

## PROMETHEE-GAIA Statistics – 1570 papers

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Bertrand Mareschal

[bmaresc@ulb.ac.be](mailto:bmaresc@ulb.ac.be)

<http://www.promethee-gaia.net>

### Introduction

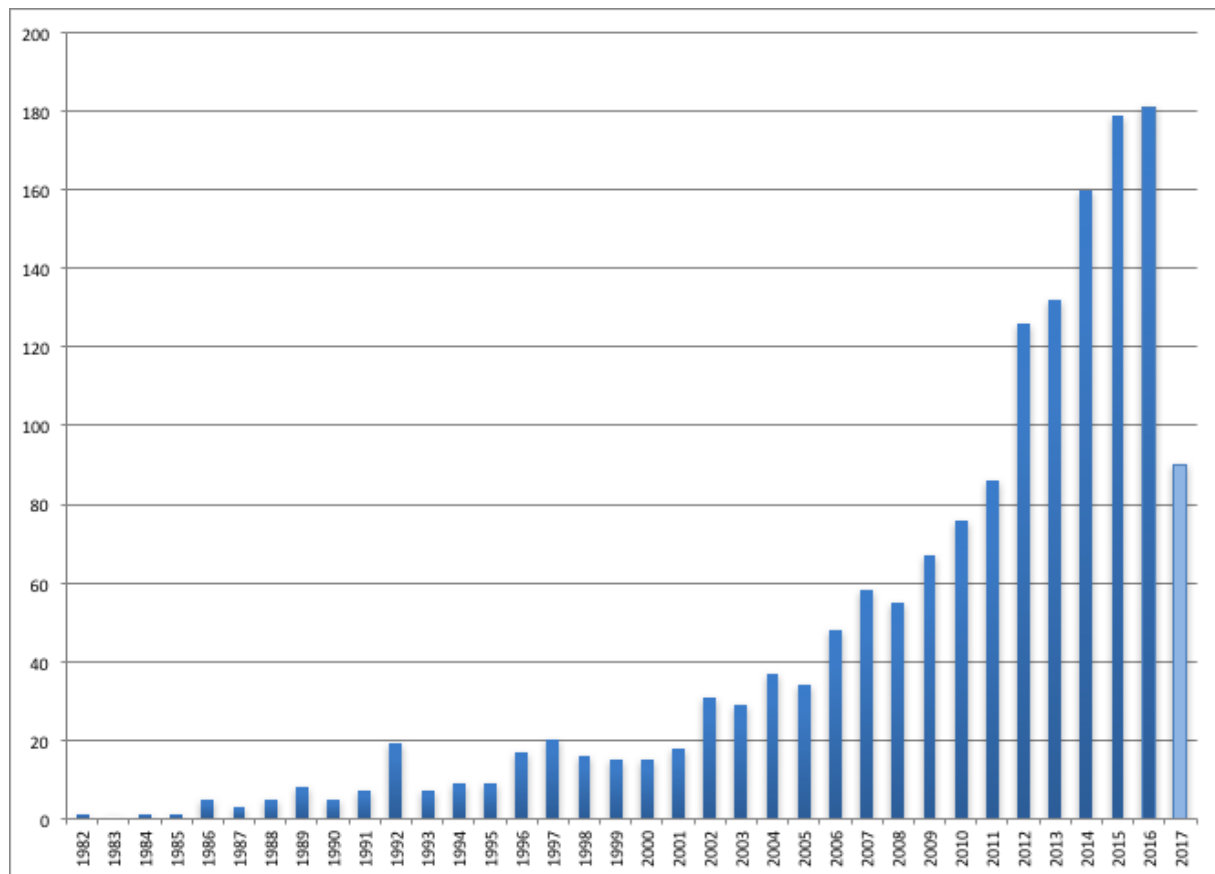
The **PROMETHEE** method was first introduced by Professor Jean-Pierre Brans in 1982.

Much seminal work has been done in the 1980's by Professors Jean-Pierre Brans and Bertrand Mareschal to develop the methodology. Two important steps were the introduction of the **GAIA** descriptive analysis and the implementation of **PROMETHEE** and **GAIA** in the interactive software **PROMCALC**.

The **PROMETHEE** Bibliographical Database tracks the scientific papers related to the **PROMETHEE-GAIA** methodology, its development, its analysis and its application.

