FIFTEEN YEARS OF POLISH MARITIME RESEARCH (PMR) IN WEB OF SCIENCE: A BIBLIOMETRIC OVERVIEW

ABSTRACT

Polish Maritime Research (PMR) is an international journal in the fields of Engineering Marine, which celebrate in 2021 the 15th anniversary in Web of Science and 27th anniversary since published its first issue in 1994. This study gives insight into a general overview of the journal by using bibliometric indicators. It has been turned out that PMR is in the 9-10th position out of 420 journals in the Web of Science Core Collection category of Engineering Marine based on the number of citations and publications. Keyword analysis shows that the content of the journal is focused on the concepts related with efficiency, simulation, optimization, navigation and model test.

Our results show the increasing trend in number of publications and citations in the period of 15 years indicating the strong impact of the journal for scientific community. Moreover, we observed that about 5.6% articles have an international co-authors. We found that Poland, China and Iran are the most productive countries in PMR. Additionally, our study reveals that international and domestic collaboration effect on the greater number of citations.

Keywords

Polish Maritime Research; bibliometric analysis; publications; citations.

INTRODUCTION

Polish Maritime Research (PMR) is a scientific international quarterly journal, which was launched in 1994. However, the first issue indexed in the Journal Citation Reports (JCR) of the Web of Science (WoS) Core Collection database appears in 2007. Publisher is Institute of Naval Architecture and Ocean Engineering in Gdańsk University of Technology. Currently, chairman is prof. Jerzy Girtler and editor in chief is prof. Wiesław Tarełko. The journal focus on the original, innovative scientific ideas and achievements in the research area of Engineering, Computing & Technology, Mechanical Engineering (Engineering Marine). PMR provides articles related with methods of the designing, manufacturing and operating processes of some technical objects and devices, especially: ships, port equipment, ocean engineering units, underwater vehicles and equipment as well as harbour facilities, with accounting for marine environment protection.

In particular, PMR gives a lot of articles associated with offshore floating and fixed structures and their components (all types of vessels and their equipment, fixed and floating offshore units and their components, autonomous underwater vehicle, remotely operated vehicle). Moreover, it should be add that PMR is an open access journal in which articles can be published under the CC-BY 4.0 license.

Many journals show a bibliometric analysis of the publication activity of the journal, especially through the celebration of their anniversary. For example, previous studies provide the bibliometric analyses of journals with various research areas: chemistry (Analytical and Bioanalytical Chemistry [1], Chemico-Biological Interactions [2], The Journal of Mathematical Chemistry [3]), information sciences (Information Sciences [4], Soft Computing [5], International Journal of Intelligent Systems [6]) and other sciences [7-10]. These studies give an insights into the articles published in the selected journal and analyse different aspects associated with the journal, such as: publication and citation structure, authors, universities, countries and keywords.

The main aim of this work is to perform the bibliometric analysis of PMR in years 2007-2020. In particular, we provide a lot of information about various bibliometric indicators related with the publications activity, citations as well as international collaboration. This study also gives an overview in the most frequently used keywords in PMR. Furthermore, we also compare PMR with other journals in the fields of Engineering Marine.

METHODS

To obtain the bibliometric analysis of Polish Maritime Research (PMR), we used the most frequently used analytical tool - InCites [11, 12]. The data were collected from the database on 9th July 2021. The analyses were performed for 983 articles which were published in PMR in the period of 2007-2020. In particular, we calculated a lot of bibliometric indicators, especially: the number of Web of Science documents, the number of citations, number of citations per publication, Category Normalized Citation Impact (CNCI, average number of citations per paper normalized for the subject, year and document type), the percentage of articles cited at least once, the percentage of articles that have international/domestic co-authors, the percentage of documents in Q3 journals. The values of particular bibliometric indicators were shown in dependence of country, institution and publication year. It is worth noting that the documents in years 1994-2006 were calculated based on the webpage of the journal, because they are not indexed in the Web of Science database. All results were analyzed using Microsoft Excel, especially we used the pivot tables and charts.

To determine author keywords, we used VOSviewer software [13, 14] which allows the visualisation of co-occurrence maps and co-citation networks at the country-, organisation- and author-level. We searched the data, including Title, Abstract and Keywords. The total strength of the co-occurrence links with other keywords was calculated and the keywords with the greatest total link strength were selected. We used a full counting method assuming that the minimum number of occurrences was equal to 5 and the minimum cluster size was equal 20 items. We also chose normalisation of the association strength.

RESULTS AND DISCUSSION

Insights into the number of publications and citations in PMR

Polish Maritime Research (PMR) has published many significant articles in the field of Engineering Marine. Although, PMR started publishing articles in 1994, the first issue of PMR indexed in Web of Science was published in 2007. In order to establish the annual number of articles published in this journal and the corresponding number of citations these articles, we calculated the number of publications and citations as a function of years. Based on Fig. 1, it can be seen that the number of articles grew up from 13 in 1994 to 78 in 2020. During the first ten years, the journal was publishing only about 22 articles per year. However, it should be highlighted that in the last 10 years, scientists published about 76 articles per year in PMR. Interestingly, the greatest number of articles scientists published in years 2017 and 2018, while the lowest number of articles scientists published in the first year 1994. The significantly growth of number of publications in years 2017 and 2018 can be explained by the huge interests of methods of the designing, manufacturing and operating processes of such technical objects and devices: (ships, port equipment, ocean engineering, underwater vehicles etc.) during the mentioned period of time. According to Fig. 1, it can be seen that, from 2007 to 2011, articles were cited about 150 times per year. The number of citations started to grow significantly in 2011 and increased to about 759 citations in 2017. However, it should be add that during the last years (2018-2020), the number of citations decreased.

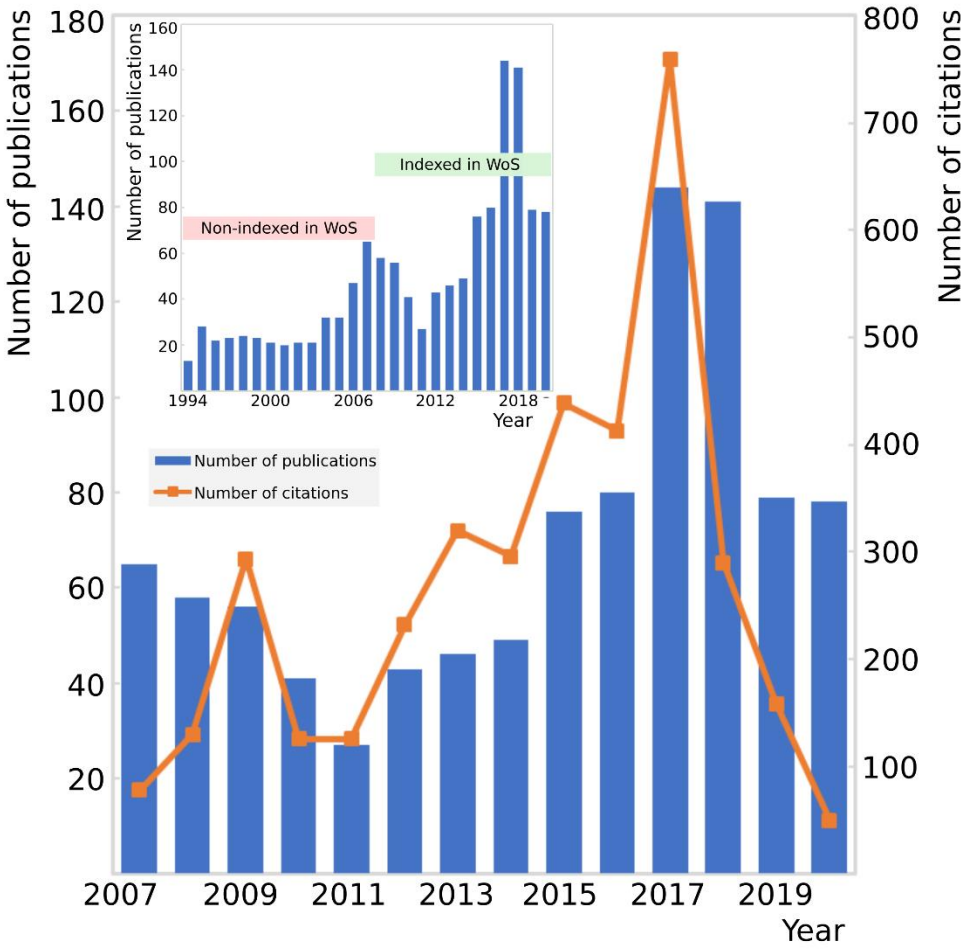

Fig. 1. Annual number of articles published in PMR over the period 2007-2020 and the corresponding number of citations. The inset shows the number of articles which were published in PMR between 1994 and 2020.

