An Overview of Nanomanufacturing with Bibliometric Indicators

A. Almarfadi, Fawaz M. Abdullah and Abdulrahman M. Al-Ahmari
Industrial Engineering Department, College of Engineering,
King Saud University, P. O. Box 800,
Riyadh 11421, Saudi Arabia
A.almarfadi87@gmail.com, samkry2000@gmail.com, Alahmari@ksu.edu.sa

Wadea Ameen
Industrial Engineering Department, College of Engineering and Architecture,
Al Yamamah University,
Riyadh-11512, Saudi Arabia
w_qaid@yu.edu.sa

Galal M. Muthanna
Business Administration Department, Faculty of Social and Applied Sciences,
The University of Aden,
Aden - 6312, Yemen
Gmuthana@yahoo.com

Abstract

Bibliometric research presented the statistical analysis of publications. The bibliometric method was applied to classify the data regarding different variables such as journals, authors, and countries. The research shows a general overview of studies that have been reported in Nanomanufacturing. The main important point is that these indicators provide the reader with a general picture that identifies the most influential research on Nanomanufacturing. The paper was divided into sub-sections that focused on the relevant journals, research papers, authors, institutions, and countries. The results were in accordance with human thinking, moreover, a few unexpected results have appeared. The main objective of this article is to be informative, and the indicators sum up the most essential research on this topic. However, some influential issues will be skipped if they are not included in the web of science database, which is the only source that is used to handle the bibliometric analysis.

Keywords: Nanomanufacturing, bibliometric research, influential authors, influential journals, influential countries.

1. Introduction

Nano-manufacturing is the production of Nano-scale materials, components, structures, systems, and devices. The production of parts could be either "bottom-up" from nanoscale materials or "top-down" which has too many steps for high precision. The production of Nano can be done by different techniques such as etching, laser ablation, and others. The necessity of Nanomanufacturing is becoming one of the important techniques to produce very small particles that could be used in various applications (Meijerl et al., n.d.). The need for Nanomanufacturing is not only by the requirement of the devices and structures with new properties but by decreasing the component of size, material applied, and consumption of products. Nano-scale manufacture indicates the production of structures, components, and materials with dimensions between 1-100 nm which include the surface and sub-surface style, nanowires, 3D Nanostructures, nanotubes, and nanoparticles. Lasers have been provided a very important opportunity in the inquiries of Nanomanufacturing (Kovalenko 2006).

© IEOM Society International

Nanomanufacturing research has been developed the physical processes to control the technical barriers that block the translation of lab-scale production of Nano-scale materials and structures to industrial-scale manufacturing. Research in scalable Nanomanufacturing presented manufacturability challenges such as reliability, scalability, controllability, yield, efficiency, quality, and affordability. Manufacturing challenges fall into two categories desired outcomes and appropriate metrics. The requirements needed are to produce with high quality and durability, manufacturing affordability and scalability, process reliability and repeatability manufacturing efficiency and yield, and product functionality and performance. The precise placement, overall registration and nanostructure density, type of size and resolution, difficulties, and their rates of construction are some of the metrics which should be determined. These are some challenges for any type of manufacturing process, but more in Nanomanufacturing regarding the measuring, manipulating, and controlling at the Nano-scale is not too hard and small errors can result in a defect of the product. Moreover, a compromise could be made to consider a feature size and resolution in the context of processing or forming rates and high volume production(Cooper 2017).

