Composite Scientometric Indicators for Evaluating Publications of Research Institutes

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Abstract

Both quantitative and qualitative evaluation of publications of research teams or institutes requires several scientometric indicators. In this paper a new composite indicator is introduced for the assessment of publications of research institutes working in different fields of science. The composite indicator consists of three part-indicators (Journal Paper Productivity, Relative Publication Strategy and Relative Paper Citedness). The different methods of calculating the composite index have only a slight effect on the value, whereas application of diverse weights for the individual part-indicators results in significant changes.

Introduction

In the year 2000 the Hungarian Academy of Sciences established the Publication Data Base of the Academy (PDB). The primary aim of the PDB is to collect the bibliographic data of all scientific publications (and citations received by the publications) of researchers at institutes of the Academy and to supply researchers, heads of the institutes and the Academy with relevant bibliographic information and statistics. The activities of the institutes cover natural sciences (physics, chemistry, mathematics, geology etc.), life sciences and social sciences. The PDB contains the bibliographic data of about 72000 publications and 1540000 citations, dating from 1992 to 2003. Citations were obtained partly from Web of Science, partly from the researchers. Latter can be found in books, proceedings or journals not covered by SCI.

The *aim* of the present work is to study the possibilities of the application of PDB data for the purpose of evaluation and to find a *composite indicator* for assessing the publication activity of institutes working in different fields. For this preliminary study, we selected 13 out of 26 different research institutes working in the area of sciences and life sciences. The main fields of activity of these (institutes) are as follows: physics (4), chemistry (2), mathematics (1), and life sciences (6).

Scientific performance is multidimensional, which could not be operationalized by a single indicator (Martin, 1996). Scientometrics offers several indicators for assessing the performance of different activities or different aspects of a single activity. Van Raan (2000), e.g., introduced an advanced, standardized, bibliometric method offering comparative indicators for assessing the journal papers of teams and universities. There is an increasing demand, however, expressed by science politicians, directors (on institutional or departmental level) to obtain information through a single composite (aggregated) measure on the *general (global) performance* of the respective organization maintained, supervised or directed by them. Although composite indicators are frequently used for analyzing social or economic activities, they are very seldom in scientometric literature.

According to the Applied Statistics Group (2002) some indexes already applied are as follows: Business Climate Indicators (DG ECFIN); Economic Sentiment Indicator (EU Commission); Composite Leading Indicator (OECD); General Indicator for Science and Technology (NISTEP, Japan). Archibugi & Coco (2004) published a Composite Index of Technological Capabilities, recently.

Koenig (1983) suggested a formula for calculating a Composite Drug Output (CDO) index of pharmaceutical works using weighted part-indicators.

Bennion and Karschamroon (1984) applied multiple regression analysis for determining the usefulness of 164 journals on physics. Immediacy Index, number of papers, mean ratio of citations and references, and the Garfield (Impact) Factor of the respective journals were selected with appropriate weighting factors for determining the usefulness.

The method of *converging indicators* suggested by Irvine and Martin (1984) can be regarded as a special procedure for arriving at a single, definite conclusion which may be assumed as an aggregate

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index. The authors mentioned consider, however, only an extreme case of aggregate indexes, namely, all indicators studied point to the same conclusion.

For characterization and evaluation of the activity of research institutes from several aspects by a single composite index, the General Performance Index (GPI) was suggested earlier (Vinkler, 1998).

Aggregated indexes have no physical meaning (except in some special cases). They yield comparative indexes within the system studied, which are characteristic of the general performance of part-organizations using an arbitrarily selected scale.

Methods for calculating composite scientometric indicators

Composite scientometric indicators can be used for informative or evaluative purposes. *Composite scientometric indicators* applied for evaluative purposes characterize the global activity (involving several types of activities) or several aspects of a single type of activity of organizations or thematic units by part-indicators appropriately weighted and aggregated. The primary goal of aggregation is to transform *part-indicators* into *part-indexes* which have uniform unit and can be summed up.

Table 1. Some methods for calculating composite indicators.