It is well known that indicators related with citations are the significant indicators providing the overview of quality publications. The data presented in Fig. 2 reveal significant differences in the number of citations per publication and the percentage of documents cited at least once in the years 2007-2020. It can be seen that the number of citations per publication grew up from 1.2 in 2007 to 7.0 in 2013 and then, the number of citations per publication slightly decreased to 0.6 in 2020. Moreover, based on Fig. 2 it can be seen that about 76.5% articles were cited at least one in the period of 2007-2020. The more detailed overview of indicators related with citations as a function of years present in Table 1 and Fig. 3. Therefore, as revealed by an analysis of citations over the span of years (Fig. 3 and Table 1), the greatest number of citations obtain articles in year 2017 (759 citations, which constitutes 20% of all number of citations in the selected period of time), while the lowest number of citations receive articles in 2020 (50 citations, which constitutes 1.3% of all number of citations).

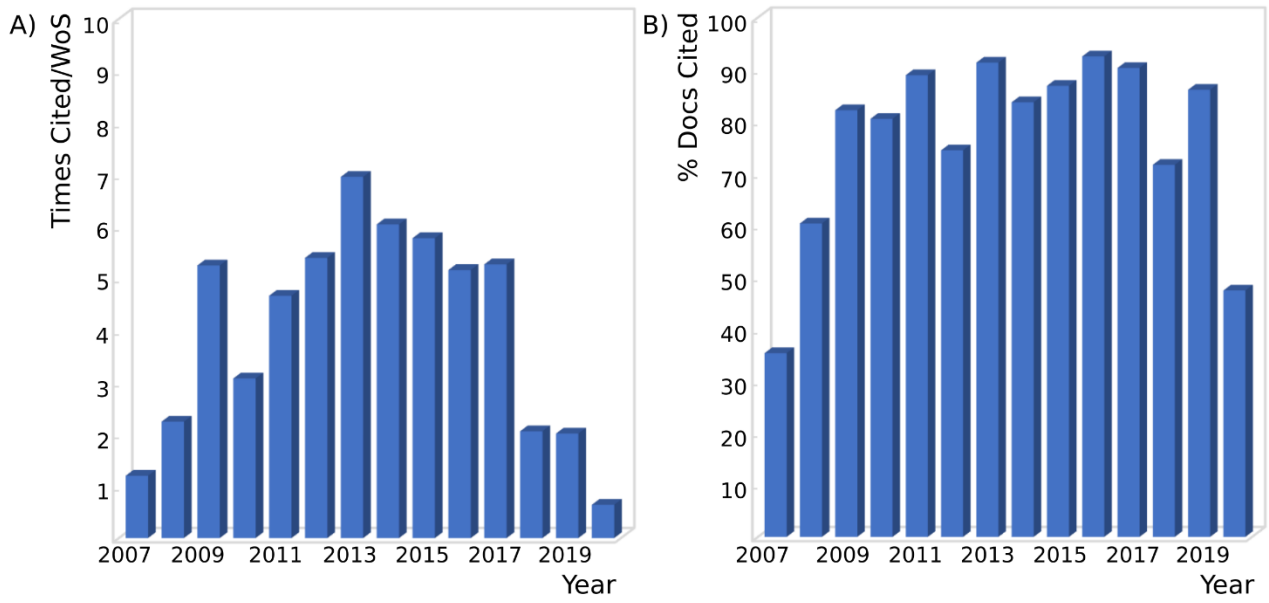

Fig. 2. (A) The number of citations per publication, (B) The percentage of publications cited at least one as a function of years in PMR.

Table 1. Analysis of bibliometric indicators related with the number of publications and citations as a function of time in PMR. The study period was from 2007 to 2020.

				Number of publications which were cited 0, 1, 2, 3-4, >=5, >=10, >=15, >=20, >=30 times								
Rok	**TP**	**TC**	**TC/TP**	**0**	**1**	**2**	**3-4**	**>=5**	**>=10**	**>=15**	**>=20**	**>=30**
2007	65	78	1,2	42	7	6	6	2	2			
2008	58	130	2,2	23	18	4	4	4	4	1		
2009	56	294	5,3	10	9	8	9	10	4	4	1	1
2010	41	126	3,1	8	8	8	9	5	2	1		
2011	27	126	4,7	3	4	3	7	6	3		1	
2012	43	232	5,4	11	4	3	4	15	3		3	
2013	46	320	7,0	4	8	4	11	7	6	2	2	2
2014	49	296	6,0	8	6	6	4	13	8	3		1
2015	76	439	5,8	10	9	9	15	21	8	2	1	1
2016	80	413	5,2	6	9	12	19	20	11	2	1	
2017	144	759	5,3	14	24	23	31	31	10	6	3	2
2018	141	290	2,1	40	43	23	17	15	2		1	
2019	79	159	2,0	11	28	20	16	2	1	1		
2020	78	50	0,6	41	26	9	2					
Total	**983**	**3712**	**55,7**	**231**	**203**	**138**	**154**	**151**	**64**	**22**	**13**	**7**
%				**23**	**21**	**14**	**16**	**15**	**7**	**2**	**1**	**1**

Abbreviation: TP – number of publications; **TC** – number of citations; **TC/TP** – number of citations per publication; **%** - the percentage of publications which have 0, 1, 2, 3-4, greater or equal (>=) 5, 10, 15, 20, 30 citations.

According to Table 1 and Fig. 3, it can be seen the annual citation structure of PMR. It should be highlighted that our study considers several specific citation thresholds to identify the number of articles published in a certain year and the number of articles with a certain number of citations. In general, it can be seen that 7 articles during that period were cited more than 30 times, which constitutes 1% of all articles in PMR. 13 papers have received more than 20 and less than 30 citations. 22 papers have received between 15 and 20 citations. 64 articles were cited between

10 and 15 times. Moreover, based on Table 1 and Fig. 3, it can be seen that 154 articles were cited 3-4 times and 151 articles were cited 5-10 times. 203 articles (21% of all articles) have one citation and 138 articles (14% of all articles) obtain 2 citations in the period of 2007-2020. Unfortunately, it should be add that 23% of all articles don't obtain any citations.

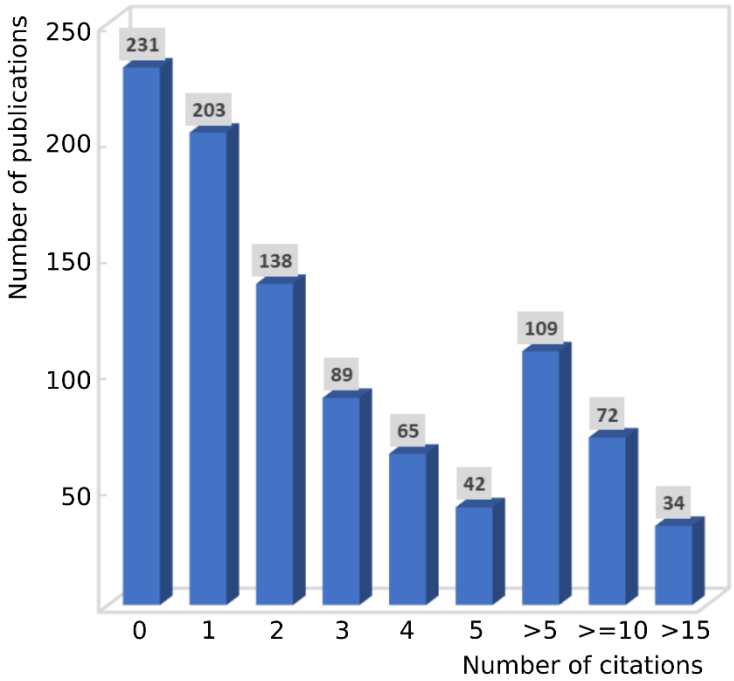

Fig. 3. The number of articles published in PMR which have 0, 1, 2, 3, 4, 5 citations as well as greater or equal (>=) 5, 10 and 15 citations in the period of 2007-2020.

In order to obtain the insights into the top 20 most cited articles in PMR between 2007 and 2020, we present the list of articles which received at least 20 citations in the selected period of time. According to Table 2, it can be seen that the most cited paper in PMR is 'Maritime laser scanning as the source for spatial data' [15] with 58 citations.

Table 2. Top 20 articles in PMR which have at least 20 citations.