### Timeline

As shown in the following bar chart, there has been an ever-increasing interest for the **PROMETHEE** methodology in the literature: as of today, we have recorded a total number of 1570 papers. The median year of publication is 2012 which means that more than half of the papers have been published during the last 5 years. More precisely 868 papers (55%) have been published since 2012.



Number of papers published per year from 1982 to 2017(current)

A closer look at the bar chart reveals three distinct periods:

- From 1982 to 2001, the number of papers published is low and is increasing slowly. 1992 is a special year in this period, perhaps because of the evolution of the **PromCalc** software at that time.
- From 2002, the number of papers starts to increase more rapidly, up to 86 papers published in 2011. This can probably be associated with the launch of the **Decision Lab** software in 2000: indeed, this was the first Windows-based and productivity-oriented **PROMETHEE** implementation.
- From 2012, we see a sharp increase of the number of papers published, up to the maximum of 181 papers in 2016. This can probably be associated with the availability of the new **Visual PROMETHEE** software and of its companion web site [www.promethee-gaia.net](http://www.promethee-gaia.net)
- As of today (May 11<sup>th</sup>), 90 papers have already been recorded for the 2017 period.

### Fields of interest

The 1570 papers cover many different topics:

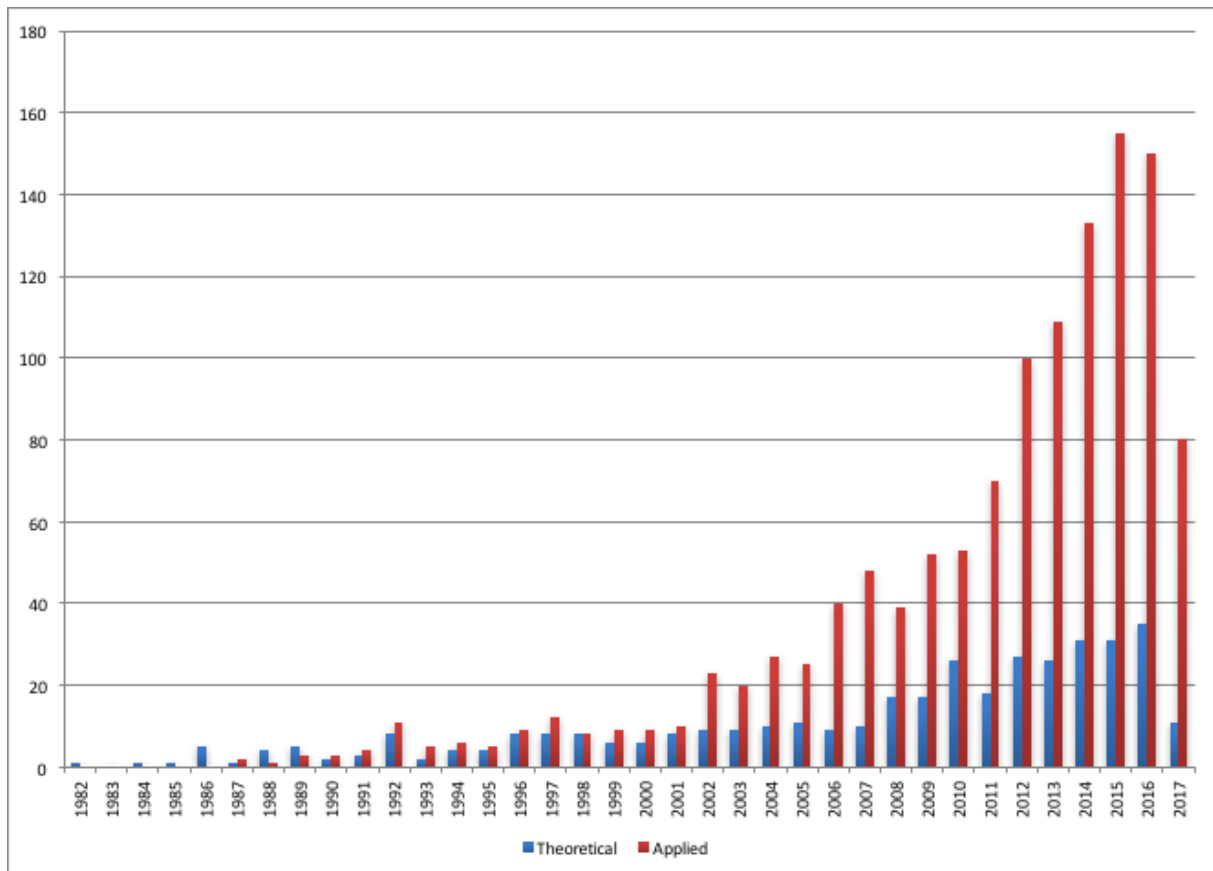
- 382 papers (24.3%) are theoretical papers about the **PROMETHEE** methodology, including many proposals for extensions or new models.
- 1221 papers (77.8%) are related to applications of **PROMETHEE** in different fields. They belong to various fields:
  - o 326 papers (20.8%) are related to environmental problems.
  - o 282 papers (18.0%) are related to services and/or public applications.

