

# THE UNCONVENTIONAL TECHNOLOGIES REFLECTED IN WEB OF SCIENCE

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**ABSTRACT:** The unconventional technologies appeared as a result of the unconventional development of the digital economy. The role of the “unconventional technologies” within the knowledge - based economy (more or less conventional) includes, among the specialists, the existence of the unconventional thinking. The main results of this thinking way are to be found in important scientific papers, such as the ones from the Web of Science data bases. The present paper includes an analysis of the scientific papers existed in the Web of Science data bases and its topic is “unconventional technologies”. The case study is focused on two periods of time: 1975-2019 and 2015-2019, as part of the economy based on knowledge. The analysis of Web of Science data was accomplished by grouping the data both regarding the topic and the countries/regions.

**KEY WORDS:** unconventional technologies, knowledge-based economy, community, web of science, open access.

## 1. INTRODUCTION

The inventions and innovations in the “unconventional technologies” domain represent the product of continuous unconventional thinking. Just as the economic thinking demands knowledge about the elements (factors, laws) that master the entire domain of Economics, in the same way, the unconventional thinking (used especially in the industrial activities) demands knowledge about the awareness, adaptation and implementation of unconventional solutions.

All these are expected to lead to the increase of quality (especially by reducing the specific consumption resources and the polluting emissions) and to the increase of productivity (with the help of technic factors - science, techniques, technology). The scientific papers from the Web of Science data base include the results of such thinking manner [1].

The researches completed for this present paper include all the specific publications of the “unconventional technologies” Web of Science domain, together with the papers from the “Open Access” category. The structure of the paper consists of three chapters: Introduction, Data analysis -Case study and Conclusions.

## 2. THE ANALYSIS OF DATA. CASE OF STUDY

The present case study considers the specific papers in the “unconventional technologies” domain that could be found the Web of Science data base. For

this purpose, the selected topic is “unconventional technologies”. The categories of the papers are systematized. Since the names of the categories are too long to be represented within categories, they were codified and classified according to Table 1.

**Table 1.** Web of Science Categories

No	WEB OF SCIENCE CATEGORIES (WSC)	WSC Code
1	ENERGY FUELS	EF
2	ENGINEERING ELECTRICAL ELECTRONIC	EEE
3	ENGINEERING CHEMICAL	EC
4	MATERIALS SCIENCES MULTIDISCIPLINARY	MSM
5	PHYSICS APPLIED	PA
6	ENGINEERING PETROLEUM	EP
7	ENVIRONMENTAL SCIENCES	ES
8	ENGINEERING MECHANICAL	EM
9	GEOSCIENCES MULTIDISCIPLINARY	GM
10	NANOSCIENCE NANOTECHONOLOGIES	NN
11	CHEMISTRY MULTIDISCIPLINARY	CM
12	GREEN SUSTAINABLE SCIENCE TECHNOLOGY	GSST
13	MULTIDISCIPLINARY SCIENCES	MS
14	ENGINEERING MULTIDISCIPLINARY	EMY
15	ENGINEERING ENVIRONMENTAL	EE

No	WEB OF SCIENCE CATEGORIES (WSC)	WSC Code
16	CHEMISTRY PHYSICAL	CP

In the first stage of the research process, after the interrogation in the Web of Science data base on the 14<sup>th</sup> August 2019, according to the former specifications, a number of 2231 published articles were identified in the period 1975-2019. From these articles, a number of 1981 are distributed in the first 12 WSC (see Table 1), as presented in Figure 1. The other 250 articles are distributed in different Web of Science domains.