ID	TC	Article Title	Authors	Publication Date
1	58	Maritime laser scanning as the source for spatial data	Burdziakowski, Pawel; Janowski, Artur; Kholodkov, Arthem; Matysik, Krzysztof; Matysik, Maciej; Przyborski, Marek; Szulwic, Jakub; Tysiac, Pawel; Wojtowicz, Aleksander	2015
2	49	A deep q-learning network for ship stowage planning problem	Shen, Yifan; Zhao, Ning; Xia, Mengjue; Du, Xueqiang	2017
3	42	A positioning lockholes of container corner castings method based on image recognition	Shen, Yang; Mi, Weijian; Zhang, Zhiwei	2017
4	41	On board LNG reliquefaction technology: a comparative study	Romero Gomez, J.; Romero Gomez, M.; Ferreiro Garcia, R.; De Miguel Catoira, A.	2014
5	34	Weldability of high strength steels in wet welding conditions	Fydrych, Dariusz; Labanowski, Jerzy; Rogalski, Grzegorz	2013

6	32	Efficient heuristic for non-linear transportation problem on the route with multiple ports	Krile, Srecko	2013
7	31	Water-lubricated bearings of ship propeller shafts - problems, experimental tests and theoretical investigations	Litwin, Wojciech	2009
8	29	An Ant Colony Algorithm for efficient ship routing	Tsou, Ming-Cheng; Cheng, Hung-Chih	2013
9	27	Path following control of the underactuated usv based on the improved line-of-sight guidance algorithm	Liu, Tao; Dong, Zaopeng; Du, Hongwang; Song, Lifei; Mao, Yunsheng	2017
10	27	Design analysis of Tesla micro-turbine operating on a low-boiling medium	Lampart, Piotr; Kosowski, Krzysztof; Piwowarski, Marian; Jedrzejewski, Lukasz	2009
11	27	Application of an autonomous/unmanned survey vessel (asv/usv) in bathymetric measurements	Specht, Cezary; Switalski, Emilian; Specht, Mariusz	2017
12	26	Implementation of spatial information for monitoring and analysis of the area around the port using laser scanning techniques	Bobkowska, Katarzyna; Inglot, Adam; Mikusova, Miroslava; Tysiac, Pawel	2017
13	24	Technology of spatial data geometrical simplification in maritime mobile information system for coastal waters	Kazimierski, Witold; Wlodarczyk-Sielicka, Marta	2016
14	24	Conceptual Design and Performance Analysis of an Exhaust Gas Waste Heat Recovery System for a 10000TEU Container Ship	Ma, Zheshu; Yang, Dong; Guo, Qiang	2012
15	23	Accuracy of the gps positioning system in the context of increasing the number of satellites in the constellation	Specht, Cezary; Mania, Mateusz; Skora, Marcin; Specht, Mariusz	2015
16	22	Game control methods in avoidance of ships collisions	Lisowski, Jozef	2012
17	21	Data fusion in a navigational decision support system on a sea-going vessel	Borkowski, Piotr	2012
18	21	Cold cracking of s460n steel welded in water environment	Tomkow, Jacek; Labanowski, Jerzy; Fydrych, Dariusz; Rogalski, Grzegorz	2018
19	20	The Added Mass Coefficient computation of sphere, ellipsoid and marine propellers using Boundary Element Method	Ghassemi, Hassan; Yari, Ehsan	2011
20	20	Peripheral challenge by Small and Medium Sized Ports (SMPs) in Multi-Port Gateway Regions: the case study of northeast of China	Feng, Lin; Notteboom, Theo	2013

Abbreviation: TC- number of citations.

To reveal the patterns and trends of number of publications as a function of number of pages, we present this dependence in Fig. 4. According to Fig. 4, it can be seen that the greatest number of articles in PMR have 7 and 8 pages.

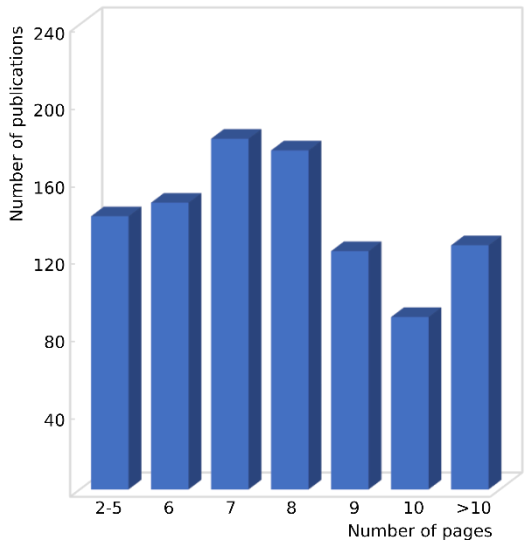

Fig. 4. The number of articles in PMR which have 2-5, 6, 7, 8, 9, 10, >10 pages.

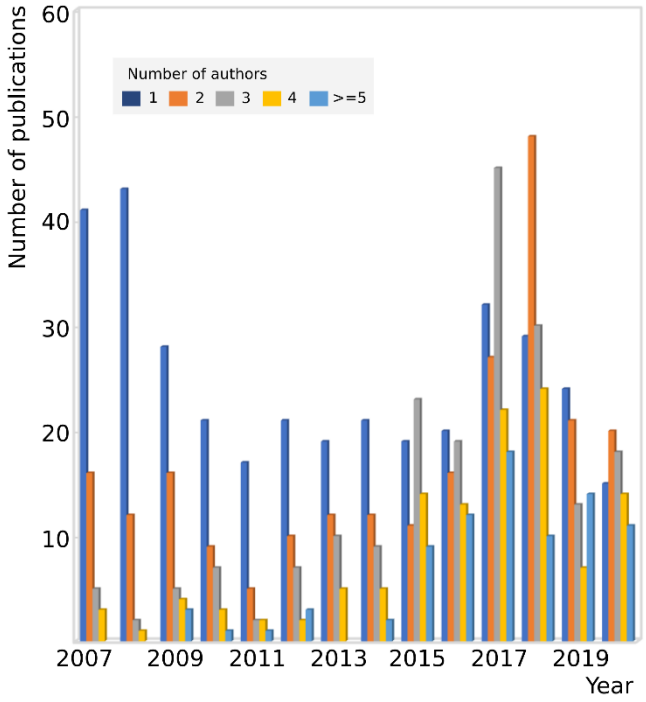

Fig. 5. The number of articles in PMR which have 1, 2, 3, 4 and greater or equal (>=) 5 authors.

To answer the question how many scientists have one publication in PMR, in Fig. 5 we perform the number of articles in PMR as a function of time and number of authors. From Fig. 5, it is interesting to note that articles which were published in PMR have usually 1 author. However, it should be noted that we observed some exceptions. For example, in years 2018 and 2020, the greatest number of articles have 2 authors and in years 2015 and 2017, the greatest number of articles have 3 authors.

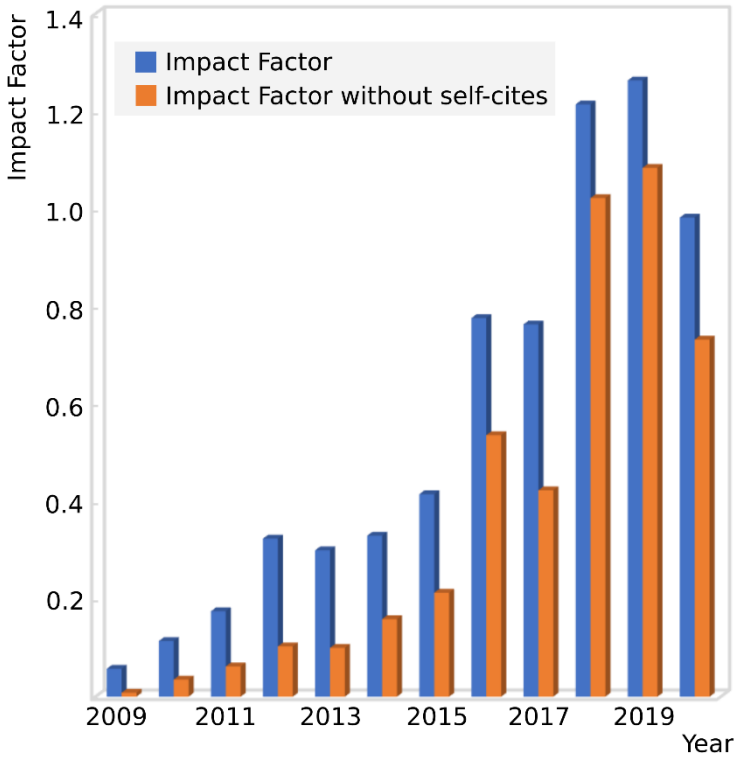

Fig. 6. Impact Factor (blue) and Impact Factor without journal self-cites (orange) as a function of years.

Next, we perform the changes in Impact Factor (blue) and Impact Factor without journal self-cites (orange) which obtain PMR in years 2009-2020. Based on Fig. 6, it can be seen that values of Impact Factor increase in the period of 2009-2020. It should be noted that the highest values of Impact Factor was observed in years 2018 (IF=1.214) and 2019 (IF=1.263). Currently, Impact Factor (2020) is equal 0.982. Moreover, it is worth noting that Impact Factor without journal self-cites is equal 30% value of Impact Factor in years 2009-2013, 56% in years 2014-2017 and 82% in years 2018-2020.