- 243 papers (15.5%) are related to industrial applications.
- 136 papers (8.7%) are related to energy.
- 102 papers (6.5%) are related to water.
- 96 papers (6.1%) are related to finance.
- 60 papers (3.8%) are related to transportation.
- 52 papers (3.3%) are related to procurement.
- 25 papers (1.6%) are related to health care.
- 18 papers (1.1%) are related to mining.
- 42 papers (2.7%) are related to other fields of application.

(note: some papers are related to multiple fields so that the total of the above percentages is larger than 100%)

It is interesting to note that more than half (55.5%) of the applied papers are in the “societal” field (including environment, energy, water, public sector and health).

The next bar chart shows the distribution of theoretical (in blue) and applied (in red) papers over time from 1982 to 2017. From 1982 to 2001, the numbers of theoretical and applied papers published achieve similar relatively low levels. From 2002 until today the number of theoretical papers continue to increase but there is a much sharper increase of the number of applied papers published. This corresponds to the availability of user-friendly and full-featured **PROMETHEE** software (**Decision Lab** in 2000 and **Visual PROMETHEE** in 2011).



Number of papers (theoretical - applied) published per year from 1982 to 2017(current)

## Worldwide interest

Looking at the nationality of the first authors, the 1570 papers originate from 70 different countries from all continents.

The following table shows the continental distribution of the papers: as expected, most papers (46.2%) come from European countries, but 32.9% of the papers originate from Asian countries as well. At the opposite, Africa has the smallest contribution with 43 papers (2.7%) only.

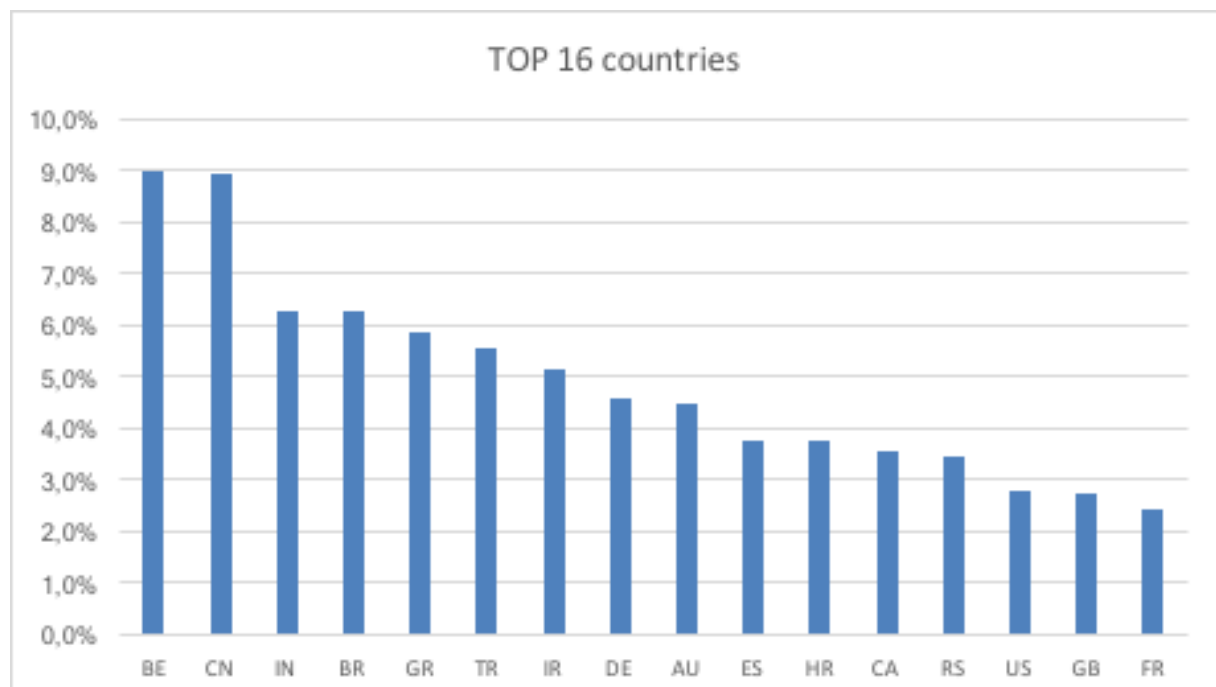
Continent	Papers	Percentage
Africa	43	2,7%
Asia	517	32,9%
Europe	727	46,2%
North America	110	7,0%
South America	103	6,6%
Australia	70	4,5%

