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La revista 'Materiales de Construcción', 2003-2012: un análisis bibliométrico

'Materiales de Construcción' Journal, 2003-2012: a bibliometric analysis

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RESUMEN

El objetivo del presente trabajo es realizar un análisis bibliométrico de los artículos y notas técnicas que se han publicado en la revista *Materiales de Construcción* entre 2003 y 2012. Se analizan la productividad de los autores y el grado de colaboración entre los mismos, las instituciones de los autores y sus países de origen, la colaboración entre las instituciones de autores utilizando técnicas de análisis de redes sociales y el factor de impacto de la revista. Los resultados indican que hay elevados niveles en la diversificación y en la colaboración de autores; un alto número de instituciones pero un escaso grado de colaboración entre las mismas; y un gran incremento en el factor de impacto durante el periodo analizado. La principal conclusión de este trabajo es que *Materiales de Construcción* ha evolucionado positivamente desde 2003 a 2012, llegando a ser una revista de calidad en su ámbito.

Palabras clave: revistas científicas; bibliometría; cemento, construcción; España.

ABSTRACT

The aim of the present work was to make a bibliometric analysis of research articles and technical notes published in the journal 'Materiales de Construcción' between 2003 and 2012. Authors' productivity and collaboration, affiliation and nationality of authors, collaboration amongst institutions using techniques of social networks analysis, and the impact factor of the journal were analyzed. The results show high levels in authors' diversification and collaboration; high number of institutions but a low level of collaboration among them; and a big increase of impact factor during all the period. The main conclusion of this work is that 'Materiales de Construcción' has evolved positively since 2003 to 2012, becoming a quality journal in its area.

Keywords: scientific journals; bibliometrics; cement, construction; Spain.

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1. INTRODUCTION

This academic communication is the study of the use and diffusion of information by different methods (1). Amongst the formal and informal communication channels established by researchers and professionals, research journals are the most used channel in almost all sciences. Researchers prefer this type of document because the articles included in this type of journals has been evaluated by specialists of their areas, and they follow the scientific method (2). The structure of Scientific Journals allows us to recognize different aspects of the articles stored in databases, in order to apply measure methods to their contents.

Up to now, Spanish architecture and construction science journals have hardly been studied using metric analysis. There are three papers, one was focused on comparison and visibility of *Materiales de Construcción* with similar journals of architecture area (3). The other two articles examine the visibility and internationality of architecture, construction science and urbanism journals (4) and a bibliometric analysis of Spanish journals about construction technologies included in the Web of Science database between 1997 and 2008 (5).

In some of the works mentioned above, it was found that *Materiales de Construcción* has a superior international standing to other similar journals in Spain, especially if their Impact Factor (IF) are compared. In order to know in greater detail other aspects of this journal, a study has been carried out which analyses different parameters of authorship (productivity of authors, collaboration index and transience index), institutions of authors (productivity by geographical zone and type of institution, collaboration of institutions), members of the editorial teams (institutional procedures, size of teams and permanence of members) and Impact Factor calculated by the Journal Citation Report at two and five years.

2. METHOD

This study had been carried out using all the numbered editions of the Journal *Materiales de Construcción* published between 2003 and 2012. It has only taken into account documents of this journal reviewed by peers: research articles and technical notes. Other documents like editorials, opinion notes and obituaries published during the defined time period were not considered. The data of research articles and technical notes have been taken from the database Web of Knowledge and Journal Citation reports (JCR). The ICYT database has also been used to find details of variation in authorship and the personal affiliations of each author. For each

article and technical note the authors' name, institutional affiliation and their bibliographic reference have been recorded. The data about research articles and technical notes have been taken from the JCR. Also, information has been recorded about the editorial team of the journal, on its paper and electronic forms.