Additionally, we also perform the list of organizations which funded the publications in PMR. Based on Fig. 7, it can be seen that the greatest number of publications were funded by National Natural Science Foundation of China (112 articles), followed by Ministry of Science and Higher Education, Poland (26 articles), Fundamental Research Funds for the Central Universities (17 articles), European Commission (14 articles) and National Centre for Research & Development, Poland (11 articles).

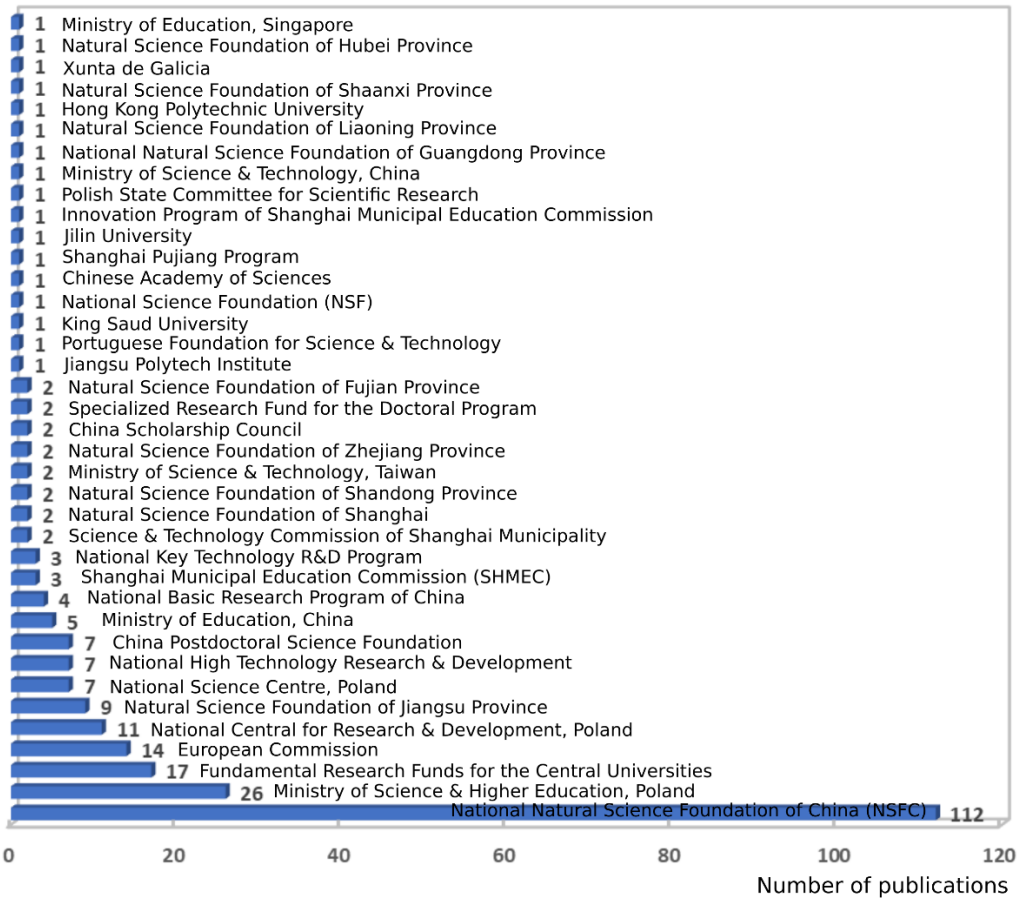

Fig. 7. Organizations which funded the publications in PMR and the correspondence number of articles for these organizations.

Insights into the effect of international/domestic collaboration on the number citations in PMR

Understanding and predicting the effect of international/domestic collaboration on the indicators related with citations can be valuable from scientist point of view. Therefore, we present the percentage of publications which have one or more authors with foreign countries and the percentage of publications which have two or more authors with more than one institution in the same country as a function of years.

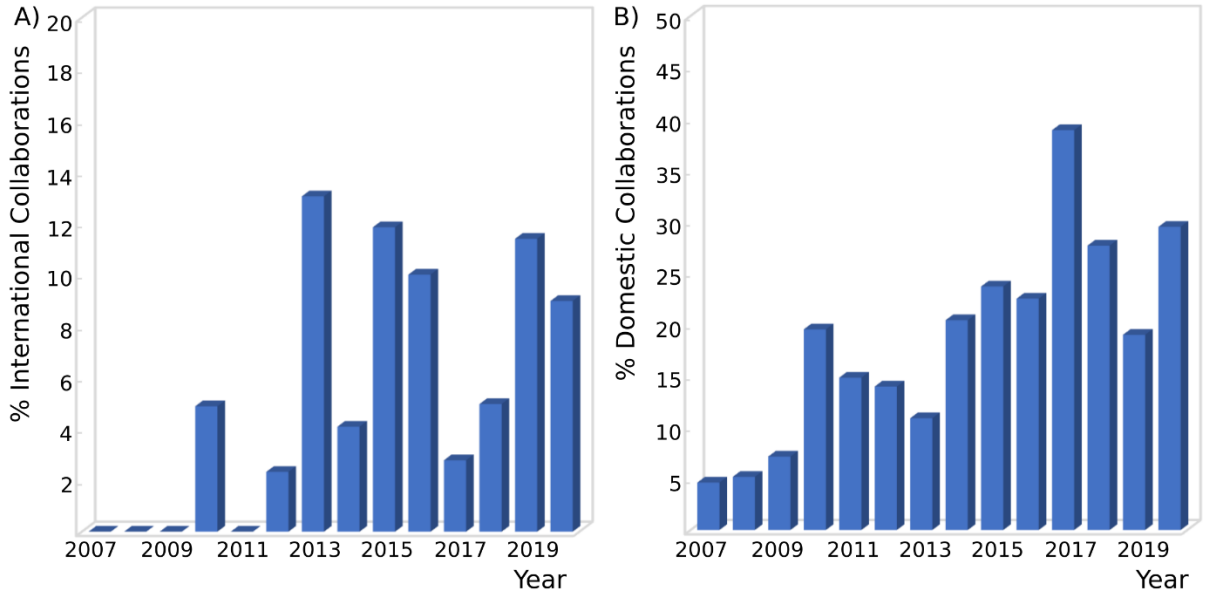

Fig. 8. The percentage of publications which have (A) international and (B) domestic co-authors.

According to Fig. 8 it can be seen that about 5.6 % articles in PMR have at least once author with foreign countries. The greatest percentage of publications which have international co-authors was observed in years 2013, 2015, 2016 and 2019 (values greater than 10%). It means that scientists who published in PMR are sometimes participants in international scientific projects. On the other hand, Fig. 8 shows that the percentage of publications which have two or more authors with more than one institution in the same country as a function of years. Based on Fig. 8, it can be seen that the domestic collaborations increased over the period from 2007 to 2020. In addition, the level of domestic collaboration is the greatest in 2017. In this place, it is worth highlighted that national and international collaboration can effect on the quality of publications [16, 17].

In order to reveal the difference between all, domestic and international publications, Fig. 9 shows CNCI, JNCI, the percentage of documents cited at least once, the number of citations per document, which were calculated for all, domestic and international publications. Based on Fig. 9 it can be seen that CNCI and JNCI have the greatest values for domestic publications, while the lowest values for all publications. Additionally, it is worth noting that values of JNCI are greater than 1.0 in the case of domestic and international collaborations. It means that these values are slightly greater than the average world values. Moreover, it is worth noting that the greatest percentage of publications cited at least one in PMR was observed for publications which have at least one author from foreign countries (85.45%). The slightly smaller values were observed in the case of domestic publications (83.49%) and the lowest values were observed in the case of all publications (76.50%). These findings is also consistent with Breugelmans results who present that internationally collaborative papers are more frequently cited than single-nation papers [18]. According to Fig. 9, it can be seen that the greatest number of citations per publication have domestic publications (4.54), followed by international publications (3.85) and all publications (3.78).