Continental distribution by first authors

The next table shows the distribution of the papers by country: as expected, the country with the largest number of published papers is Belgium (141 papers). More interestingly, 140 papers come from China, and more than two thirds of the papers (67.1%) originate from only 12 countries (Belgium, China, India, Brazil, Greece, Turkey, Iran, Germany, Australia, Spain, Croatia and Canada) on 4 different continents. And 78.5% of the papers originate from just 16 countries, adding Serbia, the United States, Great Britain and France to the previous list.

The TOP 5 countries (BE, CN, IN, BR and GR) account for 36.2% of the papers.

The TOP 10 countries (TOP 5 + TR, IR, DE, AU, ES) account for 59.7% of the papers.

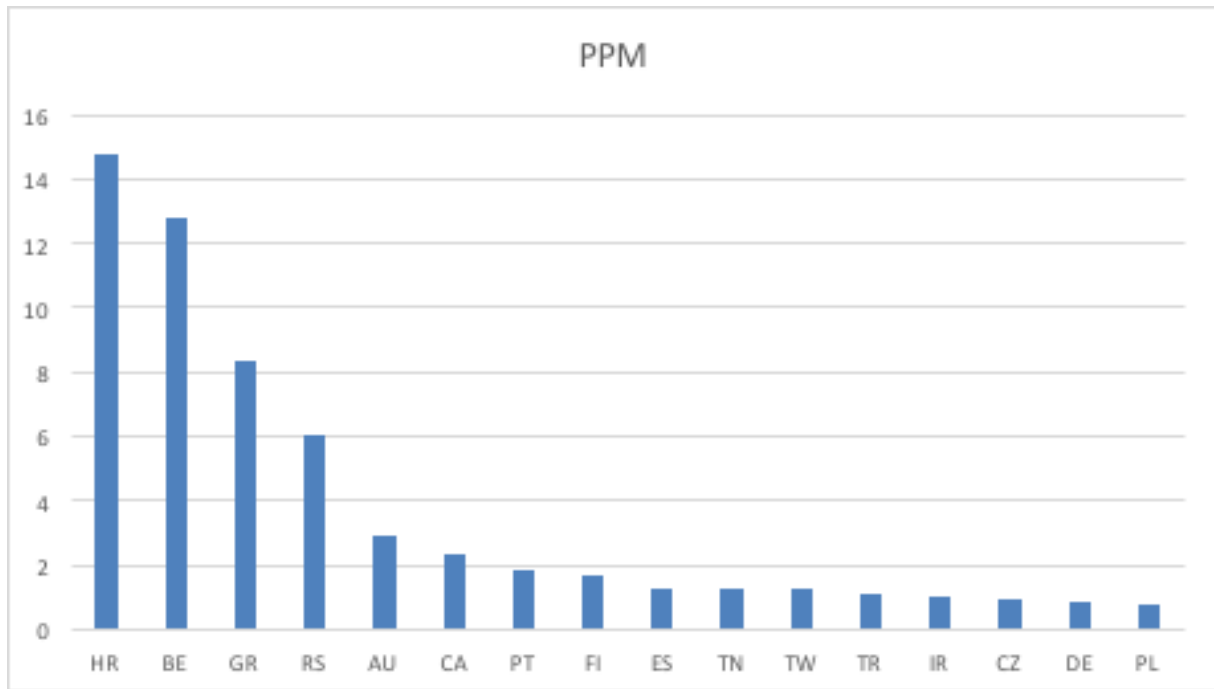


TOP 16 countries – Number of papers published

Country	Papers	Percentage	Country	Papers	Percentage
BE	141	9,0%	CH	7	0,4%
CN	140	8,9%	DK	6	0,4%
IN	98	6,2%	SE	6	0,4%
BR	98	6,2%	EG	4	0,3%
GR	92	5,9%	HU	3	0,2%
TR	87	5,5%	RO	3	0,2%
IR	81	5,2%	SI	3	0,2%
DE	72	4,6%	CY	3	0,2%
AU	70	4,5%	NO	3	0,2%
ES	59	3,8%	SG	3	0,2%
HR	59	3,8%	CL	3	0,2%
CA	56	3,6%	JP	2	0,1%
RS	54	3,4%	BA	2	0,1%
US	44	2,8%	TH	2	0,1%
GB	43	2,7%	BG	2	0,1%
FR	38	2,4%	SA	2	0,1%
TW	29	1,8%	MD	1	0,1%
IT	29	1,8%	ME	1	0,1%
PL	29	1,8%	MM	1	0,1%
ID	22	1,4%	MU	1	0,1%
PT	18	1,1%	CM	1	0,1%
MY	16	1,0%	Pal	1	0,1%
DZ	14	0,9%	LK	1	0,1%
TN	14	0,9%	VE	1	0,1%
KR	11	0,7%	AL	1	0,1%
CZ	10	0,6%	GH	1	0,1%
FI	10	0,6%	CU	1	0,1%
MX	9	0,6%	IL	1	0,1%
LT	9	0,6%	LU	1	0,1%
HK	8	0,5%	LV	1	0,1%
JO	8	0,5%	YE	1	0,1%
AT	8	0,5%	CO	1	0,1%
NL	7	0,4%	RU	1	0,1%
SK	7	0,4%	PK	1	0,1%
MA	7	0,4%	ZA	1	0,1%

Country distribution by first author

Of course, larger countries such as China or India are at an advantage in the previous ranking because they have larger numbers of scholars. Considering the population of the countries a quite different ranking is obtained: to this purpose we have computed the number of papers published per million inhabitants (PPM) for each country having at least ten papers listed in the database. The top ranked countries appear in the next figure, with Croatia and Belgium well above the other countries, followed by Greece and Serbia.