The material obtained has been used to calculate the following indicators grouped according to the origin of the data:

- Authors: It were looked for the transition index of the journal (the percentage of authors who have participated in only one article during the time period of the study), collaboration index (authors' average participation in the making of each document) and the names of the authors who have been signed most articles.
- Institutions of authors: this indicator is based on the authors' countries and type of institution where they worked for. Institutions will be accounted according to the affiliation of each signatory of each article. In addition, inter-institutional collaboration is represented through a network of centres in which the size of each node represents the weight of the entity in the network, and the thickness of the lines conjoining them represents the intensity of the relationship between those institutions. The inter-institutional network has been elaborated using the Cite space program, designed by Chaomi Chen for the representation of social networks (6).
- Institutions of editorial team members: the composition of these groups has been observed during the years 2003- 2012 to see the institutional structures in place, including directorial and secretarial positions within the research groups. It were looked for the endogamy degree of editorial team members (percentage of the members of the team who work for entity which publish the journal), the size of these groups during the time of the study and the permanence of the members of the groups.
- Impact Factor (IF): This index is the result of the division between the number of cited articles over a certain time by the total number of published articles in that time. It has been obtained from the JCR and calculated by the quotes received by the articles in 2 and 5 year periods. The results obtained are compared for each year according to the impact factor of the two years, and the levels which would be reached if the index of self-quotes which calculated the IF were removed. These results were compared with the IF within 5 years, but only from 2007.

In the index calculation, the authors were guided by the data presented by the JCR because it is an impor-

tant source used by the Comisión Nacional Evaluadora de la Actividad Investigadora (CNEAI) of Spain on the subjects of architecture, civil engineering, construction and urbanism. Other sources of information have been discounted as they are not validated by Spanish evaluation agencies.

3. RESULTS

Materiales de Construcción journal published between 2003 and 2012 a total of 328 works (301 research articles and 28 technical notes). The number of published papers varied considerably from one volume to another, as can be seen in Fig 1. This variability in the journal extension was caused in some cases by the use of the journal to publish proceedings of themes related to construction. Those works presented to symposia received the same consideration as the

research articles and technical notes, because they have been submitted to the same quality controls of their content (peer review) as the technical notes and research articles.

3.1. Authors

Analysis of the 328 works published by this journal showed a transience index of 78.53%. The data for authors that took part in more than one paper are much lower: two papers (13.18%), three papers (4.32%), four papers (1.75%), 5 or more papers (2.22%).

The collaboration index has been calculated by the years in which the research articles and technical notes were made. At the beginning of the measured time period, the average number of articles was the lowest (2.94 in 2003) and increases until 2011 (4.2), after that numbers decrease slightly. Over the past 3

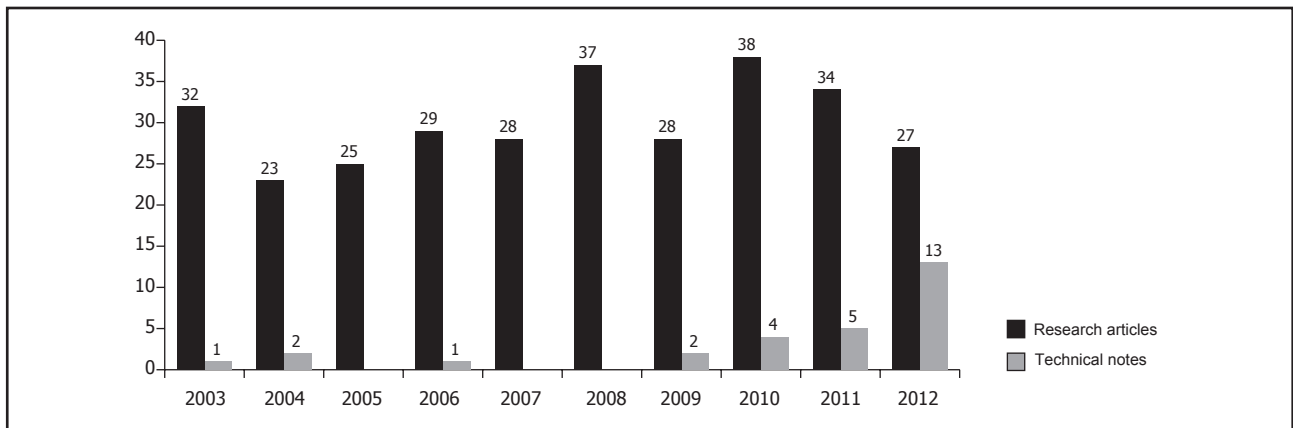


Figure 1. Papers published by year.