Method	Calculation
Mean Rank Number	$MRN = \sum_{i=1}^{N} \frac{r_i / w_i}{N}$
Mean Percentage Difference	$MPD = \frac{1}{N} \sum_{i=1}^{N} \frac{100\,(x_i - x_{i,m})}{x_{i,m}} w_i$
Total Z-scores	$TZS = \sum_{i=1}^{N} \frac{x_i - x_{i,m}}{SD_{x\,i}} w_i$
General Performance Index	$GPI = \sum_{i=1}^{N} \frac{x_i}{\sum_{j=1}^{M} x_{i,j}} w_i$

Legends
N: number of part-indicators selected.
r_i: rank number of organization assessed by i-th part-indicator.
x_i: value of i-th part-indicator.
M: number of organizations assessed.
$SD_{x,i}$: standard deviation of x_i part-indicator.
w_i: weighting factor of i-th part-indicator.
$x_{i,m}$: mean value of i-th part-indicator of organizations assessed.

Several sophisticated methods for aggregating part-indicators are known, e.g. multiple regression, principal component analysis and factor analysis, calculation of Cronbach alpha etc. In the present paper, however, some simple methods have been preferably applied (Table 1) and compared with each other.

The method calculating *Mean Rank Number (MRN)* values is the simplest way for obtaining composite indexes on ordinal level. In general the lowest rank number is preferred therefore, weighting can be made by dividing the respective rank number by the respective weighting factor. The MRN index does not reveal the measure of difference between the part-indicators of individual organizations analyzed. The advantage of the method is that it is simple and independent of the measure of deviation from the mean.

The method of *Mean Percentage Difference (MPD)* is analogous to the Z-score calculation, a method familiar from statistics. It calculates average difference from the mean. The method is less robust using relatively many data with great departure from the mean. The robustness of the method is influenced by the different distribution of the part-indicators around the mean.

The calculation of *Total Z-scores (TZS)* is a frequently used statistical method. The distribution of the different part-indicators may be different with different SD values, which has an impact on the robustness of the method. McAllister et al. (1983) suggested the application of Standardized Citation Scores (i.e. Z-scores) in analyzing the citedness of journal papers of teams.

The *General Performance Index (GPI)* method (Vinkler, 1998) calculates the sum of the respective part-indexes of the individual organizations. Each individual part-index reflects the contribution of the respective organization to the total activity of the organizations studied. From the formula in Table 1 it follows that the highest value of any part-index of an organization may be equal to unity (if w = 1) or equals the weighting factor if $w \neq 1$ and $x_i \neq 0$, where x_i is a part-index. From the above it follows that:

$$\sum_{j=1}^{M} \sum_{i=1}^{N} \left(\frac{x_{i,j}}{\sum_{j=1}^{M} x_{i,j}} w_i \right) = \sum_{i=1}^{N} w_i \qquad (1)$$

where *M* is the number of organizations assessed, w_i is the weighting factor of i-th part-indicator, and *N* is the number of part-indicators.

According to Eq. 1 the sum of GPI indexes of the organizations studied is equal to the sum of the weighting factors.

Evaluation of publications of institutes by a composite publication indicator

The indicators applied

According to one of the basic assumptions of evaluative scientometrics, the comparative scientometric unit of information in sciences is the *journal paper*. (This assumption implies that the distribution of journal papers by type, i.e. “standard” articles, reviews, scientific letters and notes, short communications etc., would be similar for the organizations assessed.)

Publication activity and publications may be analyzed from different aspects. Each aspect can be characterized by the respective scientometric indicator. In analyzing publications of several teams or institutes working in different fields, in order to obtain reasonable results, one should select only a limited number of indicators characterizing some important aspects of publications and publishing activity. For this purpose, the following three comparative evaluation indicators have been selected: Journal Paper Productivity (JPP), Relative Publication Strategy (RPS) and Relative Paper Citedness (RPC) (Table 2).

The *JPP* indicator refers to the specific amount of information production, *RPS* characterizes the relative mean international impact of journals used for publishing results, and *RPC* measures the relative impact of the information produced. The three indicators can be converted into part-indexes and combined for yielding a Composite Publication Indicator (CPI) as follows:

$$\mathrm{CPI} = f(w_1 \cdot \mathrm{JPP}) + f(w_2 \cdot \mathrm{RPS}) + f(w_3 \cdot \mathrm{RPC}) \qquad (2)$$

where *f* refers to a special mathematical calculation method (see Table 1) for obtaining part-indexes, $w_{1,2,3}$ are weighting factors. Calculation of the error of the *CPI* indicator can be performed by using the Gauss’ error propagation law, according to which the Standard Deviation (SD) of CPI can be given as the sum of SD-s of the individual part-indicators.

