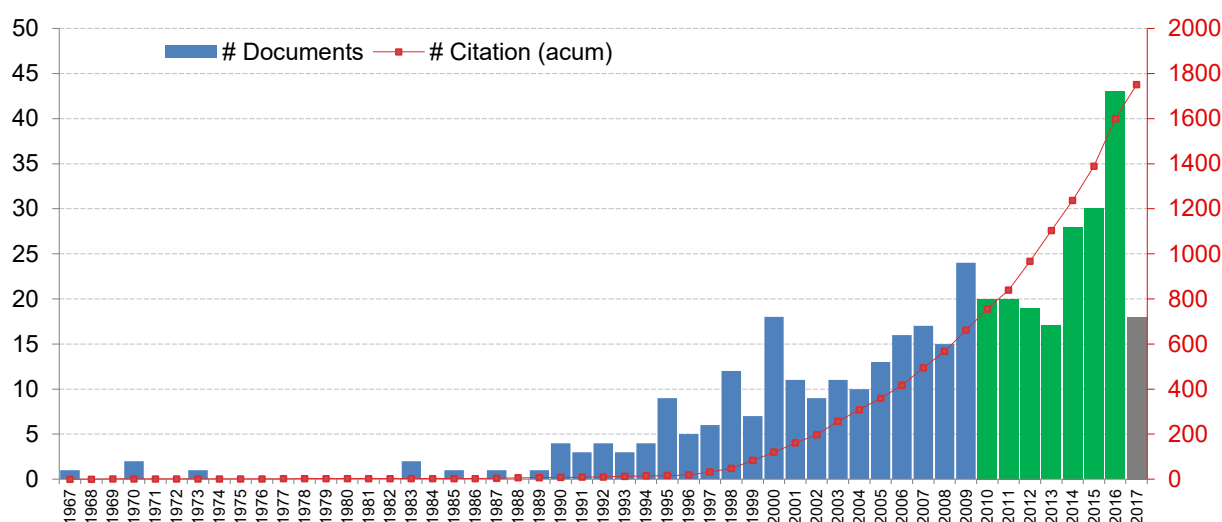
Figure 1. Distribution of Publictiosn by year (1967-2017)

The bibliography performance analysis is structured in two parts: (1) evaluation of the publications and their citations with the aim of testing and evaluating scientific growth; and (2) analysis of the authors, publications, journals and research areas to assess the impact of the publications.

3.1. Publication and Citations

The distribution of publications and citations related to Techniques and Tools of PM per year are shown in Figure 1. It shows that the number of publications has increased in the last years. Since the first publication related to the use and application of Techniques and Tools of PM, we can highlight three milestones in the evolution of this knowledge area. The first was at the beginning of this century, where the number of publications increased fifty percent in comparison to the last maximum year production. The second milestone was on 2009, when the number of publications reaches a new maximum value. Finally, like the previous milestone, the third was on 2016 when the number of publications reaches the maximum from 1967 and 2017. This evolution reveals the growing interest in the Project Management knowledge area and use and research of Techniques and Tools.

On the other hand, the distribution of citations per year is shown in the Figure 1. As with the case of the publications, the citation distribution showed a positive developmental trend in the period 1967-2017. Based on the results of the advance query applied in the Web of Science™ Core Collection of Thomson Reuters™, the citation performance is summarized in the following indicators: Average citations per publication: 4,32; Sum of Times Cited (without self-citations): 1.753 (1.726) and Citing articles (without self-citations): 1.683 (1.659).

Period	# Publications	% N=405	Citations
1967-1976	4	0,99	1
1977-1986	3	0,74	2
1987-1996	34	8,40	16
1997-2006	113	27,90	398
2007-2016	233	57,53	1182
2017	18	4,44	152

Figure 2. Total publications/citations (1967-2017)

3.2. Most Productive and Cited Authors, Geographic Distribution of Publications, Research Areas and h-index (Citation Classics)

It is also important to know which are the most productive and cited authors, along with the geographic distribution of publications and research areas. It complements the bibliometric performance analysis of the Techniques and Tools of PM and allows for an evaluation of where developments have occurred within these fields. Consequently, the most productive authors are shown in Figure 3.