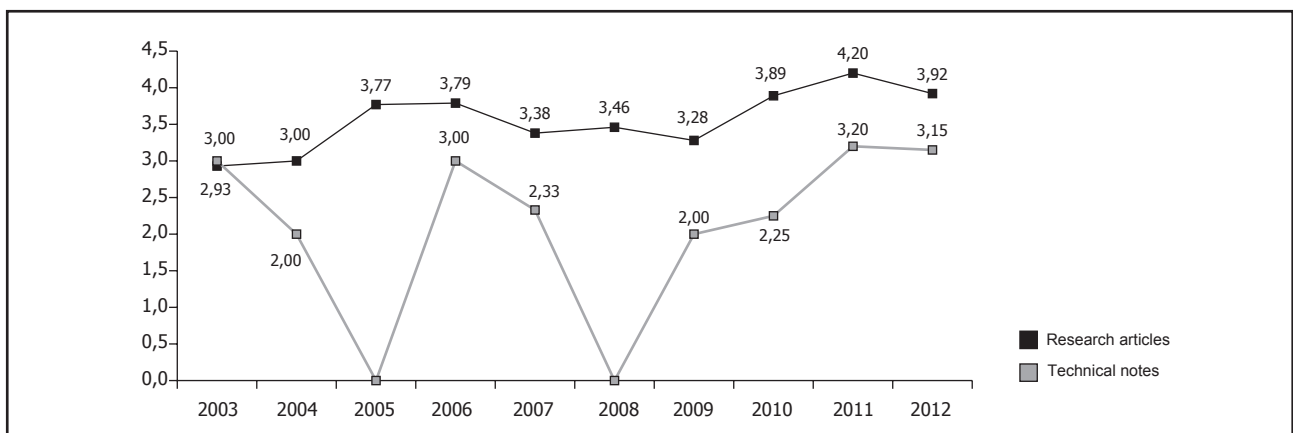


Figure 2. Collaboration index by research article and technical note.

years, the percentage of articles written by less than three authors has gone down considerably (10.53% in 2010, 11.76% in 2011, 14.81% in 2012) compared with data obtained at the beginning of the research period (28.12%, in 2003 and 43.48% in 2004), as it shows in Fig. 2. Focusing on articles with single author, it was seen that they were published almost every year, although higher percentages are seen in 2006 (10.71%, 2008 (8.11%) and 2009 (14.26%), and their influence in the last three years has been minimal (2.94% in 2011 and 3.73% in 2012). With respect to the total number of articles published with single authorship in the ten years analyzed, data shows it to be 5.32% of the total.

Technical notes appear less frequently than research articles. This type of document appears infrequently in one or two journals per year, some years with none at all. However, from 2010 they are included in all editions of the journal occupying the third part of the journal in 2012. The steady and continuous publication from 2010 of technical notes makes no fluctuation from the year average. The percentage of technical notes of single authorship represents 6.45% of the total number of the documents.

3.2. Institutions

As mentioned above in the methodology section, the count of author institutions has been made according to institution of each author of research articles. This calculation shows 216 institutions with a total of 1161 authors.

According to institutional productivity of countries, 216 institutions are based in 33 different countries, which the best 10 are shown in Table 1. From these percentages can be seen the differing origins of the articles: in the main from Spanish institutions (813) followed by Latin-American countries (15.67% of the total), Mexico

(48%), Argentina (35%) and Brazil (30%). Amongst European countries which stand out are: Italy (30%), Portugal (29%) and The United Kingdom (12%), although the total of this group reaches only 9.47% of the total authors. The latter group is formed from 11 countries that have only a testimonial presence in the results, because this group reflects only 5% of the total number of authors. Of the major articles, 157 are Spanish, 13.52% from the Instituto de Ciencias de la Construcción Eduardo Torroja, wherein attends the editor of *Materiales de Construcción* journal.

The productivity of institutions according to type is represented in Figure 3. This shows that universities and higher technical institutes have a greater presence in this group (126 institutions, 58.33% of the total) and their authors show a higher level of productivity of papers (794, 68.39% of the total). Of lesser importance, are research institutes and centers of investigation with 48 institutions (22.22%) and 320 authors (27.56%). In this group there is a clear distinction between the number of institutions and papers because of the higher productivity of authors from the Instituto de Ciencias de la Construcción Eduardo Torroja (13.52% of the total produced). The companies of the construction sector are a total of 23 institutions (10.65%) and 36 authors (3.1%). Public administration departments linked to construction have a reduced presence in the organizations: (8 institutions, 3.7% of the total) and number of authors (11, which equals a total of 0.95%).

