A survey of Quality Engineering-Management journals by bibliometric indicators

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Abstract

This article analyzes some of the most popular scientific journals in the Quality field from the point of view of three bibliometric indicators: the Hirsch (*h*) index for journals, the total number of citations and the *h*-spectrum. In particular, *h*-spectrum is a novel tool based on *h*, making it possible to (i) identify a reference profile of the typical authors of a journal, (ii) compare different journals and (iii) provide a rough indication of their "bibliometric positioning" in the scientific community. Results of this analysis can be helpful for guiding potential authors and members of the scientific community in the Quality Engineering/Management area. A large amount of empirical data are presented and discussed.

Keywords: Hirsch index, Hirsch spectrum, citations, journal authors, Quality Engineering/Management journal, bibliometrics.

1. Introduction

In the world of scientific research there is a large number of journals, which represent the natural destination of the output of researchers. These journals cover many different scientific disciplines and can be differentiated by subject/topic of interest, reputation and popularity within the scientific community. Even if representing a relatively limited portion of the Engineering field, Quality (i.e. Quality Engineering/Management) is not an exception: in this area the are several scientific journals, constantly growing in number.

Considering the perspective of a researcher of this area, many questions may be raised: "What criteria can be used to evaluate and compare different journals in the Quality field?", "How is it possible to find rough information on the author population of each Quality journal?", "What is the bibliometric positioning of different Quality journals and their influence on the scientific community?".

Answering the previous questions is not a trivial task. There are many ways to monitor, compare and study how scientific journals change over the years, like considering their circulation, the reputation/prestige of the editorial board or the presence of articles submitted by eminent authors. However, these evaluations are often subjective and not very reliable. A more objective tool for this purpose can be represented by bibliometric indicators, which are based on citation statistics. Although indicators can show some weak

points, most of the time they seem to be the main way for evaluating, comparing and ranking scientific journals [1-3].

The goal of this paper is to analyse some of the major Quality journals from the point of view of three bibliometric indicators. Analysis results can be helpful for guiding potential authors and members of the scientific (academic) community in the Quality Engineering/Management area. Indicators are respectively the Hirsch (*h*) index for journals, the total number of citations (C) and the *h*-spectrum. *h* index for journals and C are relatively diffused whereas *h*-spectrum is introduced for the first time in order to complement the others [4-5]. Differently from other very diffused indicators like ISI Impact Factor (ISI-IF), Cited Half-life and Immediacy Index – which are evaluated only for the journals indexed by Thomson Scientific – the indicators we propose can be applied to every kind of journal [6, 7]. Particular attention is given to *h*-spectrum. This indicator can be used for several practical purposes:

- to define the profile of the "typical authors" of a specific journal. This profile may represent a reference for other (potential) authors;
- to help a journal's editorial board to periodically monitor the effect of the paper selection policy, from the viewpoint of the population of the journal authors. In this sense, *h*-spectrum may become an indicator of editorial strategy.
- to provide a rough indication on the bibliometric positioning of a journal on the scientific community.

All the three examined indicators are based on citation statistics and, as well as ISI-IF, they should not be used for comparing journals of different disciplines (e.g. Medicine, Physics, Engineering, Mathematics etc.), owing to the different citation rates [8].

The remaining of this paper is organised into three sections. Section 2 provides a description of the bibliometric indicators that are used in the analysis. Section 3 focuses on the analysis methodology. Section 4 presents some analysis results and reflections about them. Finally, conclusions are given, summarising the original contribution of this paper.

2. Bibliometric indicators

2.1 *h*-index

The *h*-index is a relatively recent bibliometric indicator for evaluating the scientific productivity and diffusion of one author in terms of publications and citations respectively. *h* is defined as the number such that, for one author's publications, *h* publications received at least *h* citations while the other publications received no more than *h* citations [4, 9]. Fig. 1 illustrates the calculation of *h* for a fictitious author. In general, the larger *h*, the larger the diffusion and prestige of one author in the scientific community.

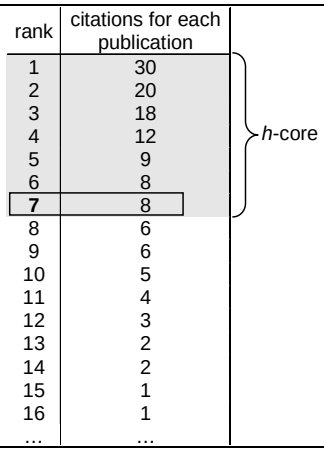


Fig. 1 – Example of calculation of the *h*-index for a (fictitious) author. Publications are sorted in descending order with respect to the citation number. In this case *h*=7 since seven publications received at least seven citations each. It can be noticed that *h* corresponds to the size of a particular subset containing the most cited publications (*h*-core) [4].

A peculiarity of *h* is that it cannot decrease with time. In fact, it aggregates the number of papers and the corresponding number of citations, and both these variables do not decrease over time. For example, in case of career interruption or retirement, the *h*-index of one author remains constant or may increase (if already published papers accumulate new citations). The negative consequence of this fact is that *h* is not perfectly suitable to compare scholars with different seniority, being in favour of those with long careers [3].

Ever since its introduction, *h* received much attention and also some criticism; in any case it has the unquestionable merit of being simple, synthetic and robust [10-24]. Another tangible sign of the popularity of *h* is the appearance of many proposals for new variants and improvements [8, 25-36].

Braun et al. [28] proposed using the *h*-index for evaluating and comparing scientific journals as well. In detail, the *h*-index of a journal is the number such that, for the group of articles published by the journal in a precise time period (e.g. one year), *h* articles received at least *h* citations while the others received no more than *h* citations. Thus, the way of calculation is the same as that one shown in Fig. 1, with the only exception that the articles are related to a journal in a specific publication period.

2.2 Total number of citations

C is the total number of citations so far received by the journal issue(s) published in a specific period (e.g. in one year). This information is immediately available from the most diffused search engines (i.e. Google Scholar, Web of Science and Scopus) and does not require any calculation [7, 23, 37].

2.3 *h*-spectrum

h-spectrum is defined as the distribution representing the *h* values associated to the authors (and co-authors) of a specific journal, considering a specific publication period [5]. The term “spectrum” is originated from the fact that this distribution provides an image of the journal author population in a precise time period. Advantages of this new indicator are discussed later on.

3. Methodology

We selected twelve different journals from the most popular and representative in the Quality Engineering/Management discipline [7, 38]. These journals belong to different publishers and only few of them (see Tab. 1) are indexed by Thomson Scientific. Also, Tab. 1 reports the journal acronyms used hereafter in the text.