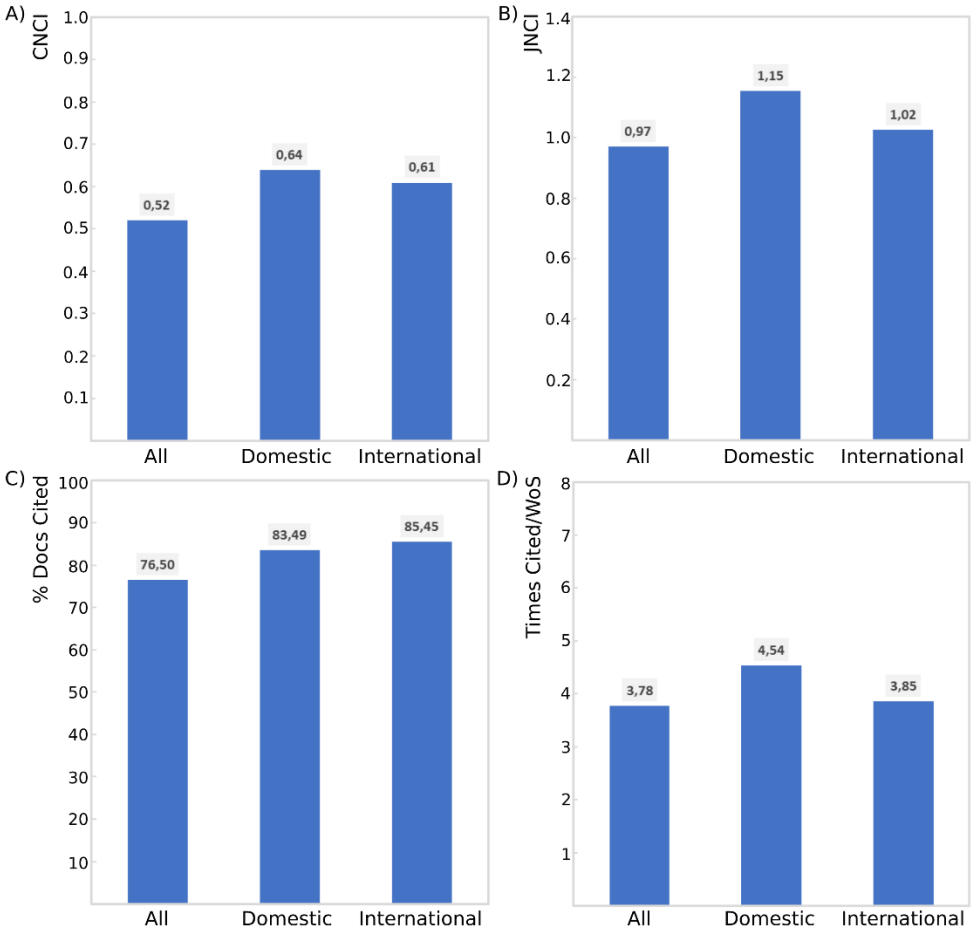

Fig. 9. (A) CNCI (B) JNCI (C) The percentage of documents cited at least once (D) The number of citations per document for all, domestic and international publications.

Insights into the countries published in PMR

In order to establish in which countries scientists published the greatest number of articles in PMR, in Table 3, we perform the list of top 25 most productive countries in PMR between 2007 and 2020. It should be highlighted that we show the countries in which scientists published at least 2 articles in PMR. According to Table 3, it can be seen that the greatest number of articles were published by scientists from Poland (618 articles and 2419 citations), followed by China with 239 articles and 693 citations as well as Iran with 31 articles and 189 citations. The first five positions are completed by Turkey and Spain (16 and 13 articles, respectively). It should be noted that scientists from Ukraine and Malaysia published 10 articles in PMR. Scientists from other countries published smaller number of articles in PMR. Although the scientists from Slovakia and Italy published only two articles in PMR, it is worth noting that articles from these countries obtain the greatest number of citations per publication, especially: Slovakia (14.5 citations per publication), Italy (10.5 citations per publication). For countries in which scientists published the greatest number of articles as can be seen that the average number of citations per publication is in the ranging from 3 to 4 (Poland: TC/TP = 3.9, China: TC/TP = 2.9). According to Table 3, it can be seen that scientists from some countries wrote the most frequently cited articles. For example, scientists from Poland published 17 articles which obtain between 15 and 20 citations, 7 articles which obtain between 20 and 30 citations and 3 articles which obtain more than 30 citations. Scientists from China published 3 articles which were cited between 20 and 30 times as well as 2 articles which were cited more than 30 times. Furthermore, scientists from Italy published 1 article which was cited 15-20 times, Slovakia – 1 article (20-30 citations), Croatia -1

article (greater than 30 times), Taiwan – 1 article (20-30 times), Spain – 1 article (greater than 30 times) and 1 article (15-20 times), Iran - 3 articles (15-20 times) and 1 article (20-30 times).

Table 3. Top 25 most productive countries (scientists with selected countries published at least 2 articles between 2007 and 2020) in PMR.

					Number of publications which were cited 0, 1, 2, 3, 4, >=5, >=10, >=15, >=20, >=30 times									
ID	**Country**	**TP**	**TC**	**TC/TP**	**0**	**1**	**2**	**3**	**4**	**>=5**	**>=10**	**>=15**	**>=20**	**>=30**
1	Poland	618	2419	3,9	148	111	78	54	48	107	45	17	7	3
2	China	239	693	2,9	56	67	40	28	9	25	9		3	2
3	Iran	31	189	6,1	3	5	3	4	2	6	4	3	1	
4	Turkey	16	40	2,5	3	4	6			2	1			
5	Spain	13	109	8,4	2	2	1		1	4	1	1		1
6	Ukraine	10	29	2,9	2	2	2	1	1	1	1			
7	Malaysia	10	27	2,7	1		5	1	1	2				
8	Taiwan	8	56	7,0		1	3			3			1	
9	USA	7	12	1,7	2	1	2	1	1					
10	Croatia	5	38	7,6		3		1						1
11	Germany	5	12	2,4	3					2				
12	Egypt	5	26	5,2	1	1	1			1	1			
13	Portugal	5	10	2,0	1	1	1	1	1					
14	South Korea	5	13	2,6	1		1	2		1				
15	Montenegro	4	16	4,0	1	1				2				
16	Saudi Arabia	3	16	5,3	1		1				1			
17	Slovakia	2	29	14,5				1					1	
18	Singapore	2	14	7,0			1				1			
19	Slovenia	2	6	3,0	1					1				
20	Italy	2	21	10,5					1			1		
21	United Kingdom	2	15	7,5				1			1			
22	Norway	2	3	1,5		1	1							
23	Vietnam	2	3	1,5		1	1							
24	Australia	2	14	7,0		1					1			
25	Serbia	2	10	5,0			1			1				
	Total	**1002**	**3820**	**124,7**	**226**	**202**	**148**	**95**	**65**	**158**	**66**	**22**	**13**	**7**

Abbreviation: TP – number of publications; **TC** – number of citations; **TC/TP** – number of citations per publication.

Insights into the institutions published in PMR

Institutions from all over the world have published in PMR. In this section, let us analyse institutions that have most publications in PMR. Hence, we show the list of top 23 most productive institutions in which scientists published the greatest number of articles (at least seven articles) over the period of 2007-2020. It should be noted that institutions represent the affiliation of the authors when they published their papers in PMR. However, it is worth add that authors can change institution and they may have articles with various institutions. Based on Table 4, it can be seen that the significantly greatest number of articles were published by scientists from Gdańsk University of Technology (346 articles, 30% of all PMR articles), followed by Gdynia Maritime University (72 articles, 6% of all PMR articles), West Pomeranian University (50 articles, 4% of all PMR articles), Harbin Engineering University (37 articles, 3% of all PMR articles) and UTP

University of Science & Technology (34 articles, 3% of all PMR articles). In order to better visualize the contributions particular institutions in which scientists published their articles in PMR, we also show the number of articles which were published in PMR in Fig. 10. Interestingly, 75 universities published 2-5 articles (18% of all articles in PMR), 20 universities published 6-19 articles (15% of all articles in PMR) and 139 universities published 1 article (12% of all articles in PMR).

Table 4. Top most productive institutions (scientists with selected institutions published at least 7 articles between 2007 and 2020) in PMR.