Collaboration between institutions, represented in Figure 3, shows a greater relationship between the entities. The initial results obtained with the Cite space program included a main group that gathered together 80 nodes (37.04% of the total number of institutions) and numerous groups formed by fewer nodes which gave little information. According to space concerns and to improve legibility of the figure content, it was

Table 1
Most productive countries.

Country	Percentage
Spain	70.03%
México	4.13%
Argentina	3.01%
Brazil	2.58%
Italy	2.58%
Portugal	2.50%
Colombia	1.98%
Venezuela	1.98%
Cuba	1.21%
United Kingdom	1.03%

decided only to include the main figure in which the relationships between organizations with high numbers of published papers can be seen.

The density of the network, represented in Figure 3 was very low. In this network there are only 83 established relationships between nodes, when the maximum number of relations for a network of reciprocal relations of this size is 4005, it means that it is only reached by 2.07% of the possible relations. This low percentage of relationships resulted because many nodes have only one relation. The thickness of the relationship line between nodes indicates the intensity of the relationship between the institutions. The relationships are particularly strong between Universidad del País Vasco and Labein Tecnalia; Universidad de Alicante and Universidad Complutense de Madrid; Universidad Politécnica de Valencia and Universidad Politécnica de Cartagena; Universidad de Oviedo and Universidad Central de Las Villas; Universidad Politécnica de Cataluña and BBS company; Universidad de Jaén and Universidad de Granada; Universidad de Aveiro and Universidad de Tras Os Montes& Alto Douro; and Instituto Politécnico de Oporto; Universidad de Sevilla and Universidad Autónoma de Tamaulipas and Esri España.

Focusing on the centrality of the node values, meaning the number of nodes to which a subject is directly joined, it can be ascertained that the Instituto de Ciencias de la Construcción Eduardo Torroja is the node with greatest number of links to institutions (19). This is followed by the Universidad Politécnica de Madrid with 12 links, mainly to Spanish institutions, then the Universidad Politecnica de Catalunya with 8 links- half of them with overseas institutions. This followed by the Universidad de Sevilla with 6 links. Looking at the degree of closeness of institutions, the lowest numbers of relationships with shortest inter-nodal distances

(geodesic distance), are the Universidad de Alicante and the Instituto de Ciencias de la Construcción Eduardo Torroja Institute of Construction Science which have the rest of the network of nodes to a maximum distance of 6 links.

With reference to the intermediate position, the University of Alicante has the greatest score as its node joins the two biggest sectors of the network, namely the Instituto de Ciencias de la Construcción Eduardo Torroja and Universidad Politecnica de Madrid. The nodes of these latter two Institutions intermediate to the most important effect, although lower ones are reached by the Universidad de Alicante.

3.3. Editorial team (editorial board and advisory board)

Editorial board and advisory board gathered in different editions of the journal, also called committee and expert overseas committee respectively, have 54 members from 33 institutions. The institutional affiliation of group members is diverse due to the countries of origin of the members or the types of institution which they represent. Regarding nation of origin, Spain has the greatest number of institutions (14, 42.4% of the total), followed by France and the United Kingdom with three institutions each, Italy with two and a group of 11 nations with one institution each (Argentina, Brazil, Canada, Chile, Colombia, Egypt, Mexico, Poland, Portugal, Sweden, Switzerland). The type of institutions shows the dominant ones to be university and superior technical institutions (51.84%) followed by centers of investigation (35.2%), private companies (9.26%) and professional associations (3.7%). Institutions with the greatest percentage of members in both groups are the Universidad Politecnica de Madrid (12.96%), and the Instituto de Ciencias de la Construcción Eduardo Torroja (18.5%), publisher of *Materiales de Construcción*.