Journal name	Acronym	Publisher	Indexed by Thomson Scientific
IIE Transactions (on Quality and Reliability Engineering)	IIETR	Taylor & Francis	Yes
International Journal of Quality and Reliability Management	IJQRM	Emerald	No
Journal of Quality in Maintenance Engineering	JQME	Emerald	No
Journal of Quality Technology	JQT	ASQ	Yes
Managing Service Quality	MSQ	Emerald	No
Quality Engineering	QE	ASQ	No
Quality Management Journal	QMJ	ASQ	No
Quality Progress	QP	ASQ	No
Quality and Quantity	QQ	Springer	Yes
Quality and Reliability Engineering International	QREI	Wiley	Yes
Technometrics	TM	ASQ	Yes
Total Quality Management & Business Excellence	TQM	Taylor & Francis	No

Tab. 1 – List of the twelve Quality journals selected for the analysis. Journals are sorted in alphabetical order with respect to the journal acronym.

For each journal we calculate *h*, C, and the *h*-spectrum relative to different years.

Citation statistics are collected using Google Scholar (GS) as search engine. It was decided to use this database (i) because of its grater coverage and (ii) since it can be easily accessed through the Publish or Perish (PoP©) freeware software, specially designed for citation analysis with GS [23]. Nevertheless, the analysis can be repeated using other databases, like Web of Science or Scopus. Indicators are calculated taking into account the citations accumulated up to the moment of the analysis (in our case, June 2009).

It is worthwhile remarking that QP is not a refereed archival journal like the others, and it is generally addressed to practitioners rather than academics. Despite this significant distinction, QP has been included in the list of journals because it sometimes contains ideas or insights of interest for the academic world. Furthermore, we point out that that IIETR is composed of four focus issues: Design and Manufacturing, Operations Engineering and Analysis, Quality and Reliability Engineering, and Scheduling and Logistics. For homogeneity with the other journals, only the contributions related to Quality and Reliability Engineering are taken into account in the analysis. As a consequence, the number of examined articles and the corresponding authors associated to IIETR are significantly smaller than those associated to the other journals.

4. Empirical data analysis

4.1 *h* and C viewpoint

Fig. 2 and Fig. 3 represent the values of *h* and C for the twelve Quality journals in Tab. 1 in twenty consecutive years (from 1989 to 2008). For example, in the year 2000 JQT's *h* is 14, meaning that the 14 most cited articles published in JQT have received at least 14 citations each.

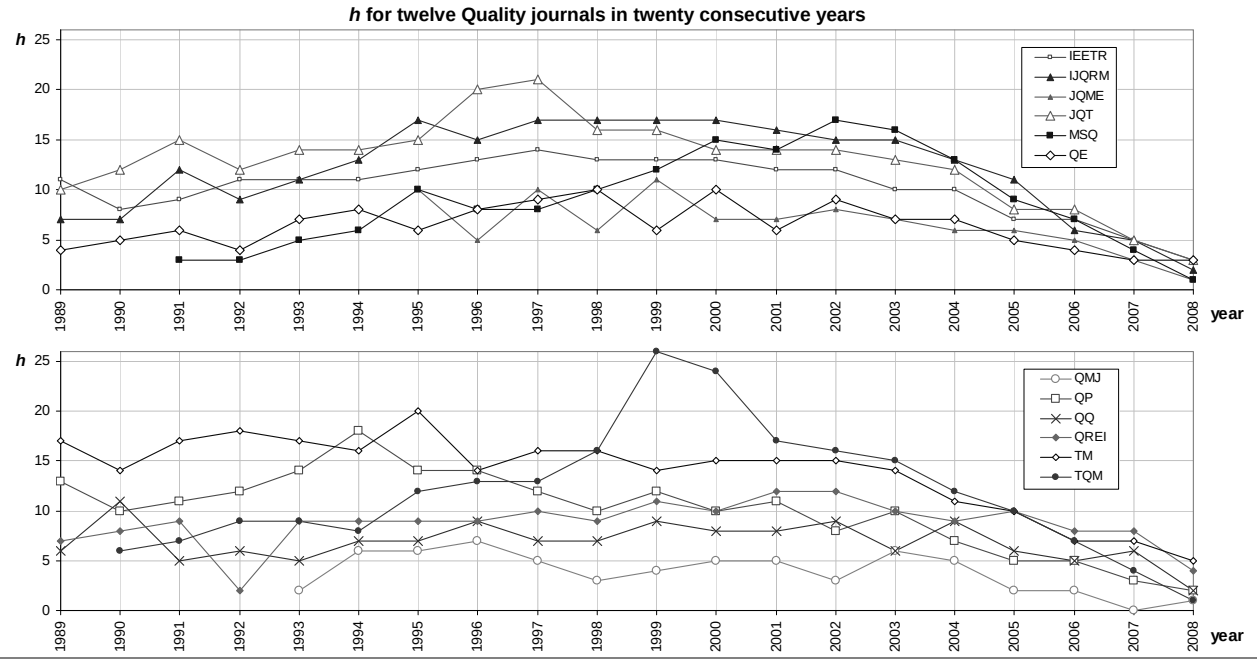


Fig. 2 − *h* values for the twelve Quality journals (see Tab. 1), in twenty consecutive years (from 1989 to 2008). Values are calculated taking into account the citations accumulated up to the moment of the analysis (June 2009). For the purpose of readability, journal profiles are first sorted in alphabetical order with respect to the journal acronyms and then divided in two groups of six each.