						Number of publications which were cited 0, 1, 2, 3, 4, >=5, >=10, >=15, >=20, >=30 times									
ID	**Institution**	**Country**	**TP**	**TC**	**TC/TP**	**0**	**1**	**2**	**3**	**4**	**>=5**	**>=10**	**>=15**	**>=20**	**>=30**
1	Gdańsk University of Technology	Poland	346	1399	4,0	86	58	44	28	26	64	22	13	2	3
2	Gdynia Maritime University	Poland	72	359	5,0	16	9	8	6	5	15	8	2	3	
3	West Pomeranian University of Technology	Poland	50	129	2,6	10	11	12	6	2	7	2			
4	Harbin Engineering University	China	37	132	3,6	6	10	4	4	2	9	1		1	
5	UTP University of Science and Technology	Poland	34	185	5,4	4	6	3	2	4	7	6	2		
6	Shanghai Maritime University	China	31	144	4,6	10	9	4	1	2	2	1			2
7	Maritime University Szczecin	Poland	27	155	5,7	4	5	3	3	4	1	4	1	2	
8	Polish Academy of Sciences	Poland	26	74	2,8	3	7	4	3	4	4	1			
9	Amirkabir University of Technology	Iran	20	114	5,7	2	2	2	3	2	5	3		1	
10	Dalian Maritime University	China	19	59	3,1	5	4	4	2		1	3			
11	Wuhan University of	China	13	52	4,0	1	5	2	2	1	1			1	

	Technology														
12	Jiangsu University of Science & Technology	China	12	55	4,6	3	3	2			2	1		1	
13	Wroclaw University of Science & Technology	Poland	10	27	2,7	4	1	1			4				
14	University of Coruna	Spain	9	95	10,6	2	1				3	1	1		1
15	Dalian University of Technology	China	9	24	2,7	1	2	2	2		2				
16	Hohai University	China	9	13	1,4	3	2	2	1	1					
17	Instanbul Technical University	Turkey	8	19	2,4	1	2	4			1				
18	Ministry of Education & Science of Ukraine	Ukraine	8	21	2,6	2	2	1	1	1		1			
19	Poznań University of Technology	Poland	7	12	1,7	3	1		2		1				
20	Sharif University of Technology	Iran	7	46	6,6		2	1	1		1		2		
21	Warsaw University of Technology	Poland	7	15	2,1	4	1	1				1			
22	University Malaysia Sabah	Malaysia	7	20	2,9			4	1	1	1				
23	University of Warmia and Mazury	Poland	7	23	3,3		3		1	1	2				
	Total		**775**	**3172**	**90,2**	**170**	**146**	**108**	**69**	**56**	**133**	**55**	**21**	**11**	**6**

Abbreviation: TP – number of publications; **TC** – number of citations; **TC/TP** – number of citations per publication.

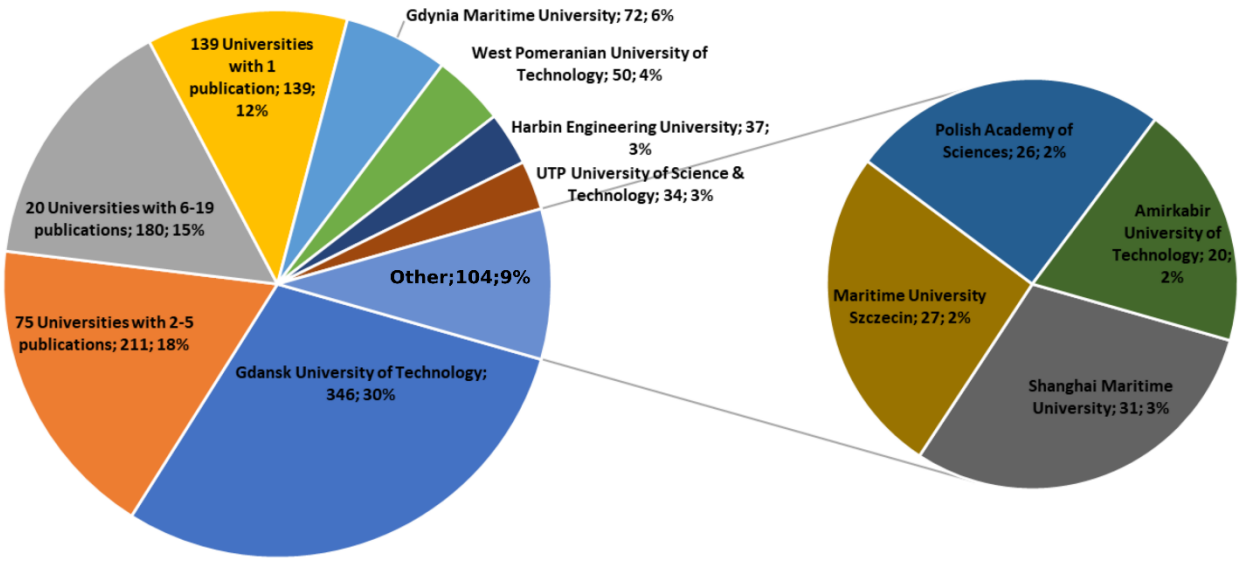

Fig. 10. The number of articles which were published in institutions over world and the corresponding percentage of publications.

It is well known that indicators related with citations are a useful measure of the impact of research output. From the microscopic point of view, it is interesting to know how the bibliometric indicators related with the number of citations varies between particular institutions in which scientists published their articles in PMR. For this purpose, we calculated the number of citations and the number of citations per publication for top most productive institutions. According to Table 4, it can be seen that the greatest number of citations were obtained by scientists from Gdańsk University of Technology (1399 citations), followed by Gdynia Maritime University (359 citations), UTP University of Science and Technology (185 citations), Maritime University of Szczecin (155 citations) and Shanghai Maritime University (144 citations). On the other hand, it is worth noting that if you take account the number of citations per publication, it can be seen that the greatest number of citations per publication have University of Coruna (10.6 citations per publication), followed by Sharif University of Technology (6.6 citations per publication), Amirkabir University of Technology (5.7 citations per publication) and Maritime University of Szczecin (5.7 citations per publication). It should be highlighted that articles from some institutions obtain the significantly large number of citations. In particular, it is worth noting that scientists from Gdańsk University of Technology, Shanghai Maritime University and University of Coruna published about 1-3 articles which were cited greater than 30 times.

To obtain a more detailed overview of institutions in which scientists published in PMR, we also show the percentage of documents which were published in Q3 journals for top institutions in which scientists published the most frequently cited articles in PMR. As can be seen in Fig. 11, for selected institutions, the percentage of articles which were published in Q3 journals is above 70%. On the other hand, it is worth noting that the percentage of documents cited at least one is above 60% for all analyzed institutions. As revealed by an analysis of this indicator, it can be seen that the greatest percentage of documents cited at least one (100%) was observed for institutions which published low number of articles (1-7 articles). If you take account the institutions in which scientists published the significantly number of articles (greater than 20 articles), it can be seen that the greatest percentage of publications which were cited at least once was observed for the following institutions: Amirkabir University of Technology (90%), Polish Academy of Sciences and UTP University of Science & Technology (88%), Maritime University of Szczecin (85%), Harbin Engineering University (84%).

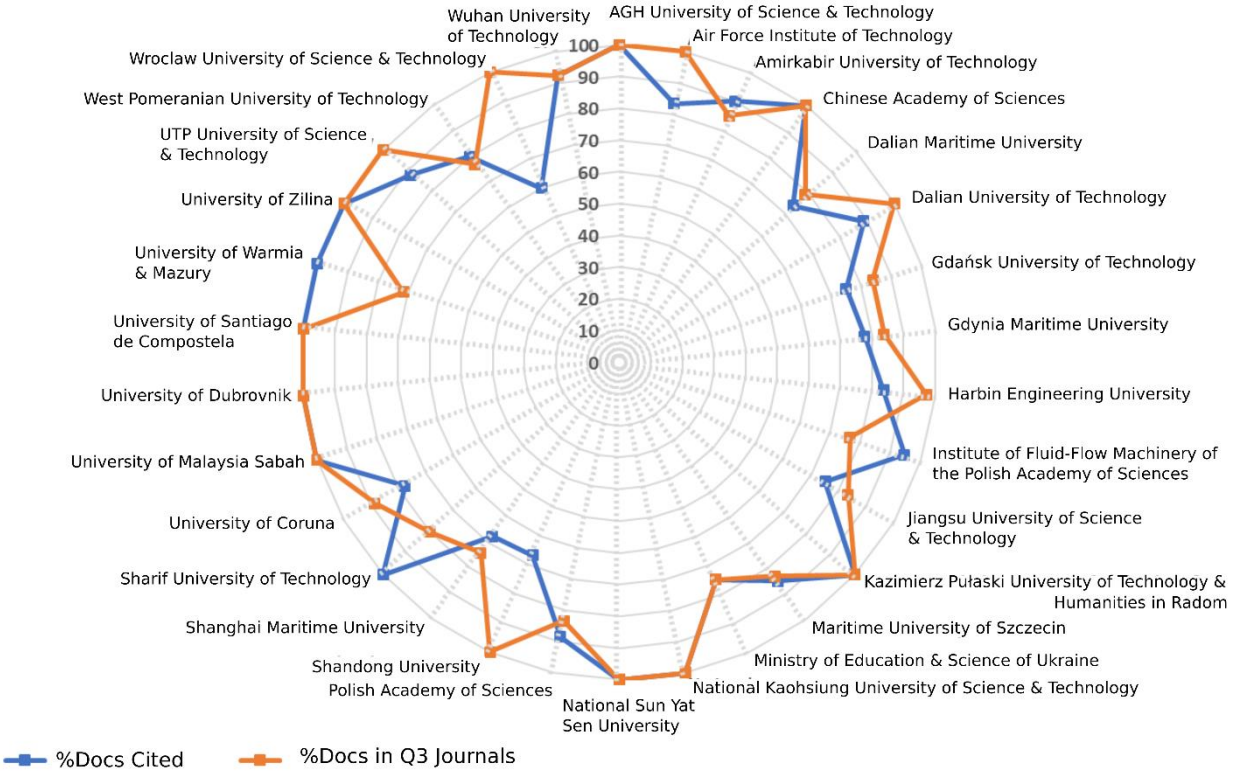

Fig. 11. The percentage of documents cited at least one (blue line) and the percentage of documents in Q3 journals (orange line) for top institutions in which scientists published in PMR the most frequently cited articles. Assumption: scientists obtain at least 20 citations for their articles between 2007-2020.