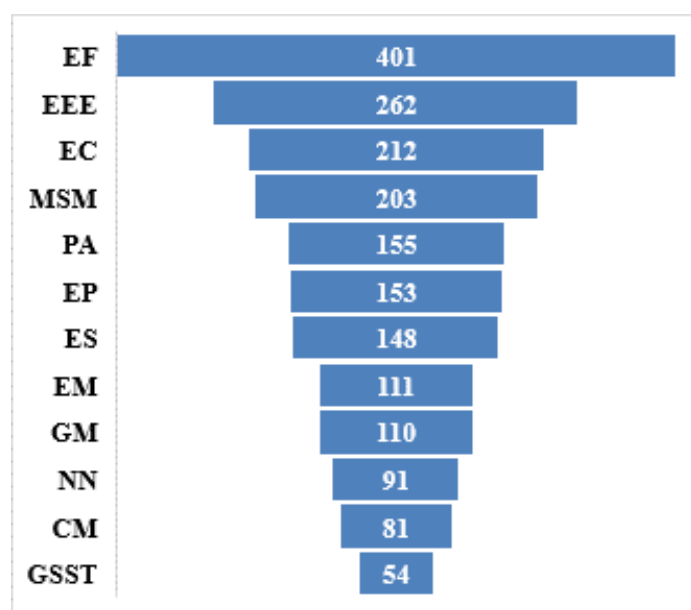


Figure 1. Articles published for the period 1975 - 2019

Within the second stage a number of 1155 of papers which were published in the period 2015-2019 were identified.

Practically, out of all these, a number of 1063 of articles from the last 5 years are distributed to the first 12 categories (see Table 2), and a number of 92 articles are distributed to the other categories. This represents only 8% from the total of articles analysed for this period.

By making a comparison regarding the distribution of the published articles from the domain of unconventional technologies (Figure 2), one can observe that for the period 2015-2019, the number of published articles doubled for the following domains: Green Sustainable Science Technology, Engineering Chemical, Chemistry Multidisciplinary, Energy Fuels, Environmental Sciences, Engineering Petroleum and Geosciences Multidisciplinary.

In order to support this process from several points of view, further on it is presented the information

notice on the 9<sup>th</sup> August 2019 by the organization committee for the 6<sup>th</sup> Central European Biomass Conference (CEBC 2020, 22<sup>nd</sup> to 24<sup>th</sup> of January in the Messe Congress Graz, Styria): “Due to the current debate on climate change, the upcoming changes in the energy transition and the enormous amounts of bark beetle infested wood, we decided to initiate a Special Call for Papers restricted to the topics *100% renewable natural gas* and *petroleum-free agriculture and forestry*”.

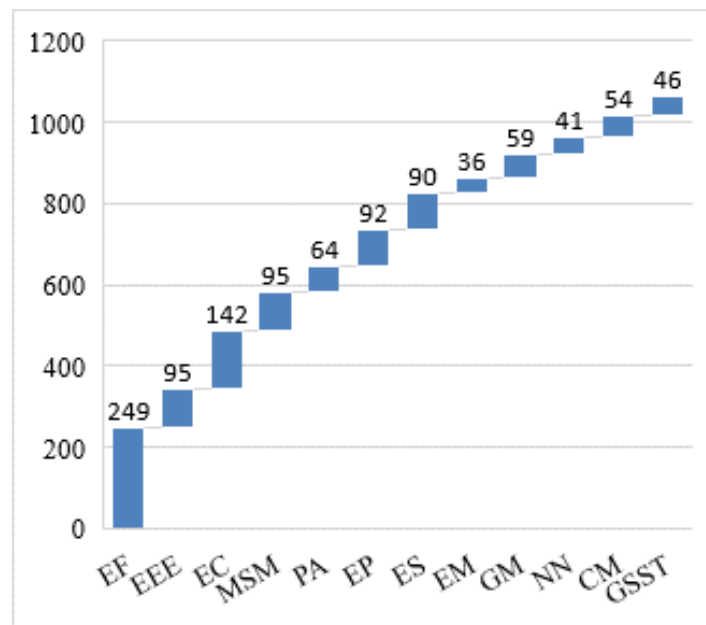


Figure 2. Articles published for the period 2015-2019

Connecting more than 1.500 participants from all continents, the CEBC is one of the world’s largest events in the industry. “*Greening the Strategies*” will act as the central topic of the 6<sup>th</sup> version of the CEBC and, therefore, examine whether the existing greening strategies are enough to serve as a realistic exit from fossil fuels [2].