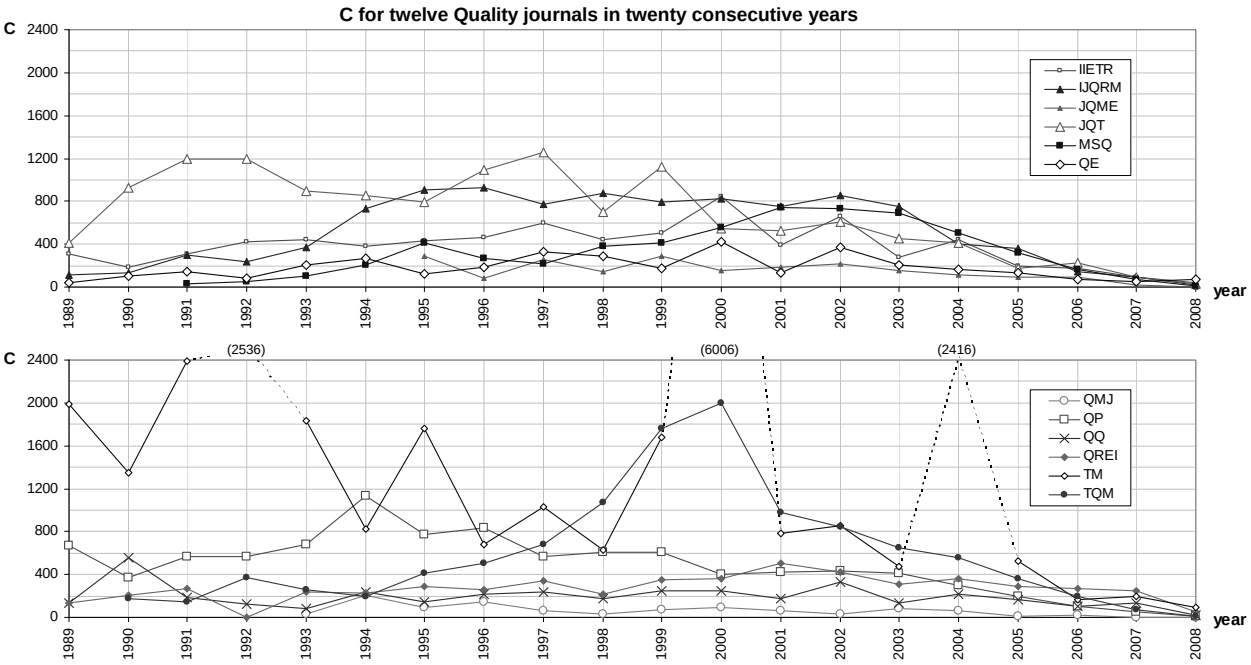


Fig. 3 − C values for the twelve Quality journals (see Tab. 1), in twenty consecutive years (from 1989 to 2008). Values are calculated taking into account the citations accumulated up to the moment of the analysis (June 2009). For the purpose of readability, journal profiles are first sorted in alphabetical order with respect to the journal acronyms and then divided in two groups of six each. The profile of TM has many peaks – precisely those related to 1992, 2000 and 2004 – falling beyond the upper limit of the vertical axis scale. The corresponding numeric values are reported in brackets. In these years, C values are inflated by a small number of "big hit" articles with a huge number of received citations.

In general, *h* and C have quite similar patterns. Their empirical correlation is represented in Fig. 4, taking into account three of the twelve examined journals. Considering the scientific production of one scholar,

Hirsch empirically showed that C is approximately proportional to h^2 [4]. Analysing the patterns in Fig. 4, this behaviour seems to apply to the *h* for journals as well.

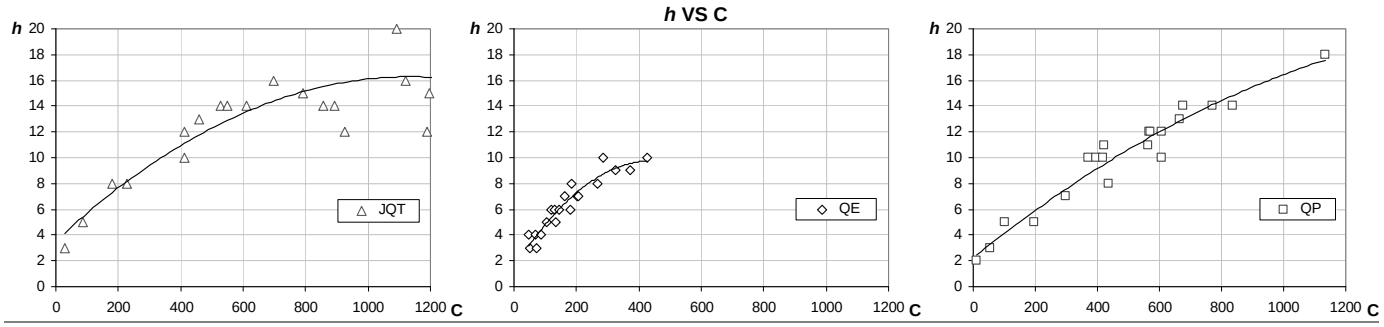
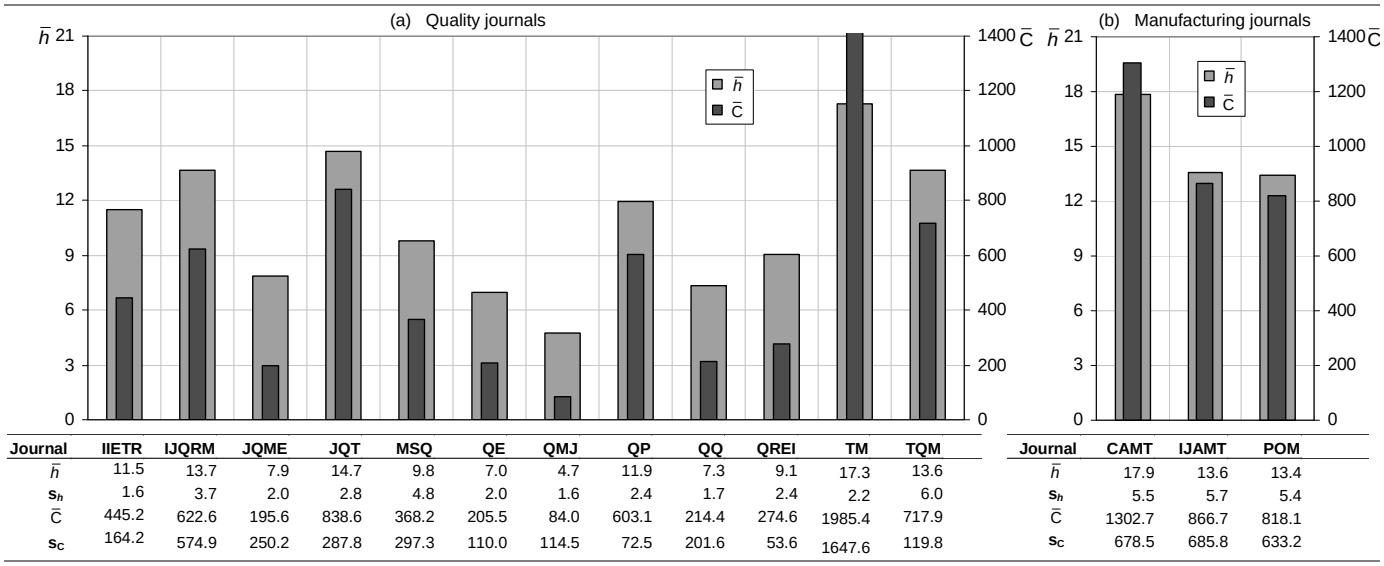


Fig. 4 – Relationship between *h* and C considering data related to three Quality journals (i.e. JQT, QE and QP), over twenty consecutive years (from 1989 to 2008). Hirsch empirically showed that, for one researcher, C is approximately proportional to h^2 [4]. This behaviour seems to apply also to the *h* for journals and can be extended to the remaining journals.