Insights into the most frequently used keywords in PMR

Next, it would be interesting to determine what are the most frequently used keywords in articles in PMR. Hence, we identified and analysed the keywords often used by authors in their publications and keywords with the greatest total link strength. Fig. 12 reveals the selected keywords (minimum number of occurrences is 5 and minimum cluster size is 20 items) and the strength of the occurrence of particular keywords. In this place, it is worth to mention that the nodes represents the units of analysis author keywords; the size of the nodes are the number of publications featuring the node; the distance between nodes means the relationship between the nodes and the colour of the node is the cluster to which the node has been assigned. Moreover, it is worth to add that a greater number of lines between particular keywords suggests a stronger connection between the keywords, while a lower number of line between keywords indicates a smaller connection between the keywords. It should be highlighted that the keywords with the highest occurrence frequency are significant. On the other hand, keywords with a smaller frequency of occurrence are less important. Furthermore, it is worth noting that this study have several limitations, especially: lack of author's keywords in some papers, the keywords are not often reflect the publication content.

Firstly, it has been found that keywords analysis could be clustered in groups. Fig. 12 shows four clusters: red, green, blue and yellow. The first (red) cluster represents keywords related to efficiency, technical diagnostics, diesel engine, emissions, reduction and computational fluid dynamics. The second (green) cluster shows keywords associated with performance, behaviour, wind turbine, energy efficiency. The third (blue) cluster contains keywords such as computer simulation, optimization, navigation and model test. The last (yellow) cluster reflects keywords related with model, flow, numerical simulation, boundary element method and cavitation.

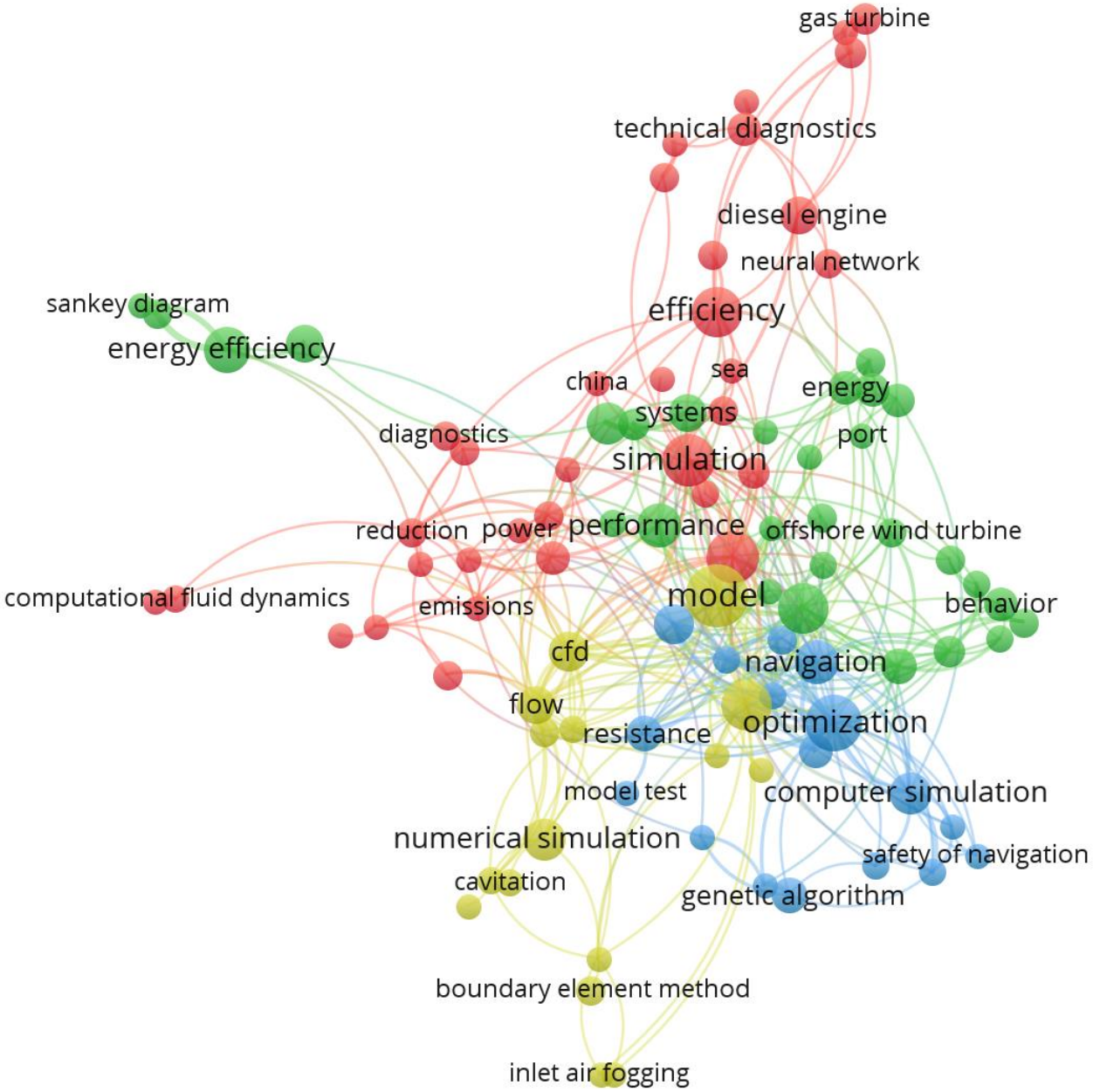

Fig. 12. Analysis of author keywords in years: 2007-2020 (minimum number of occurrences of keyword is five and minimum cluster size is twenty).

Insights into the journals in which scientists published in research area: Engineering Marine – comparison the publication activity in PMR with other journals

Finally, to identify the top 25 journals in the fields of Engineering Marine in terms of number of citations and publications, we depict the name of journals in which scientists from all world countries published the most frequently cited articles (Fig. 13) and the greatest number of papers (Fig. 14). According to Fig. 13, if you take account the number of citations, it can be seen that PMR has 9th position among journals in the fields of Engineering Marine. On the other hand, if you take account the number of articles, Fig. 14 depicts that PMR has 10th position among journals in the fields of Engineering Marine. Furthermore, based on Fig. 14 as can be seen that Naval Architect and Ocean Engineering are the journals in which scientists published the significantly greatest number of articles, 8469 and 8169, respectively.

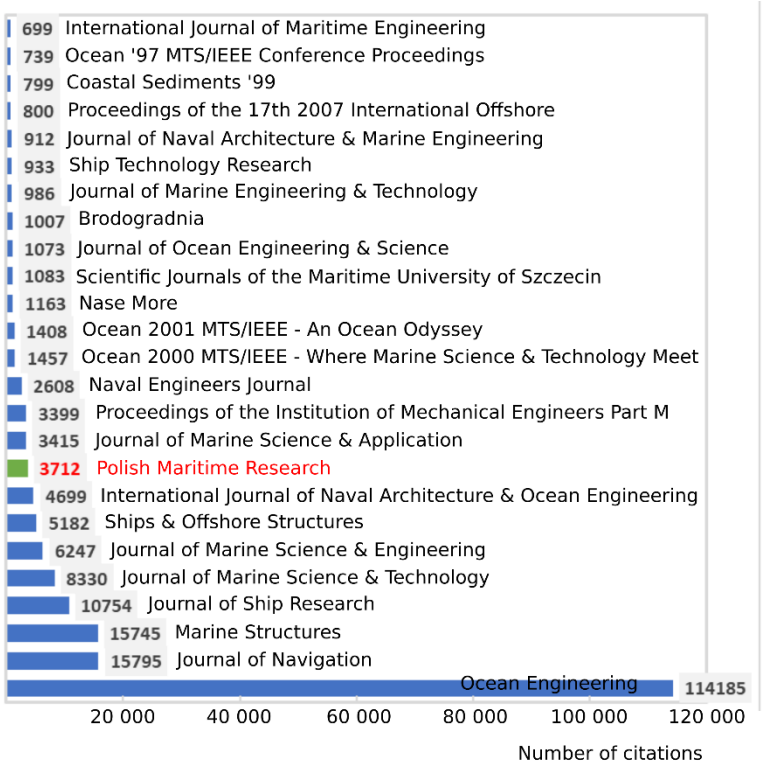

Fig. 13. Top 25 journals in the fields of Engineering Marine in terms of number of citations.