A general review in the Nanomanufacturing has been discussed in this research by using bibliometric analysis indicators. Bibliometric analysis indicators aim to specify and measure the impact of publications and articles that are based on counting the scientific papers published and their citations. Bibliometric indicators are very important to evaluate organizations, authors, institutions, universities, and countries to decide the most influence among others. Bibliometric indicators build a general picture of the research field.so, some face the research due to some particular research style that constructed by each researcher which guide to various volume of self-citations and co-authored papers(Merigó, Gil-Lafuente, and Yager 2015). However, too many definitions and explanations have been done on bibliometric in previous articles(Bar-Ilan 2008)&(Hood and Wilson, n.d.).In the previous studies, a lot of researchers have been presented bibliometric research in different fields. The research areas that have been used a bibliometric indicator are Econometrics(Baltagi 2007), Ant colony optimization(Deng and Lin 2012), Innovation(Fagerberg, Fosaas, and Sapprasert 2012), Probability and statistics(Genest and Guay 2002), Environmental and ecological economics(Hoepner et al. 2012), Operations management(Holsapple and Lee-Post 2010), Productivity in production(Hsieh 2010), Entrepreneurship(Landström, Harirchi, and Åström 2012), Profiling analysis of pricing research(Leone et al. 2012), Data envelopment analysis(Liu et al. 2013), Management(Podsakoff et al. 2008), Marketing(Seggie and Griffith 2009), Health(Wagstaff and Culyer 2012), Laser sintering (Ameen et al. 2018), Abrasive Water Jet (Alkahtani 2018), Electron beam melting (Anwar et al. 2017), Grey system(Yin 2013) and fuzzy systems (Merigó, Gil-Lafuente, and Yager 2015). However, no bibliometric article has been presented the Nano manufacturing.

The main objective of this study is to highlight the Nanomanufacturing researches from the oldest time to the recent of this field by using a bibliometric approach .according to the collected data from the web of sciences (WOS), the overview of the highest and most influential research will be discussed. The data collected can be arranged as research articles, authors, journals, institutions, and countries.

This article is organized as follows: section 2 study methodology, section 3 presents the most 50 cited articles in the Nanomanufacturing, section 4 discuss the most productive and influential authors. Section 5 comes out with the most influential organizations in this Nanomanufacturing, section 6 presents the most productive countries. Section 7 discusses and sum up the paper.

2. Methodology

The collected information for Nanomanufacturing research has been reported at the Web of Science (WOS) which combines too many databases. WOS almost has articles from all known scientific resources from more than 15,000 journals and 55 million articles. The data has been categorized into 251 topic categories and in 151 areas of study. Other areas than WOS could be considered for collecting information such as google scholar and SCOPUS. However, in this article, WOS has been only used as a source of data collection.

This search is completed in May 2017 and more than 2193 publications were reported by using the keywords in the WOS search tap since 1993. More than ten types of publications were reported such as books reviews, journal articles, proceedings, comments, notes, and editorial material. However, the article focused only on the reviews and articles which decrease the number of reported publications from 2193 to 1659 from 1993 to 2017. Nanomanufacturing a getting more attention over the last two decades as shown in Figure 1 which present an increase in the number of publications on Nanomanufacturing in the last few years. Mostly around 50% of the papers among 1659 are from the past decade. This indicates that the research in the Nanomanufacturing is getting more attention. The average number of publications per year in the According field is more than 66 with the highest

number of publications per year in 2016 and 2015 as 202 and 184 publications respectively. According to WOS, the average citation of the reported research is also too important. The citation rate is too important to show the significance of the research field so it can be classified into different thresholds according to the number of the received citation and its percentage of the article for each threshold which has been presented in this research. Form the Table1 presented below, it concluded that very low percentages with (3) articles have been received more than or equal to 300 citations, 0.4% (6) articles got more than or equal to 200 citations, 2% (24) articles got more than or equal 100 citations, 5% (78) articles got more than or equal 50 citations, 17% (281) articles got more than or equal 20 citations, while the rest papers have been received less than 20 citations. However, the overall citation in Nanomanufacturing is somehow developed according to its citations record.