The C profile of TM looks rather nervous, with many peaks that often fall beyond the upper limit of the vertical axis scale. The reason is that – in several years, such as 1991, 1992, 2000 and 2004 – C values are inflated by a small number of "big hit" articles with a huge number of received citations. For instance, in 2000, TM published 3 articles that received so far more than 1500 citations each. On the other hand, the TM's *h* profile is rather smooth. This is an empirical demonstration that, being insensitive to accidental excess of lowly and highly cited articles, *h* is a robust indicator [19]. Furthermore, in 1999 and 2000 we can observe a peak in the *h* and C profiles of TQM. Again, this is due to the presence of a relatively large number of highly cited publications. Profiles relative to the other journal are fairly more regular, with moderate fluctuations. Profiles of TQM, QMJ, MSQ and JQME are not complete since these journals appeared for the first time after 1989.

h and C can be used to compare different journals. It must be pointed out that citation accumulation of one article requires a certain amount of time to become stable. According to some authors, about five years for journals in the management/engineering field [6, 39, 40]. This "physiological" behaviour is well represented in Fig. 2 and Fig. 3 and applies to most of the journals: in the last years (e.g. from 2004 to 2008), *h* and C values tend to decrease and are significantly smaller than in the previous years. Thus, *h* and C are not suitable to evaluate the most recently published journals and, much less, to compare them with other older publications. Besides, being sensitive to the number of articles per issue, if calculated on a yearly basis, *h* and C tend to favour journals with many articles/issues per year.

Apart from the last five years, most of the journal *h* values are included between 5 and 15. Similarly, most of the journal C values are included between 100 and 1000. Fig. 5-a shows the journal *h* and C mean values (respectively $\overline{h}$ and $\overline{C}$) and the corresponding standard deviations (respectively s_h and s_C), in the years 1989-2003. It can be interesting to see how these typical values compare to those of other adjacent scientific fields. Fig. 5-b reports the values related to three major journals in the Manufacturing area.



Journal	IIETR	IJQRM	JQME	JQT	MSQ	QE	QMJ	QP	QQ	QREI	TM	TQM
$\bar{h}$	11.5	13.7	7.9	14.7	9.8	7.0	4.7	11.9	7.3	9.1	17.3	13.6
s_h	1.6	3.7	2.0	2.8	4.8	2.0	1.6	2.4	1.7	2.4	2.2	6.0
$\bar{C}$	445.2	622.6	195.6	838.6	368.2	205.5	84.0	603.1	214.4	274.6	1985.4	717.9
s_C	164.2	574.9	250.2	287.8	297.3	110.0	114.5	72.5	201.6	53.6	1647.6	119.8

Journal	CAMT	IJAMT	POM
$\bar{h}$	17.9	13.6	13.4
s_h	5.5	5.7	5.4
$\bar{C}$	1302.7	866.7	818.1
s_C	678.5	685.8	633.2

Fig. 5 − *h* and C mean values - respectively $\bar{h}$ and $\bar{C}$ - and corresponding standard deviations - respectively s_h and s_C - (a) for twelve Quality Journals and (b) for three additional Manufacturing journals, in the years 1989-2003. Manufacturing journal acronyms are: CIRP Annals - Manufacturing Technology (CAMT), International Journal of Advanced Manufacturing Technology (IJAMT), Production and Operations Management (POM).

4.2 *h*-spectrum viewpoint

The *h*-spectrum analysis can be divided in two distinct activities:

- construction and comparison of the *h*-spectra related to the twelve journals in the same reference year (i.e. 2008), so as to investigate how the *h*-spectrum changes from journal to journal;
- construction and comparison of the *h*-spectra related to the same journal(s) in five consecutive years (precisely, from 2004 to 2008), so as to investigate how a journal's *h*-spectrum tends to change over time.

Analysis in the year 2008

For each journal, we identify the authors of papers published in 2008. Then, the *h*-indexes of the individual authors are calculated. Finally, the distribution of the authors' *h*-indexes is constructed. The output of this analysis is illustrated in Fig. 6, showing the *h*-spectra related to the journals in Tab. 1.

At a first glance, all these distributions are right-skewed and have a characteristic profile, which is approximately decreasing. Analysing the distributions in more detail, some interesting aspects emerge. Fig. 7 shows the *h*-index average value ($\bar{h}$), the corresponding standard deviation (s) and the number of authors (N) associated to each journal. Journals are sorted in descending order with respect to $\bar{h}$. It can be seen that, despite their similar shape, distributions are appreciably different in terms of values of $\bar{h}$ and s.