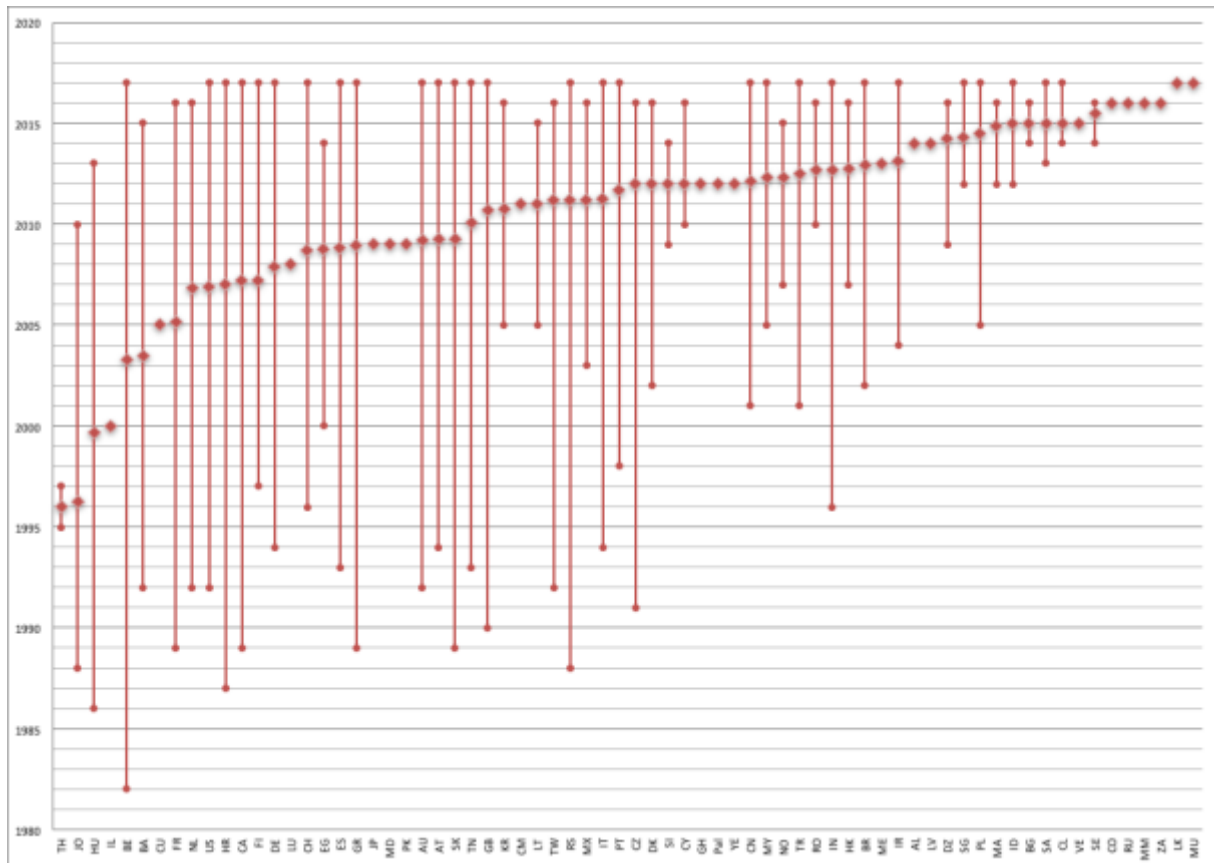


TOP 16 countries – Papers per million inhabitants (PPM)

### Age of the papers

The average age of the papers is 2010 while the median is 2012, which indicates a skewed distribution of ages with many recent papers.

For each country, we have analyzed the dates of publication of the papers and have computed the oldest, most recent and average years of publication. The results are presented in the next chart.



Years of publication (min, max and average) per country

For each country, a vertical line is drawn from the first year of publication (at the bottom) to the last year of publication (at the top). The position of the diamond corresponds to the average year of publication.

Some comments:

- The longest line is for Belgium, as expected. Indeed, the first paper was published in 1982 and publication is still active today.
- Most lines reach or are above the year 2010 (all countries except TH, IL, CU, LU, JP, MD and PK, which account for a total of only 9 papers). This means that recent publications originate from many different countries.
- 52 lines reach or are located above the year 2015 which means that papers have been published from 52 different countries (over a total number of 70 identified countries, i.e. 74% of the countries) during the last two years.
- There are many long lines, meaning that « early adopters » remain faithful to **PROMETHEE** and continue to generate publications today: for instance, all the 11 countries which started publishing papers during the ten first years (1982-1991) were still active in 2010 and 9 of them have produced papers in 2016 or later.