It can be easily observed that the greatest increase in the last 5 years was connected to the articles from the Green Sustainable Science Technology category. For the evaluation and the publication of the specific articles from this category, there are specialized journals such as: Journal of Green Science and Technology (USA) or International Journal of Environmental Sustainability and Green Technologies (Spain).

There are also higher education institutions where specialists in this domain can be educated. Helsinki Institute of Sustainability Science (HELSUS) is such an institution, a cross-faculty research unit in sustainability science within the University of Helsinki [3].

There are also communities that share specific activities on the Internet and “Engineering for Change” (E4C) is such a community [4].

According to Labs Explorer specialists, the 5 most popular sustainable science applications in Europe

are: green and blue technologies which use microorganisms and molecules to address sustainability challenges; the agriculture researchers that work on both sustainable production and sustainable methods; sustainable engineering applied also to waste management to preserve the nature of our industrialized society; sustainable forestry that engages in viable exploitation of wood resources; sustainable chemistry which aims to prevent pollution and minimize hazardous substances [5].

**Table 2.** Evolution of the specific scientific papers

WEB OF SCIENCE CATEGORIES	No. articles for 1975-2019	No. articles for 2015-2019	Percentage
GREEN SUSTAINABLE SCIENCE TECHNOLOGY	54	46	85%
ENGINEERING CHEMICAL	212	142	67%
CHEMISTRY MULTIDISCIPLINARY	81	54	67%
ENERGY FUELS	401	249	62%
ENVIRONMENTAL SCIENCES	148	90	61%
ENGINEERING PETROLEUM	153	92	60%
GEOSCIENCES MULTIDISCIPLINARY	110	59	54%
MATERIALS SCIENCES MULTIDISCIPLINARY	203	95	47%
NANOSCIENCE NANOTECHONOLOGIES	91	41	45%
PHYSICS APPLIED	155	64	41%
ENGINEERING ELECTRICAL ELECTRONIC	262	95	36%
ENGINEERING MECHANICAL	111	36	32%

The development of unconventional technologies is integrated in the knowledge - based economy. This development includes the continuous increase of the role of “Open Access & Open Source” information and knowledge. Both Open Access and Open Source could be defined as the results of the digital

economy that are used to produce and divide knowledge [6].

Even if several definitions and types of Open Access (Budapest 2002, Bethesda 2003 and Berlin 2003) can be found, the following conclusion that can be drawn implies that this action demands that the academic publications to be available free of charge within libraries and for the final users: Open Access per capita (according to the income per capita specific to each country), abstracts Open Access only, Open Access for journals Open Access for articles etc [7]. In this way, Open Access contribute to ensuring the long-term access to academic publications.

The main element that ensures the success of an open source environment (generally supported by volunteers) is the scale – the number of capable users and passionate users who obtain anticipated profits. The improvement of projects (to be more reliable and easier to be used) and solving the technological problems that occur represent processes accomplished by the will of the entire community: if the problem was solved by someone else, this implies saving time and avoiding repeated mistakes.

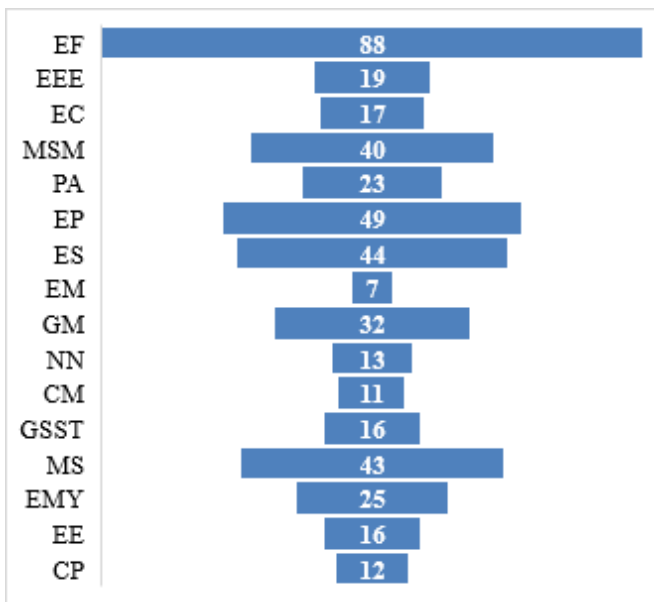
If a problem was solved, there is the possibility of helping others when they find themselves in the same situation, by using the previous experience. [8][9].