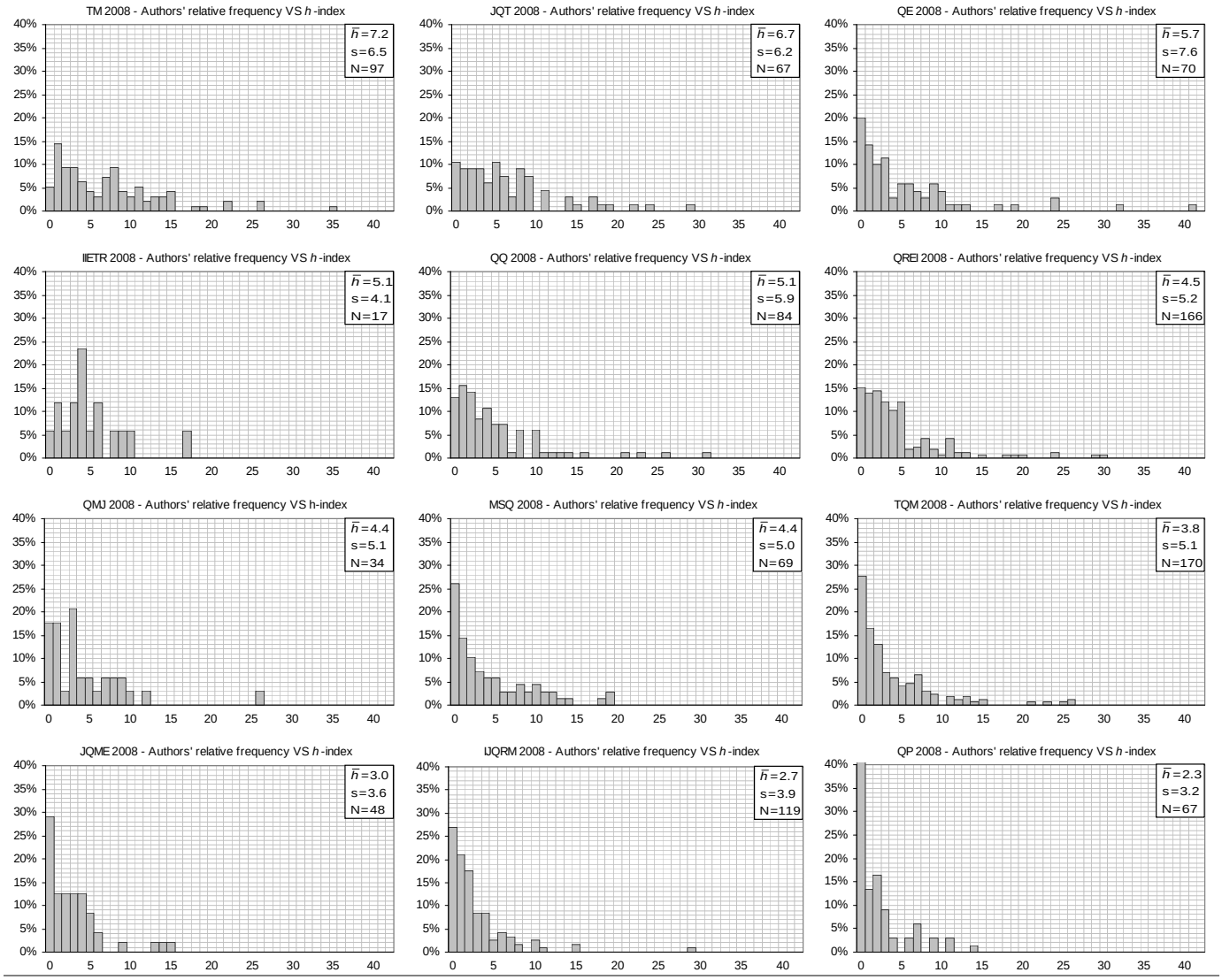
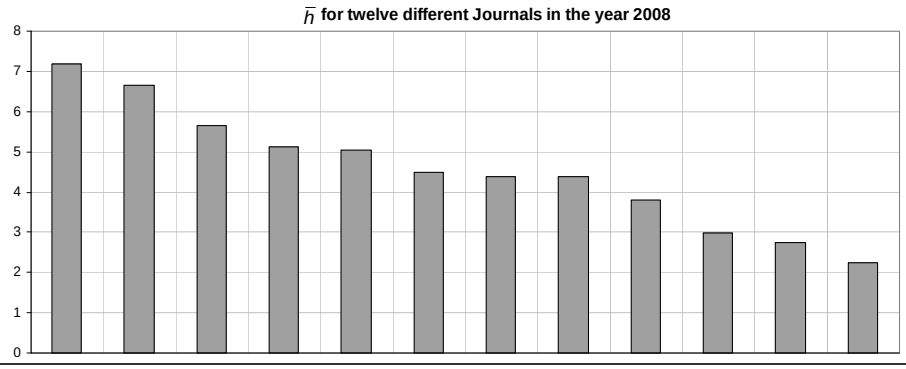


Fig. 6 − *h*-spectra (authors' relative frequency VS *h*-index) for twelve Quality journals (see Tab. 1), in the year 2008. For each journal, the authors' *h*-index average value ($\bar{h}$), the corresponding standard deviation (s) and the number of authors (N) are reported. Spectra are sorted in descending order with respect to $\bar{h}$ values.



Journal	TM	JQT	QE	IIETR	QQ	QREI	QMJ	MSQ	TQM	JQME	IJQRM	QP
$\bar{h}$	7.2	6.7	5.7	5.1	5.1	4.5	4.4	4.4	3.8	3.0	2.7	2.3
s	6.5	6.2	7.6	4.1	5.9	5.2	5.1	5.0	5.1	3.6	3.9	3.2
N	97	67	70	17	84	166	34	69	170	48	119	67

Fig. 7 − Synthetic results of the analysis of twelve Quality journals, in the year 2008. The table reports the $\bar{h}$, s and N values relative to each journal. In the bar-chart, journals are sorted in descending order with respect to $\bar{h}$.

Furthermore, it is interesting to notice that – considering the same journal – $\bar{h}$ and s have generally similar values. Their empirical correlation is nearly linear with a rather high coefficient of determination

($R^2 = 0.85$, see Fig. 8). On the other hand, there is no empiric correlation between $\bar{h}$ and N or s and N ($R^2 \approx 0$).

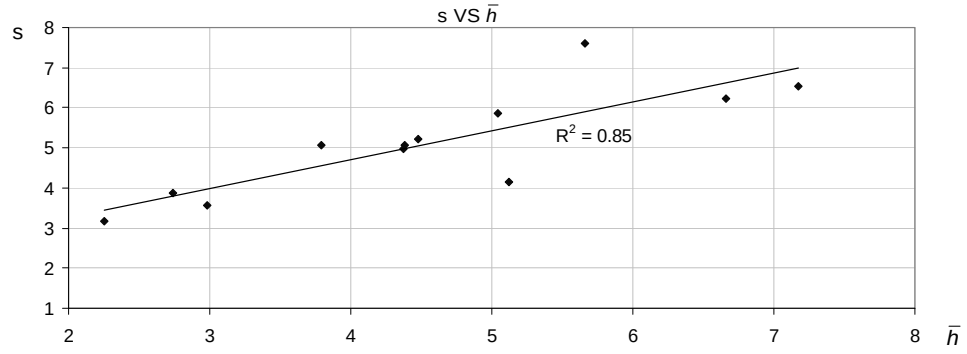


Fig. 8 – Relationship between s and $\bar{h}$ related to the *h*-spectra in Fig. 6.

On the basis of this result, it seems quite appropriate using $\bar{h}$ as a synthetic indicator to perform quick evaluations and comparisons among different *h*-spectra.

Analysis over five consecutive years

The second part of our study is aimed at finding how *h*-spectra changes over time. To this purpose, the construction of the journal *h*-spectrum is extended to five consecutive years (from 2004 to 2008). For simplicity, Fig. 9 reports the resulting spectra concerning only three of the previous twelve journals (JQT, QE and QP).