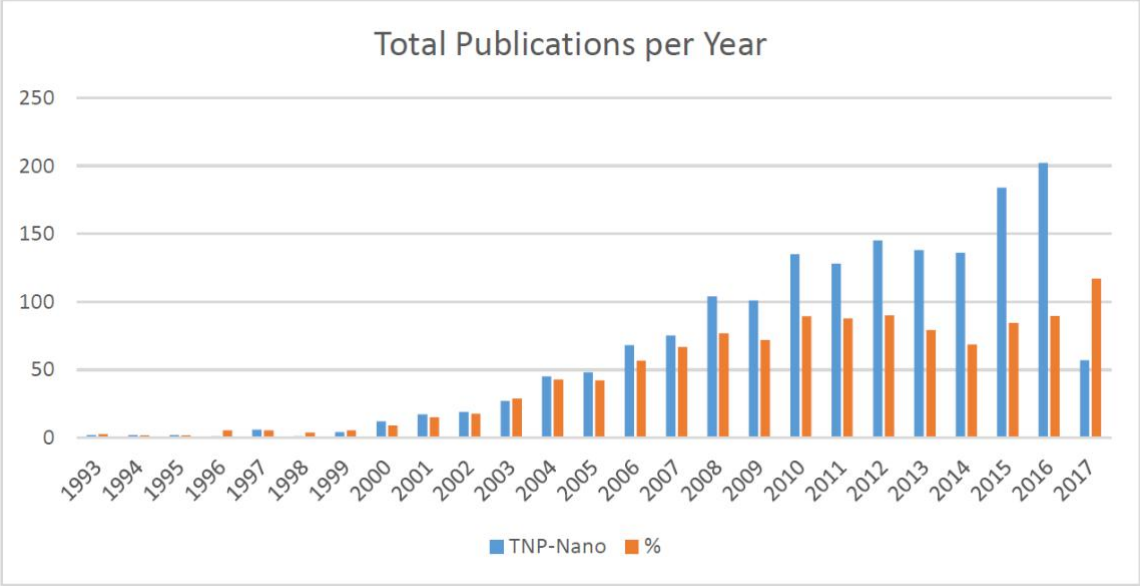

Figure 1. The number of publications per year in NM research (reviews &articles) from 1985 to 2017. The bars with blue color indicate the total number of NM articles published each year in the web of science and the orange one indicate the ratio (N- NM -P/TNP) × 1,000,000 where N- NM -P is the number of NM papers in year X and TNP is the total number of papers published in the WOS in year X.

Table 1. General citation structure in Nanomanufacturing research from WOS.

Number of citations	Number of papers	% Papers
>=300citations	3	0.180832
>=200citations	6	0.361664
>=100 citations	24	1.446655
>=50 citations	78	4.701627
>=20 citations	281	16.93791
< 20citations	1267	76.37131
Total	1659	

The H-index is also called H-classics (Martínez et al. 2014) which can analyze the Nanomanufacturing research- index applied to measure the importance of articles (Alonso et al. 2009). To make it clear, if some papers got an H-index of 60, then 60 of the papers included in these articles have received at least 60 or more citations for each article. For all data collection of papers in Nanomanufacturing, the H-index is 67. However, 67 papers have received at least 67 citations. The H-index has been presented by some authors (Gee 1999).

3. Most Influential journals in Nanomanufacturing

The reported journals on Nanomanufacturing research are increasing from one year to another. The 50 top most influential journals on Nanomanufacturing are presented in Table 2. According to the H-index Classifications, the most two influential journals from the 50 are Journal of Nanoparticle Research and Materials Letters. In addition to that, some other journals that consider as the top influential journals such as RSC Advances, Journal of Alloys and Compounds, Ceramics International, and so on as shown in table 2. However, some productive journals are interested in this field such as Materials Research Bulletin, Applied Surface Science, and others as presented on the table. The paper's quality is measured by the impact factor which has been presented in table 2. Moreover, according to the highest number of publications and citations at all field Journal of Nanoparticle Research and Applied Physics Letters. Advanced Materials and Nano Letters have been received the highest impact factor among the top 50 journals presented in the table at all fields. Overall the Applied Physics Letters journal has got the most H-index among the most influential and productive journals in all publications field.