Table 2. Part-indicators used for calculating the Composite Publication Indicator.

Name	Acronym	Calculation method
Journal Paper Productivity	JPP	$\frac{P_c}{K}$
Relative Publication Strategy	RPS	$\frac{GF_m(50, P_c)}{GF_m(25, GF)}$
Relative Paper Citedness	RPC	$\frac{C}{P_c \cdot GF_m(25, GF)}$

Legends

P_c: number of papers published in journals referenced by SCI.

K: mean number of research associates.

$GF_m(50, P_c)$: mean GF of journals containing 50 per cent of the total papers published by the respective institute. The journals are ranked by decreasing number of papers.

$GF_m(25, GF)$: mean GF of journals containing 25 per cent of the total papers of the respective institute. The journals are ranked by decreasing GF.

C: number of citations obtained. (Instead of C (C/1.9) is used, for explanation see the text.)

The data obtained from the Publication Data Base and the indicators calculated for the institutes are given in Tables 3 and 4.

The *JPP* indicator can be reasonably used only for organizations publishing in journals preferably (see P/U-indicators, Table 3). If only papers published in SCI journals are taken into consideration, the respective indicators will reflect some quality aspects, as well (see P_c/P indicators, Table 3).

The *RPS* and *RPC* indicators apply the Garfield (Impact) Factor (GF) for measuring the eminence (international *impact*) of the journals. The GF of a journal characterizes *the specific measure of the contribution to the total impact* of journals within a field or subfield (Vinkler, 2004). The RPS indicator relates the mean GF of the journals publishing the papers of a team to be evaluated to the mean GF of the journals of the respective field or subfield.

Table 3. Main bibliometric data for the scientometric analysis of the research institutes studied.

Main research field of the institute	K	P_c	P/U	P_c/P (in percentage)	C	C/1.9
Mathematics	59.0	458	77.4	92.1	514	271
Nuclear energy	89.0	1026	82.5	92.1	3736	1966
Atomic energy	88.0	165	88.2	87.3	113	59
Particle physics	121.0	746	71.0	84.2	3581	1885
Solid state physics and optics	101.0	749	78.8	79.1	2932	1543
Chemistry	154.0	993	70.6	94.6	1561	822
Isotope chemistry and catalysis	52.6	303	73.8	91.0	469	247
Biochemistry	32.0	164	88.2	95.7	956	503
Biophysics	27.4	178	88.3	94.3	640	337
Enzymology	31.0	159	90.5	87.4	1117	588
Genetics	33.0	126	90.1	92.0	991	522
Botanics	47.0	164	78.2	87.7	1078	567
Biomedicine	51.0	288	90.5	92.0	1768	931

Legends

K: mean number of researchers in 1998-2002.

U: total number of publications (journal papers, proceedings and book chapters published in the period 1998-2002).

P: number of journal papers published in 1998-2002.

P_c: number of papers in journals in 1998-2002 referenced by SCI.

C: total number of citations (self-citations excluded) obtained by SCI journals to P_c papers in 1998-2002.

The reference standards applied

The application of appropriate reference standards is crucial in calculating both RPS and RPC. Selection of the journals covering the activity of teams is very difficult. Even research teams working on special (more or less homogeneous) topics may publish papers in several journals devoted to different disciplines, depending on various objective and subjective factors (e.g. field of results, eminence of journals, habits and personal relations of the authors).

The weighted mean GF of the journals, ranked *by decreasing values of GF*-s, in which 25 per cent of the total papers were published by an institute, is suggested here as the reference standard. (Weighting is made by the number of papers published by the institute in the journal.) The journals selected can be regarded as an elite set of journals in the respective field according to the authors of the respective institute.