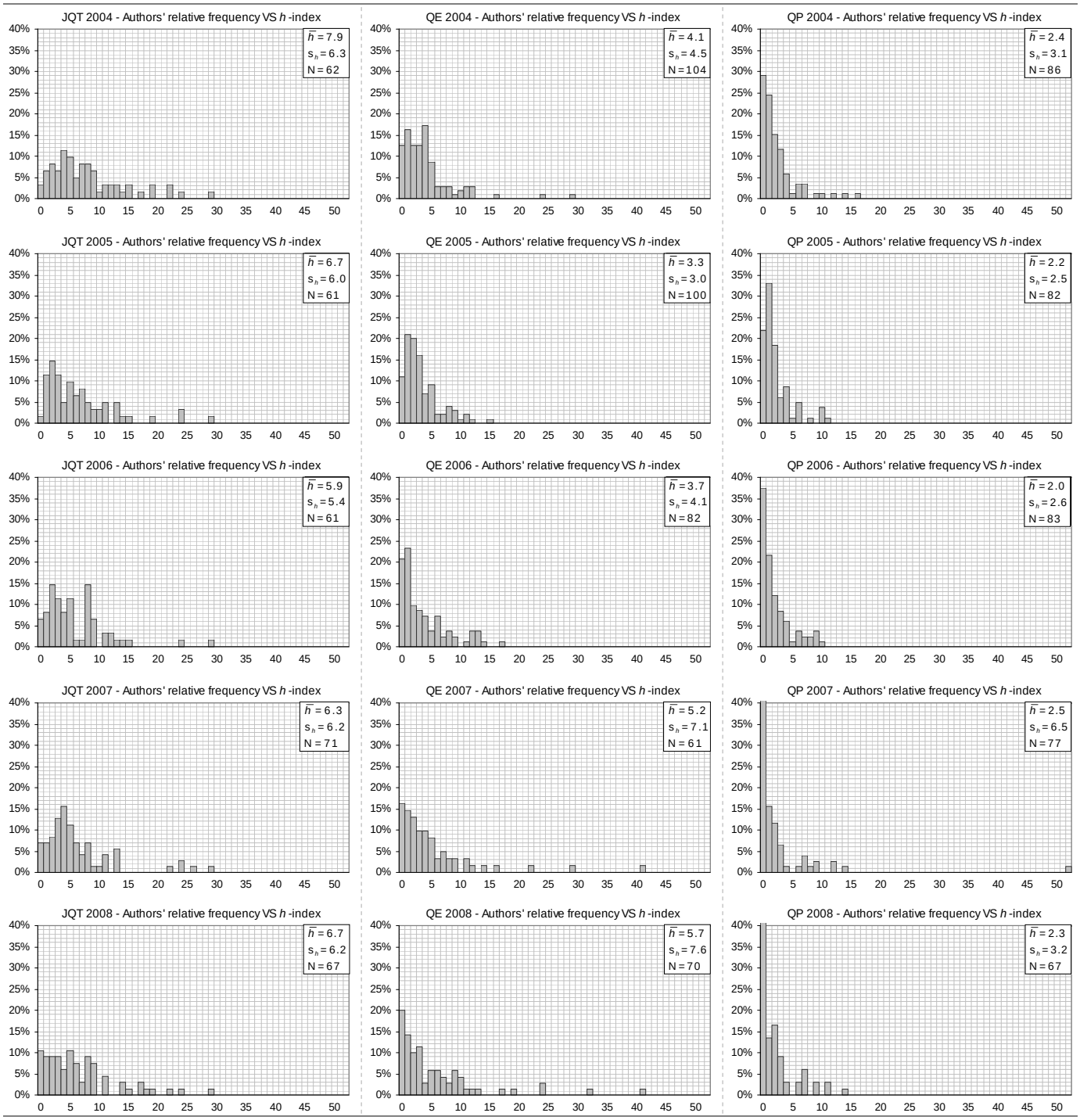
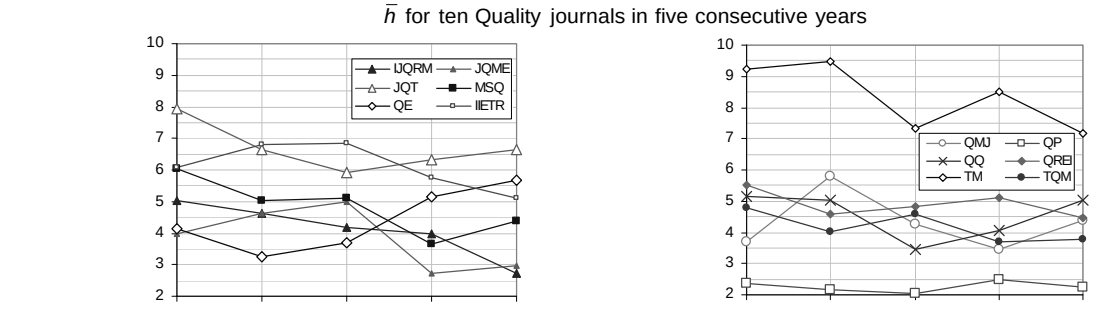


Fig. 9 – *h*-spectra associated to three Quality journals (JQT, QE and QP), in five consecutive years (from 2004 to 2008). For each spectrum, $\bar{h}$, s and N are reported.

For each of these journals, the *h*-spectrum seems relatively robust and stable over the five examined years. This behaviour can be extended to the nine remaining journals, as it emerges analysing the $\bar{h}$ profiles in Fig. 10. Possible variations in one journal profile are due to (i) change of the journal editorial board, (ii) variation of the article selection policy, (iii) appearance of a competing journal etc…

Considering the shape of *h*-spectrum profiles, moderate fluctuations can be observed over the years (see Fig. 10). Two possible reasons of the profiles' relative stability are:

- authors of a particular journal tend to be "attracted" to it over the years;
- the editorial board policy tends to be consistent over time.



		2004	2005	2006	2007	2008
IIETR	$\bar{h}$	6.1	6.8	6.8	5.8	5.1
	s	3.4	6.0	5.9	4.1	4.1
	N	22	25	19	13	17
IJQRM	$\bar{h}$	5.0	4.6	4.2	4.0	2.7
	s	4.4	4.5	4.7	4.4	3.9
	N	117	116	111	110	119
JQME	$\bar{h}$	4.0	4.6	5.0	2.7	3.0
	s	3.9	3.8	5.4	2.9	3.6
	N	50	57	57	65	48
JQT	$\bar{h}$	7.9	6.7	5.9	6.3	6.7
	s	6.3	6.0	5.4	6.2	6.2
	N	62	61	61	71	67
MSQ	$\bar{h}$	6.0	5.0	5.1	3.7	4.4
	s	5.8	5.2	4.9	3.5	5.0
	N	80	75	82	82	69
QE	$\bar{h}$	4.1	3.3	3.7	5.2	5.7
	s	4.5	3.0	4.1	7.1	7.6
	N	104	100	82	61	70