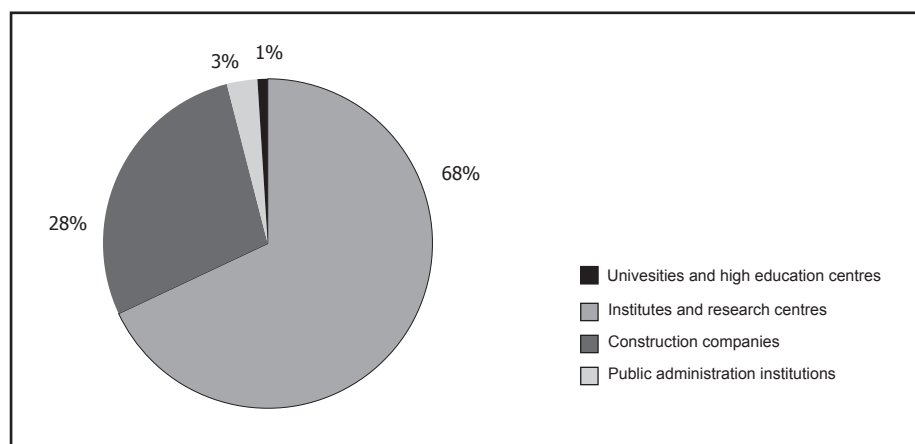


Figure 3. Productivity rates by institution type.

Group composition varies with time, so there are more members in recent years. In 2003, the editorial board was formed by 12 people and the advisory board was composed of 8 people. In 2007, memberships grew in number to 11 and 13, respectively. During 2010, membership again increased to 13 and 22 respectively. At the end of 2012 each group lost one member respectively.

With regard to the permanence of membership, the 37 members of the groups included in the final edition of the journal of 2012, 7 (18.92%) were already in position in 2003, including the journal Director and Secretary of the editorial board, the latter two posts belonging to the Instituto de Ciencias de la Construcción Eduardo Torroja. Of the remaining 37 members, eight (21.62%) joined the groups in 2007 and twenty two (59.46%) were added to the memberships in 2010.

3.4. Impact Factor

The data of the IF for the journal obtained by JCR show a clear tendency to increase during the 10 years of the study, although they decreased in 2007 and 2011. In 2003, the impact factor is very low even when the self quotes within the journals are included in the calculations, (included 0.125 or excluded 0.089). As can be seen in Table 2, from 2004, the IF grows considerably (from 0.125 to 0.483 in one year), although when only considering the self quotes. When calculation of the two years impact factor excludes self quotes, there is a considerable decrease (to less than a third) of the figures obtained with the normal calculation of the IF as occurred in 2006-7.

The position of the journal, in the two areas of the JCR varies considerably during 2003- 2012. In the area of Construction and Building Technology, it starts in 2003 in the fourth quartile, with the lowest position of the whole period (28 out of 29) continuing to the second

quartile in 2004-6. The best positions observed are reached (9th out of 31) in 2005 and (12th out of 31) in 2004. Later, in 2007-8, the position decreases leaving it in a worse position than the previous year 36th out of 56 in 2011 as opposed to 23rd out of 53 in 2010. In 2012, its position improves (27th of 57) as it reached the second quartile.

In the area of 'Multidisciplinary Materials Science' the position occupied between 2003 and 2012 was worse than that achieved by the journal in the area of 'Construction and Building Technology'. In 2003 it was in the fourth quartile ascending to the third quartile from 2004 to 2006 when it gains best position of the period (120th of 177 in 2004, 118th of 178 in 2005 and 123rd of 176 in 2006). The position falls in the fourth quartile in 2007, improving in the third quartile of 2008-10. In 2011, the last quartile, it achieved a lower position of 192nd of 232, and in 2012, improves in third to a position of 164th of 239.

The Impact Factor calculated in the last five years and collected in the JCR from 2007, shows a constant increase. If we compare it with the I.F. obtained over two years from the editions of the journal (from 2007 to 2012) it can be seen that the figures are similar in most years with little variation.

4. DISCUSSION

Overall, the results obtained for *Materiales de Construcción* according to the measurements used, show that the scientific journal is one of high quality. Indicators within the bibliometric data relating to the impact of the published works, place the journal alongside other prestigious scientific, architectural and construction science and materials journals, as can be seen in the JCR rankings. In the case of scientific productivity and the level of collaboration between institutions, no

Table 2
Impact Factor 2 and 5 years.