By the standard suggested, Relative Publication Strategy (RPS) and Relative Paper Citedness (RPC) indicators may regulate each other, automatically. If, e.g., researchers from a certain institute are very ambitious and publish in relatively "good" journals (with high GF), their RPS indicator will be high. But, if the "expected impact" of their results is not realized in citations, their RPC indicator will be low. The Composite Publication Indicator can reflect the opposite trends of the indexes depending on the weights chosen.

Table 4. Mean GF of journals used for publication by the institutes (GF_m), Journal Paper Productivity (JPP), Relative Publication Strategy (RPS) and Relative Paper Citedness (RPC) indicators of the institutes.

Institute	$GF_m(50,P_c)$	$GF_m(25,P_c)$	$GF_m(25,GF)$	JPP	RPS	RPC	RPC'
Mathematics	.404	.410	.566	1.55	.714	1.045	1.41
Nuclear energy	3.146	4.582	4.366	2.31	.721	.439	.59
Atomic energy	1.555	1.447	2.559	.38	.608	.140	.19
Particle physics	4.589	4.213	5.240	1.23	.876	.482	.65
Solid state physics and optics	2.135	2.225	3.258	1.48	.655	.632	.85
Chemistry	1.831	1.748	2.571	1.29	.712	.322	.43
Isotope chemistry and catalysis	1.132	1.277	1.857	1.15	.610	.439	.59
Biochemistry	4.271	4.841	6.301	1.03	.678	.487	.66
Biophysics	3.694	4.383	5.177	1.30	.714	.366	.49
Enzymology	5.588	5.698	7.603	1.03	.735	.486	.66
Genetics	5.793	5.354	8.318	.76	.696	.498	.67
Botanics	5.261	6.176	7.850	.70	.670	.440	.59
Biomedicine	3.147	2.691	4.283	1.13	.735	.755	1.02
Mean	3.273	3.465	4.611	1.18	.702	.502	.68
SD	1.773	1.909	2.434	.46	.067	.218	.30

Legends

$$JPP = \frac{P_c}{K}$$

P_c: number of papers published in SCI journals in 1998-2002.
K: mean number of researchers in 1998-2002.
Publication Strategy (PS) = $GF_m(50,P_c)$

Relative Publication Strategy (RPS) = $$\frac{GF_m(50,P_c)}{GF_m(25,GF)}$$

GF_m(25 or 50, P_c): mean GF of journals containing 25 or 50 per cent of the total papers. GF-s are weighted by the number of papers. The journals are ranked by decreasing number of papers.
GF(25,GF): mean GF of journals containing 25 per cent of the total papers. GF-s are weighted by the number of papers. The journals are ranked by decreasing GF.

Relative Paper Citedness $$(RPC) = \frac{C/1.9}{P_c \cdot GF_m(25,GF)}$$

C: number of citations obtained by papers in SCI journals in 1998-2002.
C/1.9: number of citations normalized to one year citation and two years publication period.
RPC' = 1.35 RPC (see text).

Fewer papers (e.g. 10 or 20 per cent) may be used for calculating the standards, as well. But, having analyzed the research topics of the institutes and the topics of the journals publishing the results, we concluded that 10 or 20 per cent of the papers did not cover all main topics characteristic of the activity of the institutes.

Table 4 contains the mean GF-s of journals used for publication by the institutes. GF_m (50, P_c) and GF_m (25, P_c) refer to the respective set of journals ranked by a *decreasing number of papers* published therein, whereas GF_m (25, GF) refers to the respective journals ranked by *decreasing GF-s*. The data reveal there is no regularity concerning the relation of GF_m (50, P_c) and GF_m (25, P_c) but, these indicators are lower than GF_m (25, GF) except for the Institute of Nuclear Energy.

For obtaining the RPS index, relating the mean GF of *all* journals, in which the papers of an institute are published, to an appropriate standard would not be relevant. One of the reasons for this is that a relatively great percentage of journals (mean of the institutes: 56.05 per cent; SD = 12.28) is used for publishing a single paper, only. These journals cannot be regarded as characteristic of the research activities conducted by the institutes.

In calculating GF_m (50, P_c) the mean of the highest and lowest number of papers published in a single journal is 64.96 (SD = 51.84) and 10.54 (SD = 8.92), resp. The high SD values show great discrepancies among the institutes. The GF_m (50, P_c) index may be used for representing the Publication Strategy (PS) of the authors.