In this manner, a logic corollary could be defined as follows: Open Sourcing represents the accumulations and the sharing of knowledge through a group (or a community), all having a common aim whose management must prevent the “impact” among the developers.

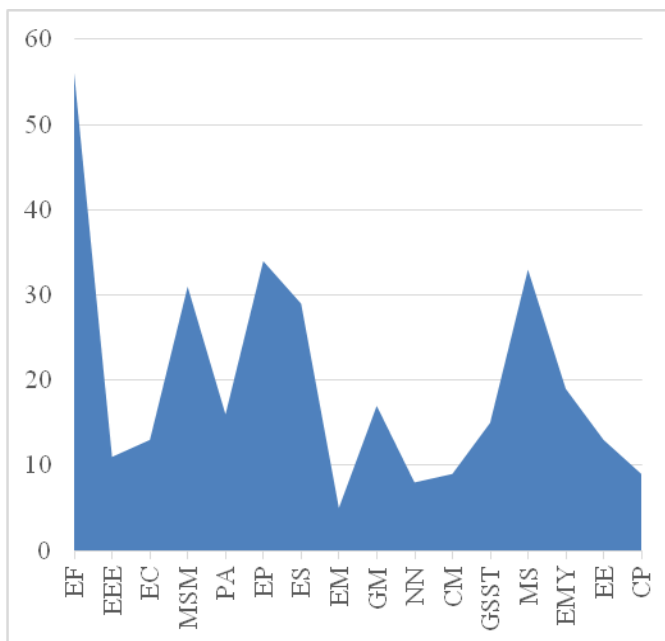
Web of Science enables the selection of Open Access type articles. Within this stage, in the topic fields were searched for “unconventional technologies” keywords. For the period 1975-2019 a number of 474 of occurrences were obtained (Figure 3).

In the following stage, in the last 5 years (2015-2019) scientific papers from the Open Access category were investigated. The result was the 338 occurrences having “unconventional technologies” as their topic (Figure 4).

Table 3 was created using as main source the results presented in Figures 3 and 4. It represents the evolution of Open Access publications within the economy based on knowledge.



**Figure 3.** Open Access articles published for the period 1975 - 2019



**Figure 4.** Number of Open Access papers for the period 2015-2019

The basic conclusion revealed from Table 3 was that the percentage of the Open Access articles increased in the period when the economy was based on knowledge with values between 53% and 93%: 4 WSC had increased values between 53% and 63%, 4 WSC between 63% and 73%, 7 WSC between 73% and 83% and, finally, for 1 WSC was recorded an increase of 93%.

For the period 1975-2019, the ratio of the Web of Science Core Collection citations for the “unconventional technologies” field was of 2231.