Abbreviations: R, rank; H-PC, H-index with Nano manufacturing only ; TC_PC and TP_PC, total citations and papers only with red; %P-NM, percentage of Nano manufacturing papers in the journal; TP and TC, total papers and citations; IF, impact factor; T50, number of papers in the top 50 list shown in Table 4; H, H-index; JNR, Journal of Nanoparticle Research; ML, Materials Letters; RSCA, RSC Advances; JAC, Journal of Alloys and Compounds; CI, Ceramics International; JNN, Journal of Nanoscience and Nanotechnology; JPS, Journal of Power Sources; N, Nanotechnology; ACSN, ACS Nano; MRB, Materials Research Bulletin; ASSC, Applied Surface Science; CAMT, CIRP Annals Manufacturing Technology; MCP, Materials Chemistry And Physics; JMSET, Journal Of Manufacturing Science And Engineering Transactions Of The ASME; JMC, Journal of Materials Chemistry; RMME, Rare Metal Materials And Engineering; ACSAMI, ACS Applied Materials Interfaces; AM, Advanced Materials; EACTA, Electrochimica ACTA; JMS, Journal of Materials Science; US, Ultrasonics Sonochemistry; APL, Applied Physics Letters; AJC, Asian Journal of Chemistry; CEJ, Chemical Engineering Journal; NL, Nano Letters; NS, Nanoscale; PT, Powder Technology; SR, Scientific Reports; CJIC, Chinese Journal Of Inorganic Chemistry; EEE-TASE, IEEE Transactions on Automation Science And Engineering; IIE-T, IIE Transactions; JIM, Journal of Inorganic Materials; CN, Current Nanoscience; JAST, Journal of Adhesion Science and Technology; JSGST, Journal of Sol Gel Science and Technology; TSF, Thin Solid Films; APMSP, Applied Physics a Materials Science Processing; CP, Carbohydrate Polymers; IEEE-TN, IEEE Transactions on Nanotechnology; JECS, Journal of The European Ceramic Society; S, Small; JCPR, Journal of Ceramic Processing Research; JMC-A, Journal of Materials Chemistry A; JMR, Journal of Materials Research; JPC-C, Journal of Physical Chemistry C; JACS, Journal of The American Ceramic Society; MSECMBA, Materials Science Engineering C Materials for Biological Applications; ME, Microelectronic Engineering; AFM, Advanced Functional Materials; JCS, Journal of Cluster Science.

Table 2. Most influential and productive journals in Nano manufacturing research

Rank	Name	TP-Nano	TC-Nano	H-Nano	%P-Nano	TP	TC	H	IF
1	JNR	51	879	17	0.998%	5109	63350	86	2.101
2	ML	37	892	17	0.163%	22700	278146	103	2.437
3	RSCA	34	262	10	0.081%	42050	269868	81	3.289
4	JAC	33	487	13	0.080%	41057	501660	132	3.014
5	CI	32	373	11	0.222%	14431	120321	72	2.758
6	JNN	26	123	5	0.161%	16186	97638	84	1.338
7	JPS	21	493	14	0.089%	23497	683790	227	6.333
8	N	21	289	8	0.143%	14662	303728	149	3.573
9	ACSN	20	825	13	0.201%	9935	461870	241	13.334
10	MRB	20	277	9	0.147%	13622	220882	127	2.435
11	ASSC	18	363	10	0.050%	35835	460185	139	3.15
12	CAMT	17	347	10	0.740%	2297	38434	75	2.492
13	MCP	17	221	10	0.127%	13398	188989	11	2.101
14	JMSET	16	113	6	0.636%	2517	24985	59	1.022
15	JMC	15	793	11	0.089%	16901	672238	230	6.626
16	RMME	14	36	3	0.110%	12761	17679	20	0.236
17	ACSAMI	13	75	6	0.082%	15868	233683	119	7.145
18	AM	13	490	10	0.089%	14526	1137264	386	18.96
19	EACTA	13	184	9	0.043%	30414	693481	201	4.803
20	JMS	13	252	10	0.038%	34070	570655	196	2.302
21	US	13	231	9	0.436%	2979	61589	85	4.556
22	APL	12	168	7	0.010%	117347	3953370	416	3.142
23	AJC	12	18	3	0.081%	14761	19058	24	0.355
24	CEJ	12	175	7	0.092%	13043	246381	129	5.31
25	NL	12	515	9	0.096%	12509	927261	372	13.779
26	NS	11	182	7	0.104%	10561	189992	133	7.76
27	PT	11	144	5	0.100%	11017	160574	105	2.759
28	SR	11	135	5	0.024%	46489	369868	97	5.228
29	CJIC	10	32	3	0.166%	6041	16952	24	0.488
30	EEE-TASE	10	100	5	0.912%	1096	12814	47	2.696
31	IIE-T	10	38	3	0.371%	2696	45334	78	1.463
32	JIM	10	28	3	0.227%	4400	9917	20	0.551
33	CN	9	22	3	0.828%	1087	7035	32	0.934
34	JAST	9	124	7	0.257%	3507	36386	60	0.863
35	JSGST	9	190	6	0.184%	4901	57958	73	1.473
36	TSF	9	168	5	0.022%	40564	646435	182	1.761
37	APMSP	8	86	5	0.057%	13986	198505	134	1.444
38	CP	8	226	7	0.070%	11445	249661	138	4.219
39	IEEE-TN	8	152	6	0.431%	1854	24305	61	1.702
40	JECS	8	180	7	0.082%	9805	180538	111	2.933
41	S	8	516	6	0.149%	5365	188112	168	8.315
42	JCPR	7	33	3	0.334%	2094	5788	23	0.32
43	JMC-A	7	68	5	0.069%	10181	154536	97	8.262
44	JMR	7	122	6	0.058%	12012	256532	155	1.579
45	JPC-C	7	152	5	0.022%	32348	730423	199	4.509
46	JACS	7	59	5	0.026%	26987	681338	227	2.787
47	MSECMBA	7	55	4	0.148%	4745	37846	53	3.42
48	ME	7	83	6	0.065%	10744	92327	77	1.277
49	AFM	6	104	5	0.081%	7372	377515	227	11.382
50	JCS	6	10	2	0.437%	1372	8771	29	1.664