The *Relative Paper Citedness* (RPC) indicator is calculated by relating a modified number of citations obtained by the papers published between 1998-2002 to GF_m(25, GF) multiplied by the total number of journal papers published (P_c). The reference standard refers to the mean citedness (i.e. impact factor) of the papers (i.e. journals) calculated with both dependent citations (i.e. self-citations) and independent citations (the authors citing and cited are different) obtained in *a specific year* (t_c) by papers published in the preceding two years (t_p). The citations (C) in Table 3, however, refer only to *independent citations* obtained between *1998-2002* (t_c) by papers published *during the same period* (t_p). Consequently, citations and publications of the institutes and those of the journals used for calculating a standard should be reduced to a common denominator.

The *Annual Impact Factor* (AIF) is defined as the ratio of the number of citations in *a* given year (t_c) to papers published in *a* single preceding year (t_p). Annual Impact Rate (AIR) indexes can be calculated by normalizing AIF values to the highest AIF in the time period studied (Vinkler, 1999). AIR indexes were calculated for 55 journals. The sum of the mean AIR indexes for a synchronized five year period was found to be 9.84. The citation period (t_c) for the synchronized $GF_s(5)$ indicator is considered to be 5 years, whilst that for the asynchronized $GF_a(2)$ only one year. The ratio is as follows:

$$\frac{GF_s(5)}{GF_a(2)} = \frac{9.84}{5} = 1.97 \qquad (3)$$

The ratio ($GF_s(5)$ / GF_a (2)) of journals publishing 25 per cent of the papers of the institutes was calculated for each journal. The total number of journals studied was: 61. The mean ($GF_s(5)$ / GF_a (2)) ratio was found to be 1.886; SD = .358.

The value calculated earlier (1.97) and that obtained here (1.89) are in excellent agreement. Therefore, as an approximation, a factor of 1.90 was used to decrease the number of citations obtained in the five-year-period studied (Table 3) for calculating the RPC indicators (Table 4).

The dependent (self-) citations are omitted from the citation data in Table 3. As is well-known, the rate of (self-citations / total citations) depends on the fields and authors. As an approximation, we may use a self-citation rate of 35 per cent for the fields and authors studied. The RPC' values (RPC' = 1.35 RPC) show a more reliable picture for making possible comparisons with the "world level".

Part-indicators of the institutes
The part-indicators calculated for the institutes are given in Table 4.

The mean *information productivity* (JPP) of the institutes is 1.18 (papers/researcher/year). The dynamic range is .38-2.31.

The *Publication Strategy* (PS) indicators reflect not only the quality of the method of selection used by authors for finding appropriate publishing channels but also the difference in the citedness of journal papers according to the different fields (Table 4). The lowest value (.404) was obtained for the Institute of Mathematics, which is in accordance with the relatively low value of GF-s for mathematic journals. Contrary to this, the majority of institutes dealing with life sciences offer relatively high PS indicators (Institutes of Biochemistry, Enzymology, Genetics and Botanics). It is worth mentioning that the Institute of Particle Physics offers a very high PS indicator.

The mean RPS of the institutes is .702 with relatively low standard deviation (.067). All RPS values are lower than unity, which indicates that the journals selected for publications show, on an average, a lower impact than the elite set of journals of the field.

The modified mean *Relative Paper Citedness* (RPC') indicator is lower than unity (.68) and corresponds to the mean citedness value of the country as a whole (see e.g. Braun et al, 1995). There are two institutes above unity (Mathematics: 1.41; Biomedicine: 1.02).

The Pearson correlation coefficients indicate strong relations between the mean GF-s of different sets of journals in which the researchers of the institutes publish (Table 5). In contrast with this, there is no significant correlation between the Journal Paper Productivity (JPP), Relative Publication Strategy (RPS) and Relative Paper Citedness (RPC) indicators. This observation contradicts earlier findings (Vinkler, 1998) according to which the correlation coefficients between JPP and Publication Strategy or JPP and Citations per Researcher or Publication Strategy and Citations per Researcher for 19 research institutes of the Hungarian Academy of Sciences were significant (.56, .73, .80, resp.). The contradiction mentioned indicates a strong dependence of the scientometric indicators and their relations on the scientometric system studied.