		2004	2005	2006	2007	2008
QMJ	$\bar{h}$	3.7	5.8	4.3	3.4	4.4
	s	4.5	8.0	6.5	4.7	5.1
	N	31	28	35	25	34
QP	$\bar{h}$	2.4	2.2	2.0	2.5	2.3
	s	3.1	2.5	2.6	6.5	3.2
	N	86	82	83	77	67
QQ	$\bar{h}$	5.1	5.0	3.4	4.1	5.1
	s	4.4	5.8	3.3	4.9	5.9
	N	77	80	84	87	84
QREI	$\bar{h}$	5.5	4.6	4.8	5.1	4.5
	s	5.3	4.8	4.8	5.3	5.2
	N	120	135	141	150	166
TM	$\bar{h}$	9.2	9.5	7.3	8.5	7.2
	s	7.9	8.1	5.6	6.9	6.6
	N	54	63	90	86	97
TQM	$\bar{h}$	4.8	4.0	4.5	3.7	3.8
	s	5.4	4.3	5.3	4.8	5.1
	N	128	153	155	157	170

Fig. 10 − Graphs showing the $\bar{h}$ time evolution for the twelve Quality journals (see Tab. 1), in five consecutive years (from 2004 to 2008). For the purpose of readability, journal profiles are first sorted in alphabetical order with respect to the journal acronyms and then divided in two groups of six each. Tables report the corresponding s and N values.

Since, there can be small variations from one year to the next, we noticed that the characteristic shape of one journal's *h*-spectrum becomes more and more consolidated by increasing the reference time period. This aspect is shown in Fig. 11, reporting the *h*-spectra for three of the twelve Quality journals, in three different time periods (one year, three years and five years, respectively). Numerical data related to the *h*-spectra of all the examined journals are reported on Tab. 2.

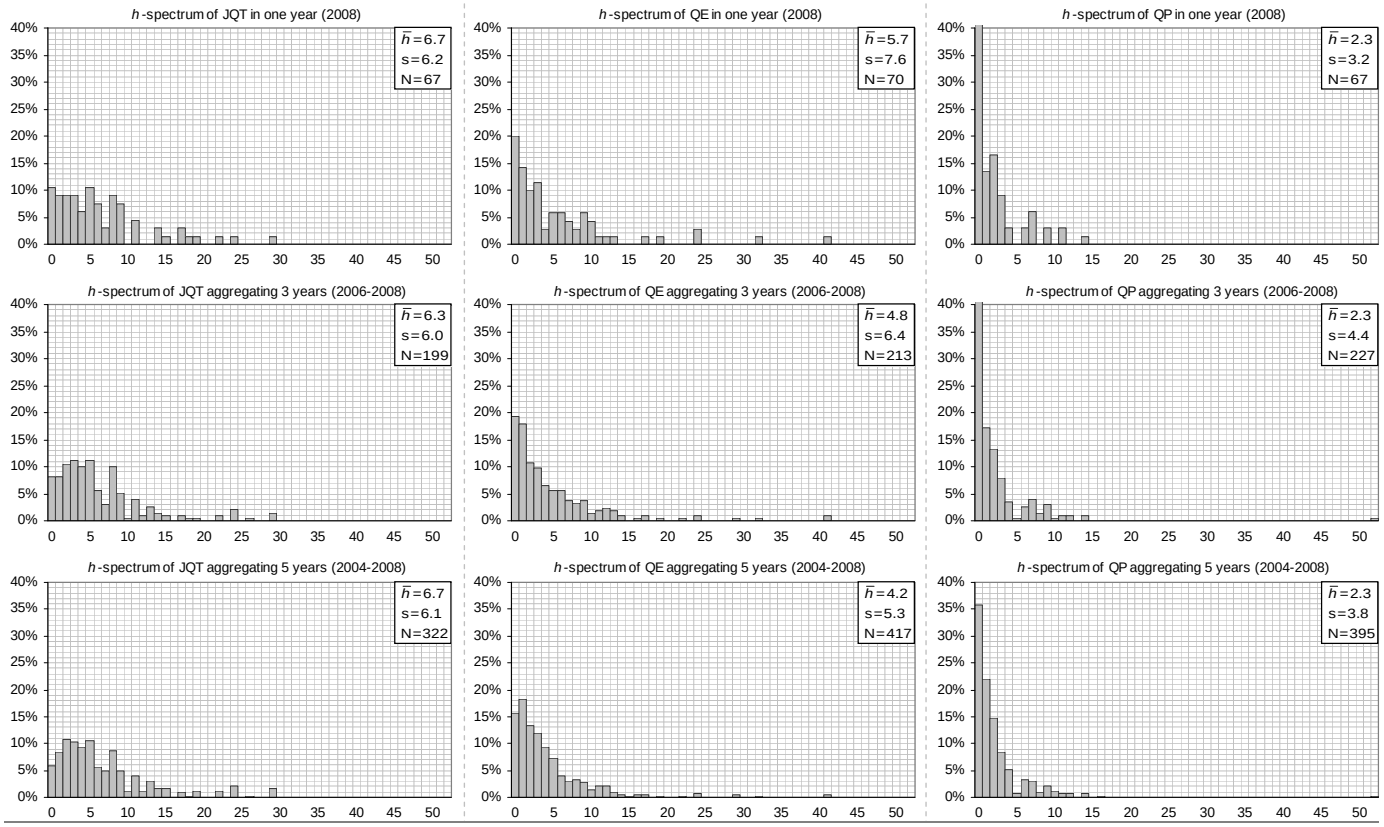


Fig. 11 – *h*-spectra for three Quality journals (JQT, QE and QP), calculated considering three different reference time periods (respectively, one year, three years and five years). For each journal, $\bar{h}$, s and N values are reported. It can be seen that the larger the time period, the more consolidated the journal's *h*-spectrum.

		1 year	3 years	5 years
IIETR	$\bar{h}$	5.1	5.9	6.2
	s	4.1	4.8	4.8
	N	17	42	84
IJQRM	$\bar{h}$	2.7	3.6	4.1
	s	3.9	4.4	4.5
	N	119	340	573
JQME	$\bar{h}$	3.0	3.6	3.9
	s	3.6	4.2	4.1
	N	48	170	277
JQT	$\bar{h}$	6.7	6.3	6.7
	s	6.2	6.0	6.1
	N	67	199	322
MSQ	$\bar{h}$	4.4	4.4	4.8
	s	5.0	4.5	5.0
	N	69	233	388
QE	$\bar{h}$	5.7	4.8	4.2
	s	7.6	6.4	5.3
	N	70	213	417
QMJ	$\bar{h}$	4.4	4.1	4.3
	s	5.0	5.5	5.9
	N	34	94	153
QP	$\bar{h}$	2.3	2.3	2.3
	s	3.2	4.4	3.8
	N	67	227	395
QQ	$\bar{h}$	5.1	4.2	4.5
	s	5.9	4.8	5.0
	N	84	255	412
QREI	$\bar{h}$	4.5	4.8	4.9
	s	5.2	5.2	5.1
	N	166	457	712
TM	$\bar{h}$	7.2	7.7	8.2
	s	6.6	6.4	6.9
	N	97	256	313
TQM	$\bar{h}$	3.8	4.0	4.1
	s	5.1	5.1	5.0
	N	170	482	763

Tab. 2 – Numerical data related to the *h*-spectra of the twelve examined Quality journals. Journals are sorted in alphabetical order with respect to the journal acronym. Data are evaluated considering three different reference time periods (respectively, one year, three years and five years). This table reports the values of $\bar{h}$, s, and N associated to the resulting *h*-spectra.