- Most shorter lines are located to the right and correspond to « new adopters » for which publications started more recently.
- Several very short lines appear at the right: these are new countries and it shows that **PROMETHEE** publications are still expanding to other countries.

## Authors

We have analyzed the number and origin of the authors of the 1570 papers. They belong to the **PROMETHEE Community**.

There is a total of 2769 individual authors coming from 79 countries. This corresponds to an average of 1.76 authors per paper or 0.57 papers per author (PPA ratio). It confirms the diversity of the origins of the papers.

The following table shows the continental distribution of the authors.

Continent	Authors	Percentage
Africa	86	3,1%
Asia	975	35,2%
Europe	1186	42,8%
North America	253	9,1%
South America	157	5,7%
Oceania	112	4,0%

Continental distribution of authors

The next table shows the distribution by country of the authors, for the 25 top countries with at least 20 authors each.

Country	Authors	Percentage	Cumulative	PPA	APM
CN	267	9,7%	9,7%	0,52	0,19
IR	177	6,5%	16,2%	0,45	2,21
IN	162	5,9%	22,1%	0,59	0,12
GR	153	5,6%	27,7%	0,58	13,91
RS	139	5,1%	32,8%	0,39	15,44
TR	139	5,1%	37,9%	0,63	1,74
BR	133	4,9%	42,7%	0,71	0,63
BE	124	4,5%	47,2%	1,14	11,27
US	118	4,3%	51,6%	0,36	0,36
CA	114	4,2%	55,7%	0,49	4,75
AU	111	4,1%	59,8%	0,63	4,63
DE	107	3,9%	63,7%	0,65	1,32
GB	92	3,4%	67,0%	0,47	1,42
ES	85	3,1%	70,1%	0,69	1,85
FR	81	3,0%	73,1%	0,47	1,25
HR	67	2,4%	75,5%	0,88	16,75
IT	48	1,8%	77,3%	0,60	0,80
PT	48	1,8%	79,0%	0,35	4,80
MY	39	1,4%	80,5%	0,41	1,26
ID	38	1,4%	81,9%	0,55	0,15
PL	30	1,1%	82,9%	0,97	0,77
DZ	29	1,1%	84,0%	0,48	0,73
NL	28	1,0%	85,0%	0,25	1,65
KR	24	0,9%	85,9%	0,46	0,47
TN	21	0,8%	86,7%	0,67	1,91