Table 5. Pearson product moment correlation coefficients of the scientometric indicators studied.

	$GF_m(50,P_c)$	$GF_m(25,P_c)$	$GF_m(25,GF)$	JPP	RPS	RPC
$GF_m(50,P_c)$	1.00	.96*	.99*	- .27	.39	- .21
$GF_m(25,P_c)$		1.00	.96	- .11	.31	- .26
$GF_m(25,GF)$			1.00	- .32	.24	- .24
JPP				1.00	.31	.36
RPS					1.00	.24
RPC						1.00

Legends
*: significant at $p < .05$ level.
n = 13
JPP: Journal Paper Productivity.
RPS: Relative Publication Strategy.
RPC: Relative Paper Citedness.
For the explanation of $GF_m(50,P_c)$ etc. see Table 2.

Composite Publication Indicators of the institutes
For comparing the effect of the different methods for calculating composite indexes (Table 1) MRN, MPD, TZS and CPI indexes are calculated (Table 6). The CPI indicators are calculated by the GPI method (Table 1). The data reveal that the ranks obtained by the methods applied differ only slightly. Choosing the MRN rank as a reference standard, we may see that the greatest deviation is shown for the Institute of Genetics with rank differences of +3, +2, +3 by the MPD, TZS and CPI rank, respectively. There are four institutes (Mathematics, Atomic Energy, Biophysics, Enzymology) with identical rank numbers attained by any of the methods studied. The Pearson correlation coefficients

(not given here) between the values obtained by the different aggregation methods are high and significant.

Table 6. Publication performance of the institutes calculated by different methods (Mean Rank Number, MRN; Mean Percentage Difference, MPD; Total Z-scores, TZS; Composite Publication Indicator, CPI).

Institute	MRN		MPD		TZS		CPI	
	value	rank	value	rank	value	rank	value	rank
Mathematics	2.8	1	150.4	1	3.504	1	.346	1
Nuclear energy	4.8	4	99.6	2	2.244	3	.307	2
Atomic energy	13.0	13	-151.0	13	-4.413	13	.115	13
Particle physics	4.7	3	31.4	5	2.742	2	.256	5
Solid state physics and optics	5.6	5	53.4	4	.598	5	.272	4
Chemistry	8.0	10	-17.4	9	- .328	8	.217	9
Isotope chemistry and catalysis	9.5	11	-21.2	10	-1.559	12	.214	10
Biochemistry	7.8	9	-13.0	8	- .563	9	.221	8
Biophysics	6.8	7	-7.5	7	- .077	7	.225	7
Enzymology	6.0	6	-5.1	6	.284	6	.227	6
Genetics	7.7	8	-32.8	11	- .748	10	.206	11
Botanics	10.0	12	-53.5	12	-1.514	11	.190	12
Biomedicine	4.2	2	57.5	3	1.704	4	.275	3
Mean	6.992		6.98		.144		.236	
SD	2.768		74.60		2.103		.057	

The composite indexes shown in Table 1 and 6 *cannot be used* as weights for distributing resources, directly. The main methodological reason for this is that the indexes do not involve the growth of the organizations assessed. For the distribution of resources basic (simple or global) or contribution (distribution) indicators referring to the growth of the respective entities must be used. The *total number* (or share) of journal papers (P) or publications (U) may be preferably used. The total number of citations greatly depends on subfield and time windows. Input indicators (e.g. number of researchers) do not reflect the measure of production. Therefore, their use cannot be recommended.

The effect of attributing *different weights* to the part-indicators can be seen in Table 7. Three sets of weighting factors (w) have been selected. Set *A* attributes greater importance to producing more information (w(JPP) = 5), whereas set *B* to publication strategy (w(RPS)=5) and set *C* to the relative impact of the information published w(RPC) = 5). Comparison of the ranks obtained shows that the Institute of Chemistry falls from rank 7 (according to A) to 12 (according to C), whilst Institute of Biophysics from rank 6 (according to A) to rank 11 (according to C). Institute of Isotope Chemistry and Catalysis ranks higher from rank 12 (according to B) to rank 8 (according to A).

From the above one may conclude that different weighting of the part-indexes may affect the rank of the institutes significantly, only if their rank positions differ significantly by the individual part-indicators.