**Table 3.** Trends of the Open Access Articles

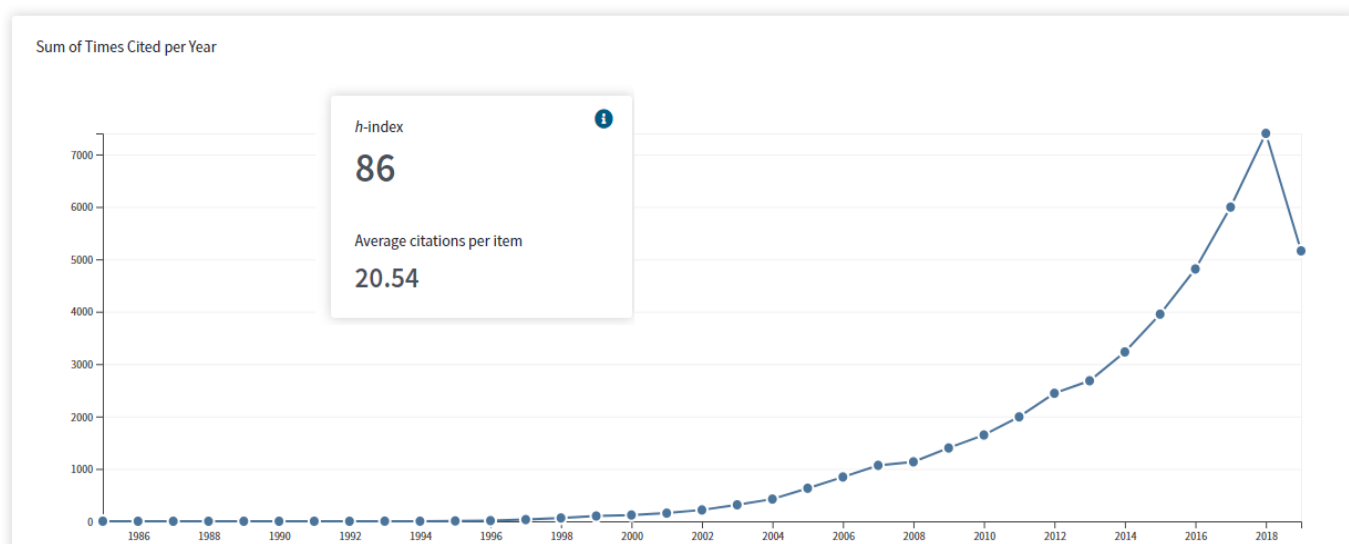
WSC Code	Open access Number articles for period 1975-2019	Open access Number articles for period 2015-2019	Percentage
EF	88	56	0,63636
EEE	19	11	0,57895
EC	17	13	0,76471
MSM	40	31	0,77500
PA	23	16	0,69565
EP	49	34	0,69388
ES	44	29	0,65909
EM	7	5	0,71429
GM	32	17	0,53125
NN	13	8	0,61538
CM	11	9	0,81818
GSST	16	15	0,93750
MS	43	33	0,76744
EMY	25	19	0,76000
EE	16	13	0,81250
CP	12	9	0,75000

The h-Index (Hirsch Index) was developed by J.E. Hirsch and published in USA on 15<sup>th</sup> November 2005.

The index reflects the authors’ productivity and the impact of scientific activities based on their publication and citation occurrences. The h-Index is based on a list of publications classified in ascending order by the Times Cited.

The h value is equal to the number of papers (N) from the list that have N or more citations. Currently, Web of Science has a limit of 10000 records that can be used to generate a Citation Report [10].

For the papers belonging to the “unconventional technologies” domain, published in the period 1975-2019, the Hirsch index (h-Index) has the value 86. This represents a big value considering that the majority of specialists have a h-Index  $\leq 10$  (Figure 5).



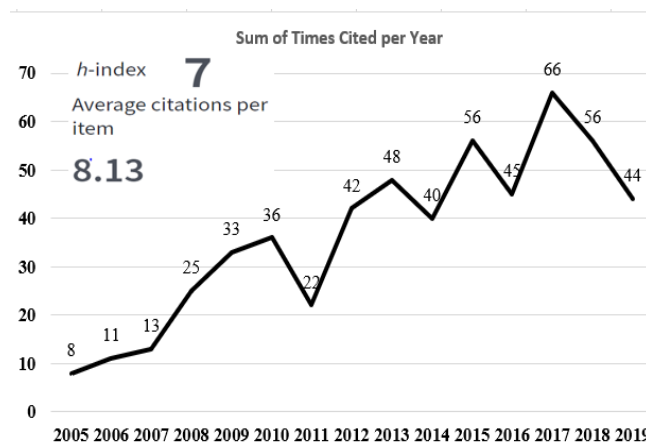
**Figure 5.** The Hirsch Index for the period 1975-2019

By creating the Web of Science data analysis on countries/regions and considering the above mentioned criteria, it can be observed that Romania brought a contribution of 67 papers, being placed on the 10<sup>th</sup> position, just as South Korea (see Table 4). The number of Romanian articles has a h-Index=7 (see Figure 6), which leads to an increase of 8% to the value of h-Index=86.