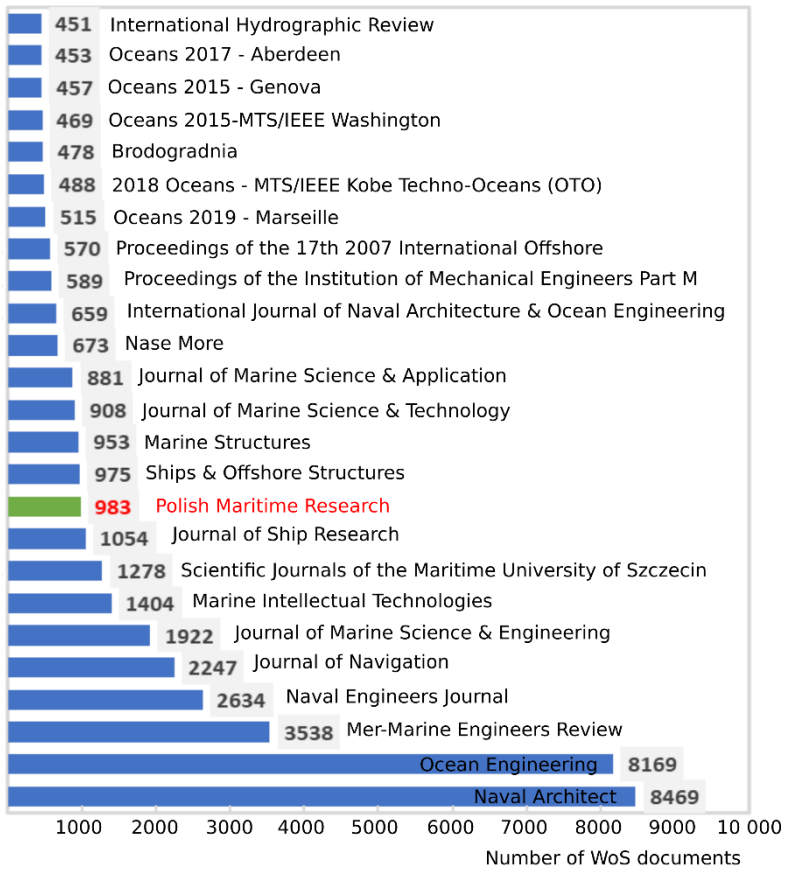

Fig. 14. Top 25 journals in the fields of Engineering Marine in terms of number of publications.

CONCLUSIONS

Our study performs an overview of publication activity in PMR in years 2007-2020. In particular, we depict the increasing trend in the number of publications and citations in the period of 15 years, which means the strong impact of the journal for scientists. Average number of citations per paper in PMR is equal 3.78 and the percentage of documents cited at least one is equal 76.5%. Moreover, it is worth noting that some articles which were published in PMR obtain a large number of citations (greater or equal than 30). It has been turned out that Poland is top-ranked, providing 618 articles with China (239 articles) and Iran (31 articles) sharing the podium. The first five positions are completed by Turkey and Spain (16 and 13 articles, respectively). Additionally, we observed that scientists from Gdańsk University of Technology, Gdynia Maritime University, West Pomeranian University, Harbin Engineering University and UTP University of Science & Technology published the greatest number of articles. If you take account, the institutions in which scientists published at least 7 articles in PMR, it has been turned out that articles which were published in institutions (University of Coruna, Sharif University of Technology, Amirkabir University of Technology, Maritime University Szczecin, UTP University of Science & Technology, Gdynia Maritime University) obtain the greatest number of citations per publication (approximately 5.0-10.6). The most frequently used keywords are associated with simulation, optimization, model and efficiency. Furthermore, it was found that PMR is in the 9 and 10th position out of 420 journals in the Web of Science Core Collection category of Engineering Marine based on the number of citations and publications, respectively. Finally, our findings indicate that international and domestic collaboration increases the number of citations.

REFERENCES

[1] Téllez H., Vadillo J. M. (2010). Bibliometric study of journal publications on analytical chemistry 2000–2007: publication productivity and journal preferences by country, *Analytical and Bioanalytical Chemistry*, 397, 1477-1484, http://dx.doi.org/10.1007/s00216-010-3732-6

[2] Hassan W., Kamdem J. P., da Rocha J. B. (2020). Research trends in chemico-biological interactions: The golden jubilee (1969-2019), *Chemico-Biological Interactions*, 327, 109177 https://doi.org/10.1016/j.cbi.2020.109177

[3] Restrepo G., Willett P. (2017). The *Journal of Mathematical Chemistry*: a bibliometric Profile, *Journal of Mathematical Chemistry*, 55, 1589-1596, https://doi.org/10.1007/s10910-017-0747-7

[4] Merigo J. M., Pedrycz W., Weber R., de la Sottta C. (2018). Fifty years of Information Sciences: A bibliometric overview, *Information Sciences*, 432, 245-268, https://doi.org/10.1016/j.ins.2017.11.054

[5] Merigo J. M., Cobo M. J., Laengle S., Rivas D., Herrera-Viedma E. (2019). Twenty years of Soft Computing: a bibliometric overview, *Soft Computing*, 23(5), 1477-1497, https://doi.org/10.1007/s00500-018-3168-z

[6] Merigo J. M., Blanco-Mesa F., Gil-Lafuente A. M., Yager R. R. (2017). Thirty Years of the International Journal of Intelligent Systems: A Bibliometric Review, *International Journal of Intelligent Systems*, 32(5), 526-554, https://doi.org/10.1002/int.21859

[7] Laengle S., Merigo J. M., Miranda J., Słowiński R., Bomze I., Borgonovo E., Dyson R. G., Oliveira J. F., Teunter R. (2017). Forty years of the European Journal of Operational Research: A bibliometric overview, *European Journal of Operational Research*, 262, 803-816, http://dx.doi.org/10.1016/j.ejor.2017.04.027

[8] Garg K. C., Tripathi H. K. (2018). Bibliometrics and scientometrics in India: An overview of studies during 1995-2014 Part II: Contents of the articles in terms of disciplines and their bibliometric aspects, *Annals of Library and Information Studies*, 65(1), 7-42, http://op.niscair.res.in/index.php/ALIS/article/view/14266/465464656

[9] Kumar S., Pandey N., Haldar A. (2020). Twenty years of Public Management Review (PMR): a bibliometric overview, *Public Management Review*, 22(12), 1876-1896, https://doi.org/10.1080/14719037.2020.1721122
[10] Gaviria-Marin M., Merigo J. M., Popa S. (2018). Twenty years of the Journal of Knowledge Management: a bibliometric analysis, *Journal of Knowledge Management*, 22 (8), 1655-1687 https://doi.org/10.1108/JKM-10-2017-0497
[11] Clarivate Analytics (2018). *InCites Indicator Handbook*
[12] Clarivate Analytics (2018). *InCites Benchmark & Analytics*
[13] van Eck, N. J., Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, 84(2), 523-538, https://doi.org/10.1007/s11192-009-0146-3
[14] van Eck N. J., Waltman L. (2018). VOSviewer Manual. Manual for VOSviewer version 1.6.9, *Universiteit Leiden*, https://www.vosviewer.com/documentation/Manual_VOSviewer_1.6.9.pdf
[15] Burdziakowski P., Janowski A., Kholodkov A., Matysik K., Matysik M., Przyborski M., Szulwic J., Tysiac P., Wojtowicz A. (2015). Maritime laser scanning as the source for spatial data, *Polish Maritime Research*, 22(4), 9-14, https://doi.org/10.1515/pomr-2015-0064
[16] Schubert A., Schubert G. (2020). Internationality at university level, *Scientometrics*, 123, 1341-1364, https://doi.org/10.1007/s11192-020-03443-3
[17] Luna-Morales M. E., Luna-Morales E., Perez-Angon M. A. (2020). Influence of the international collaboration in the field of metric studies of science and technology: the case of Mexico (1971–2018), *Scientometrics*, https://doi.org/10.1007/s11192-020-03522-5
[18] Breugelmans J. G., Roberge G., Tippett C., Durning M., Struck D. B., Makanga M. M. (2018). Scientific impact increases when researchers publish in open access and international collaboration: A bibliometric analysis on poverty- related disease papers. *PLoS ONE* 13(9), e0203156. https://doi.org/10.1371/journal.pone.0203156