Table 7. Effect of part-indicators on the rank of the institutes weighted by various factors.

Institute	A		B		C	
	index	rank	index	rank	index	Rank
Mathematics	.744	2	.652	1	.980	1
Nuclear energy	.899	1	.613	3	.566	4
Atomic energy	.212	13	.379	13	.199	13
Particle physics	.571	4	.634	2	.545	5
Solid state physics and optics	.651	3	.552	5	.652	3
Chemistry	.548	7	.524	8	.409	12
Isotope chemistry and catalysis	.509	8	.476	12	.478	9
Biochemistry	.485	10	.513	9	.515	7
Biophysics	.558	6	.532	7	.443	11
Enzymology	.491	9	.544	6	.520	6
Genetics	.400	11	.507	10	.507	8
Botanics	.369	12	.480	11	.456	10
Biomedicine	.565	5	.592	4	.733	7

Weights

Indicator	A	B	C
JPP	5	1	1
RPS	1	5	1
RPC	1	1	5

Considering scientometric and science political viewpoints, the present author would suggest weights for the indicators in Table 2 in assessing organizations which can be regarded as active parts in the international scientific system as follows: JPP: 1.0; RPS: 1.3; RPC: 1.6. It should be mentioned that the weighting factors should reflect the purposes of the assessment and should correspond to the mission of the respective organizations.

Conclusions

The *assessment* of publications of different scientometric systems (e.g. teams or institutes) cannot be performed by standard methods. Each system is unique. There are, however, several general and specific rules for evaluating scientific articles. One of the main concerns is due to the different bibliometric features of fields, subfields and topics, and different types of activity. Consequently, the use of *relative indicators* is recommended.

Publication activity can be characterized from various scientometric aspects. For the practical evaluation of organizations, however, it is advisable to select only some aspects that can be appropriately characterized by part-indicators and to form a *composite index* which may represent the global performance of the respective organization. The part-indicators appropriately *weighted* can represent the purpose of the assessment.

References

Applied Statistics Group (2002). State-of-the-art Report on Current Methodologies and Practices for Composite Indicator Development.
from: http://www.jrc.cec.eu.int/uasa/prj-comp-ind.asp

Archibugi, D. & Coco, A. (2004). A new indicator of technological capabilities for developed and developing countries (ArCo). *World Development,* 32, 629-654.

Bennion, B.C. & Karschamroon, S. (1984). Multivariate regression models for estimating journal usefulness in physics. *Journal of Documentation*, 40, 217-227.
Braun, T., Glänzel, W. & Grupp, H. (1995). The scientometric weight of 50 nations in 27 science areas, 1989-1993. Part I. All fields combined, mathematics, engineering, chemistry and physics. *Scientometrics*, 33, 263-293.
Irvine, J. & Martin, B.R. (1984). CERN: Past performance and future prospects II. The scientific performance of the CERN accelerators. *Research Policy*, 13, 247-284.
Koenig, M.E.D. (1983). Bibliometric indicators versus expert opinion in assessing research performance. *Journal of the American Society for Information Science*, 34, 136-145.
Martin, B.R. (1996). The use of multiple indicators in the assessment of basic research, *Scientometrics*, 36, 343-362.
McAllister, P.R., Narin F. & Corrigan J.G.: Programmatic evaluation and comparison based on standardized citation scores, *IEEE Transactions on Engineering Management*, 30 (1983) 205-211.
Van Raan, A.F.J. (2000). The Pandora's box of citation analysis: Measuring scientometric excellence–the last evil? In B. Cronin & H.B. Atkins (Eds.), *The Web of Knowledge* (pp. 301-319). Medford, New Jersey: ASIS Monograph Series, Information Today Inc.
Vinkler, P. (1998). General performance indexes calculated for research institutes of the Hungarian Academy of Sciences based on scientometric indicators. *Scientometrics*, 41, 185-200.
Vinkler, P. (1999). Ratio of short term and long term impact factors and similarities of chemistry journals represented by references. *Scientometrics*, 46, 621-633.
Vinkler, P. (2004). Characterization of the impact of sets of scientific papers: The Garfield (Impact) Factor. *Journal of the American Society for Information Science and Technology,* 55, 431-435.