**Table 4.** Evaluation by countries/regions (extract)

No	Record Count	Papers No.	% of 2,231
1.	USA	699	31.317 %
2.	PEOPLES R CHINA	331	14.830 %
3.	ITALY	136	6.093 %
4.	ENGLAND	119	5.332 %
5.	GERMANY	113	5.063 %
6.	CANADA	100	4.480 %
7.	POLAND	77	3.450 %
8.	INDIA	75	3.360 %
9.	RUSSIA	74	3.315 %
10.	ROMANIA	67	3.002 %
11.	SOUTH KOREA	67	3.002 %
12.	AUSTRALIA	65	2.912 %
13.	FRANCE	62	2.778 %
14.	CZECH REPUBLIC	58	2.599 %
15.	SPAIN	52	2.330 %
16.	NETHERLANDS	50	2.240 %
17.	JAPAN	45	2.016 %
18.	SWITZERLAND	44	1.971 %
19.	SLOVAKIA	32	1.434 %
20.	BRAZIL	26	1.165 %
21.	SINGAPORE	26	1.165 %
22.	SWEDEN	26	1.165 %
23.	SCOTLAND	23	1.030 %
24.	SAUDI ARABIA	22	0.986 %

No	Record Count	Papers No.	% of 2,231
25.	IRAN	19	0.851 %



**Figure 6.** The Hirsch Index for Romania (1975-2019)

For the period 2015-2019, the ratio regarding the Web of Science Core Collection citations with "unconventional technologies" as topic is of 1155. In this situation, the Hirsch index (h-Index) has the value 40 (Figure 7). The results presented in Figures 5 and 7 can be centralized according to Table 5.

**Table 5.** Citations Trend

Period	Citations	h-Index
1975-2019	2231	86
2015-2019	1155	40

It can be observed that 52% of the cited papers were produced during the period of the knowledge-based economy and 46% were produced from the h-Index value obtained from the same period.

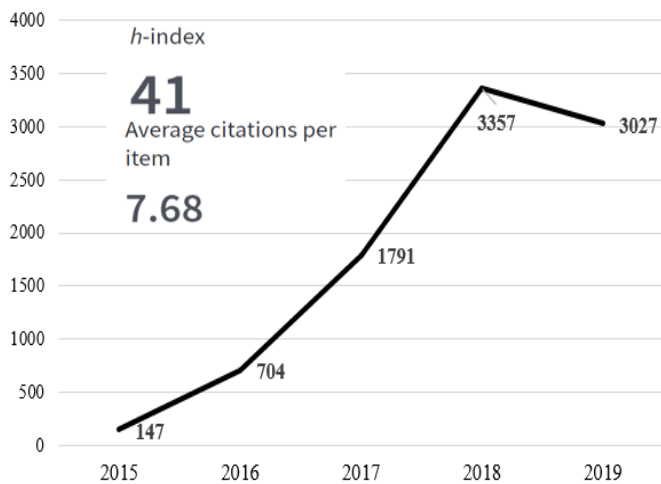


Figure 7. The Hirsch Index for the period 2015-2019

### 3. CONCLUSIONS

The great number of papers from the “unconventional technologies” scientific domain emphasize both the importance of the results of the researches (inventions, innovations, etc.) as well as the increase of the general interest regarding this domain.

The results of this paper contribute to the simplification process and to the role of visualization of “unconventional technologies” placed at the junction between the digital economy and the knowledge-based economy.

According to the analysis of Web of Science data on countries/regions it was identified the fact that in Romania were produced 67 papers (revealing 548 citations), on the position number 10, on the same position with South Korea.

Conducting a comparison between Europe and Asia, the result is of 779 to 544, encouraging the European continent with a difference of 235 papers. In USA, the number of papers was of 699.

The majority of unconventional technologies is developed by European and American companies. The quantity and the quality of shared knowledge (including Open Access) through books, magazines, conferences and specialized journals contribute to the generation of new specialists and to the increase of their creative-innovative potential, also included in the domain of unconventional technologies.

### 4. ACKNOWLEDGEMENTS

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