Authors	# Publications
Goncalves, R.Q.	5
Von Wangenheim, C.G.	5
Baina, K.	3
Benali, K.	3
Godart, C.	3
Kayis, B.	3
Kostalova, J.	3
Tetrevoya, L.	3
Miranda, S.	3

Figure 3. Most productive authors (1967-2017)

Along these years, the most cited authors are shown in Figure 4.

Authors	# Citations (% N=1753)
Isakowitz, T., Sthor, E. A. and Balasubramanian, P.	252 (14,38%)
Eppinger, S. D., Sapsed, J. and Salter, A.	107 (6,29%)
Demaio, A.Verganti, R. and Corso, M.	61 (3,48%)

Figure 4. Most cited authors (1967-2017)

It is important to mention that the most productive authors are not included in the list of most cited. It is important mention that these authors are related to the query used to obtain the publications and these don't have to be prominent authors in the PM's field.

The most productive countries related to the Techniques and Tools of PM during the last 50 years are shown in Figure 5.

Countries	# Publications	%
USA	104	25,61
England	29	7,14
Peoples R. China	24	5,91
Australia	20	4,92
Canada	16	3,94
Germany	16	3,94
Italy	16	3,94
India	13	3,20
Spain	13	3,20

Figure 5. Most productive countries (1967-2017)

On the other hand, the journals with the largest number of documents published and their citations are shown in the Figure 6. It highlights that host the main publications, covering sectors as: Construction, Engineering, Information Technology and Project Management.

Name	# Publications	# Cites
International Journal of Project Management	7	107
Project Management Journal	5	84
Automation in Construction	4	105
International Journal of Information Technology Project Management	3	55
Journal of Construction Engineering and Management	3	0

Figure 6. Journals with the highest number of Publications (1967-2017)

Still on the subject of this point, the most relevant WOS Subject Categories are shown in Figure 7.

WoS Categories	# Publications	%
Management	87	21,42
Computer Science Software Engineering	67	16,05
Computer Science Information Systems	56	13,79
Engineering Electrical Electronic	49	12,06
Computer Science Interdisciplinary Applications	45	11,08
Computer Science Theory Methods	44	10,83
Operations Research Management Science	40	9,85
Business	35	8,62
Computer Science Artificial Intelligence	31	7,63

Figure 7. Most relevant WoS Categories (1967-2017)

Finally, the search query used in the database Web of Science™ Core Collection has an h-index of 20. Using as reference the h-index value, we could identify the relevant publications to this research.