4.2.3 Further reflections on the h-spectrum

h-spectrum may have many different practical utilizations, such as:

- providing a "snapshot" of the author population of a specific journal, representing a reference for other (potential) authors. For example, assuming that a (potential) author with *h*=3 compares himself with the

QP authors in 2008, he will fall on the 80th percentile of the corresponding *h*-spectrum, or another author with *h*=1 will fall on the 55th percentile.

- helping a journal's editorial board to periodically monitor the practical effect of the article selection policy from the point of view of the author population. In this sense, *h*-spectrum may be interpreted as a signal of editorial strategy. For example, if $\bar{h}$ decreases significantly from one year to the next, it probably means that – among authors – the portion of young researchers or professionals/managers (generally, with small *h* values) tends to increase with respect to the portion of senior academics (generally, with high *h* values).
- providing a rough indication of one journal's bibliometric positioning on the scientific community.

h-spectra can be reliable tools for evaluating a journal at the very moment of the publication, despite the fact that they are based on the publications/citations accumulated before the publication itself. There are empirical proofs of the fact that the citations received by a new article are generally consistent with the citations received by previous articles of the same author, that is to say the *author's reputation* [39]. Being the number of authors per journal quite large (typically more than 60-70 authors per year), it is reasonable to assume that the authors' reputation will be generally respected.

4.3 Remarks on the combined use of different bibliometric indicators

Evaluating and comparing scientific journals by bibliometric indicators is a very delicate task. To make this activity as much complete as possible, it is convenient to use a combination of different indicators and to construct a bibliometric map. Each indicator can be used to define an axis of this map. The map allows the bibliometric positioning and comparison of journals, and can be subdivided in "journal reputation regions", according to which journals are classified (see Fig. 12). Alternatively, the different bibliometric indicators can be synthesised into a single global ranking by a proper aggregation technique [10, 41]. A more detailed description of the bibliometric map and the techniques for aggregating indicators will be analysed in detail in future works.

Finally, it is worthwhile underlining the difference between *h*-spectrum, which is related to the reputation of one journal's authors, and ISI-IF, C, h for journals and other traditional bibliometric indicators, which are related to the citations effectively accumulated by one journal's articles. Generally speaking, the academic reputation of a journal's author group is not the equivalent of the reputation of the journal, as well as not the equivalent of the influence of the journal. For this reason, these different indicator typologies represent two complementary ways to evaluate/compare scientific journals.

For example, a combined use of these indicators can be performed for identifying the following situations:

1. Journals with medium-high authors' reputation (in terms of $\bar{h}$ values) but few received citations. This can be the case of relatively recent journals which are still struggling to become popular in the scientific community.

2. Journals containing articles with a high number of citations, submitted by authors with low *h*-indexes. This can be the case of journals open beyond the academic world, for instance to professionals and industrial managers (like QP, as mentioned before). Alternatively, they can be journals with a relatively large group of young authors, consisting of brilliant young researchers with relatively low citation indexes.

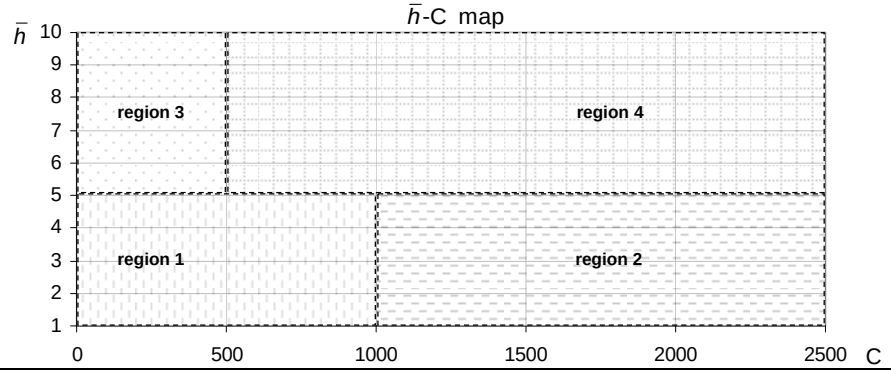


Fig. 12 − Example of a simplified map for comparing journals on the basis of different bibliometric indicators. The map associates $\bar{h}$ values (vertical axis) with C values (horizontal axis) and makes it possible to identify four regions: (1) journals with low authors' reputation (in terms of $\bar{h}$ values) and few received citations; (2) journals containing articles with a high number of citations, submitted by authors with low *h*-indexes; (3) journals with medium-high authors' reputation but few received citations and (4) journals containing articles with a high number of citations, submitted by authors with high *h*-indexes.

5. Conclusions

This paper analyzed twelve of the major journals in the Quality Engineering/Management field by three bibliometric indicators: *h* for journals, citation number and *h*-spectrum. Differently from other diffused indicators like ISI-IF, these indicators can be applied to every kind of journal – not necessarily those indexed by Thomson Scientific or other organizations. Citation statistics are collected using the GS freeware search engine.

One novelty of this paper is the introduction of the *h*-spectrum, a new tool based on the *h*-index. It is interesting to observe that the *h*-spectrum has a peculiar shape and it is rather robust over the years. Furthermore, it can be calculated at the very moment of the journal publication, unlike ISI-IF (which is calculated one-two years after the publication), *h* and C. Differently from *h* and C, *h*-spectrum does not tend to favour journals with many articles/issues per year.

The bibliometric analysis we proposed can be helpful for different reasons: (i) it provides a reference for the (potential) authors of the major scientific journal on Quality sector; (ii) it makes it possible to perform rough comparisons between different journals and estimate their bibliometric positioning; (iii) it supports a journal's editorial staff to periodically monitor the effect of the paper selecting policy.

Several ideas for further research activities may originate from this work. It would be interesting to extend the analysis to a wider set of journals and to other disciplines – such as manufacturing, industrial engineering and mechanical engineering – and define a guideline for ranking journals by using several

bibliometric indicators. Moreover, alternative author spectra can be constructed on the basis of other indicators, different from *h*.

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