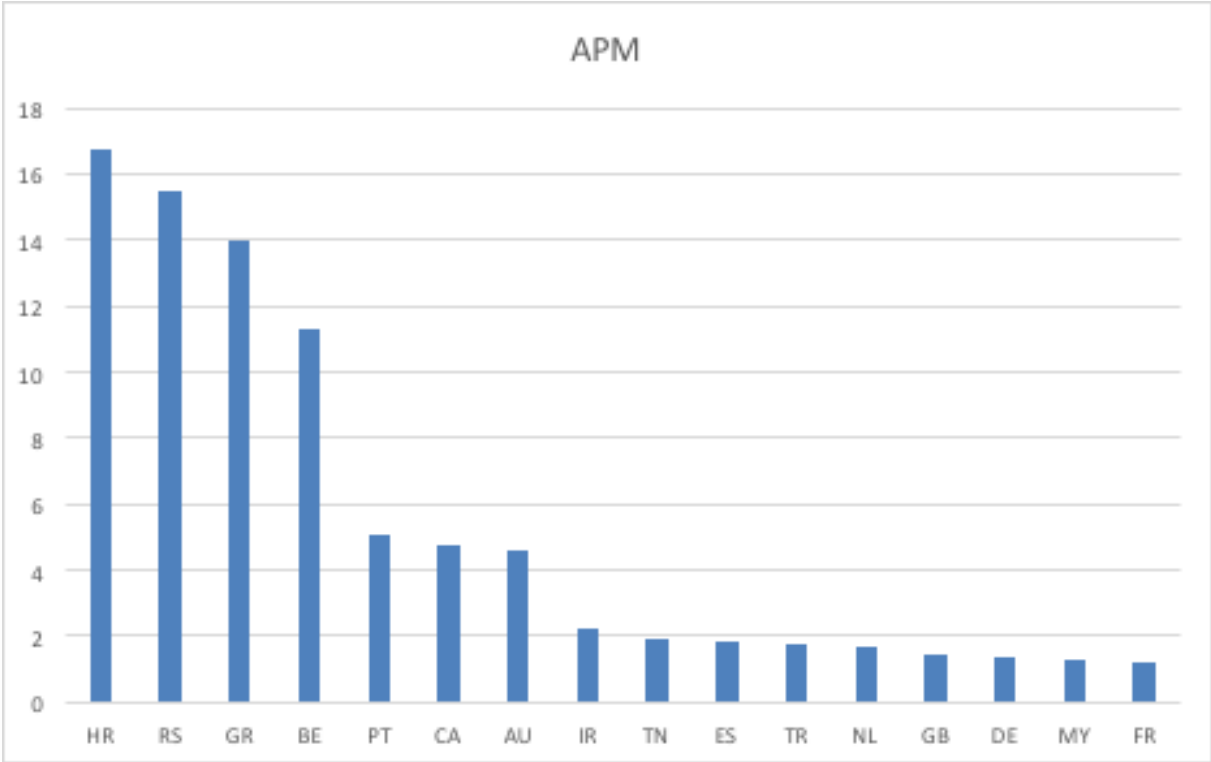
Distribution of the authors by country (25 top countries)

More than 50% of the authors are concentrated in the top 9 countries (CN, IR, IN, GR, RS, TR, BR, BE and US) while the top 25 countries include close to 90% of the authors (86,7%).

The higher PPA (papers/authors) ratio observed for Belgium is easily explained by the number of original papers (20) published by Jean-Pierre Brans and Bertrand Mareschal.



Again, it is interesting to consider the size of the countries in this ranking. To this purpose, we have computed the number of authors per million inhabitants (APM) for each country. The next table shows the top 16 countries ranked according to their APM. All the other countries have an APM smaller than 1.



Top 16 countries – Authors per million inhabitants (APM)

The top of the APM ranking is quite similar to that of the PPM ranking, with HR, RS, GR and BE well above the other countries.