To effectively analyze, the next step is to determine the link between the PMBOK 6 Knowledge areas and the main Techniques and Tools of PM using VOSviewer (software tool for constructing and visualizing bibliometric networks) [5].
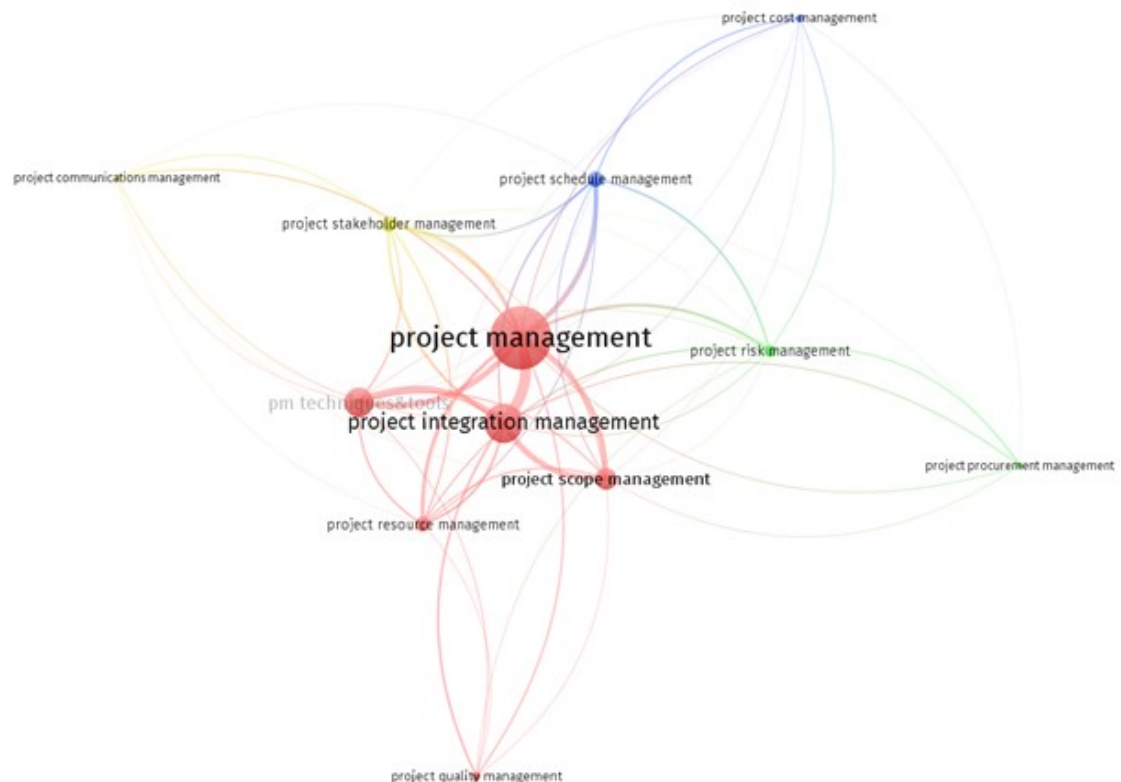

Figure 8. Network visualization map of Techniques and Tools of PM based on the PMBOK knoweldge areas

Cluster	Items	Links (Total link strength)	Occurrences
Cluster 1 (6 items)	Project Management	11 (131)	121
	Project Integration Management	11 (109)	72
	Project Scope Management	11 (59)	37
	Project Quality Management	6 (21)	14
	Project Resource Management	10 (49)	24
	PM Techniques&Tools	10 (62)	53
Cluster 2 (2 items)	Project Risk Management	10 (36)	20
	Project Procurement Management	6 (15)	8
Cluster 3 (2 items)	Project Schedule Management	9 (48)	26
	Project Cost Management	9 (19)	13
Cluster 4 (2 items)	Project Communication Management	7 (18)	7
	Project Stakeholder Management	10 (49)	26

Figure 8. Network visualization map of Techniques and Tools of PM based on the PMBOK knoweldge areas

4. Network visualization map of Project Management Techniques and Tools

The Network visualization map of Techniques and Tools of PM based on the PMBOK knowledge areas is shown in Figure 8. The concepts with minimum occurrences of 5 times were shown in the map. The concepts with the same color were commonly listed together (Cluster). For example, concepts with red color such as PM Techniques&Tools, Project Integration Management, Project Management and Project Scope Management existed in Cluster 1 and had the highest percentage of links within this cluster. The thickness of connecting line between any two concepts indicates strength of relation. For example, the link strength (relation) between Project Management and PM Techniques&Tools is 17 and it represents a thick line. On the other hand, the line between Project Management and Project Integration Management had link strength of 32 [1, 6, 7].

It is important to mention that three items (Project Management, Project Integration Management and Project Scope Management) are related to all other items. In addition, the entire Cluster are interrelated.

5. Conclusions

The size of literature related to techniques and tools of PM showed a noticeable increase in the past decade. Given the large volume of citations received in this field, it is expected that the use of techniques and tools of PM will be seen as part of the projects.

Research in techniques and tools of PM needs to be encouraged, particularly in the new industrial sectors and collaborative projects.

Techniques and Tools are related mainly to the Project Integration Management and Project Scope Management, but has interaction with all of the knowledge areas of PM.

Keep in mind that the focal point of reference for all the items are the Project Management and Techniques and Tools, we identified four Cluster interrelated that group the knowledge areas based on the use of the use and application of Techniques and Tools of PM.

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