Year	FI 2 years	FI 2 years without self quotes	FI 5 years
2003	0.125	0.089	
2004	0.483	0.167	
2005	0.542	0.373	
2006	0.519	0.173	
2007	0.393	0.125	0.444
2008	0.603	0.259	0.552
2009	0.730	0.492	0.579
2010	0.646	0.523	0.591
2011	0.437	0.366	0.677
2012	0.788	0.600	0.757

comparisons can be made because of the lack of previous bibliometric research in Spain.

With reference to the production of articles, the author indexes show a high level of collaboration between and the production of articles from the relevant authors. The degree of diversity amongst the authorship may be tested by the high level of the transience index. The presence of researchers from the institution publisher of the journal in the most prolific list may give a false idea of the productivity of this institution because only 17.18% of the articles have been published by the Instituto de Ciencias de la Construcción Eduardo Torroja. This data contrasts with study in the journal in 2008 (3) in which it was seen that 45% of articles were published by personnel from the Institute.

The Collaboration Index gradually increases during the 2003-12 period in the documents seen, but with variation due to a lack of documental consolidation between the authors of technical notes. The average number of authors by article is 3.56, whereas the average for technical notes is 2.09. The level of collaboration is high on the articles and low on the technical notes for the reasons mentioned above.

Productivity by Institution shows moderate levels of inclusion of overseas institutions. The high percentage of papers written by authors from Spanish organizations (70.03%) followed by Latin-american ones (15.67%) leaves little opportunity for collaboration between organizations in countries with high levels and quality of scientific production (USA, China, United Kingdom, Japan and Germany, amongst others). The percentage of authors from Spanish organizations is over 58% which was seen in Puertas et al, 2008 (3). Limitation to specific geographical areas could make authors favors *Materiales de Construcción* as journal with low visibility, in particular those researchers from within the USA, Canada, and Asiatic countries as was seen in the 2008 study.

In the productivity by type of institutions, it shows a high presence of university research centers and technical colleges following the tendency of Spanish journals included in the category Construction and Building Technology of Web of Science database (5). As can be seen in the study, the interest in publishing in this journal reveals a high level of permanence in the scientific community, as mentioned in another study (3). The scarcity of works made by professionals in the

construction industry hindered the research. The low percentage of authors who work in the construction sector suggests that the themes seen in *Materiales de Construcción* have little interest for those outside the academic or research fields.

Collaboration between institutions is rare and tends to be done via personal contact rather than interest in a particular author from individual institutions or organizations. The illustration of network collaboration (Figure 4) shows that just over one third of organizations have an inter-institutional relationship and over half of the established relationships are with four institutions: Instituto de Ciencias de la Construcción Eduardo Torroja, Universidad Politecnica de Madrid, Universidad Politecnica de Catalunya, and Universidad de Sevilla. The inter-institutional relationships represented by the network show a high level of localism to institutions by authors of the journal.

The *Materiales de Construcción* boards vary during the study period, so there are high numbers of members of organizations and overseas companies which must be adapted to the criteria of admission to differing scientific databases (7, 8), even excluding the endogamy observed in earlier editions of the journal (3). In 2003, 30% of the contributors were employed by the publisher of the journal and 60% of those previously worked in Spanish institutions. In 2007, the number of contributors had risen to 24, but the number of contributors from their own institution had decreased with the percentage of overseas contributors increasing to 41.66%. In 2010, the number of contributors increased to 34 then reducing to 32 in 2012 with a limited number of contributors from the Instituto Eduardo Torroja (15.62%). Also a high number of Spanish members (62.5%) were seen, this according to the localism noticed in author productivity. This percentage is lower than that observed in other journal studies with different themes in which they have up to 75% of overseas contributors to standing committees (4).

The impact factor during the study period sees the position of *Materiales de Construcción* improve considerably within the areas of construction and building and multidisciplinary materials science according to the JCR, thus raising their profile significantly. It is the Spanish journal with the best position in the JCR ranking in the afore mentioned sectors, in which, unfortunately, there are only two other journals, namely: *Materiales de Construcción* and *Informes de la Construcción* (5).

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