Table 3. The Impact factor in Nano manufacturing research.

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
TP	75	104	101	135	128	145	138	136	184	204
TC	3365	2115	2703	2622	1867	1963	1790	1437	980	534
TC2	299	423	179	571	719	677	725	934	1037	1203
TP2	116	143	487	205	236	263	273	283	274	320
IF	2.58	2.96	0.368	2.785	3.047	2.574	2.656	3.3	3.785	3.759

Abbreviations: TP, total published papers per year n; TC, total citations received from articles published in year n; TC2, all citations received in year n – 1 and n − 2 from year n; TP2, total published papers per year n − 1 and n − 2; IF, impact factor of year.

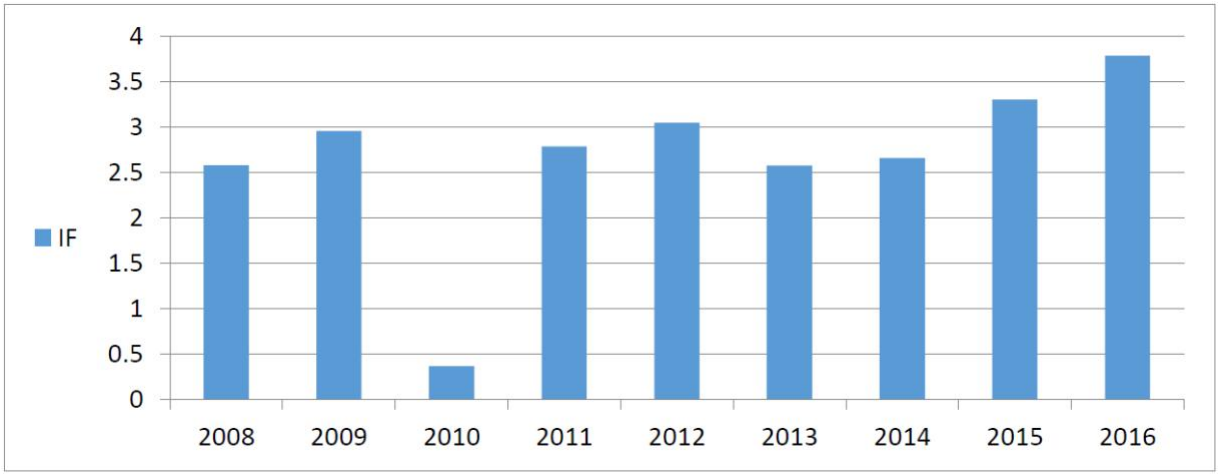

Figure 2. Impact factor for the last 10 years NM (articles + reviews) since 2008

The impact factor is just an indicator which shows the publication's value that could be calculated by dividing the number of citations received in the last two years (i.e. n − 1 and n – 2) from year n by the total papers reported in the last two years (n − 1 and n – 2).

The impact factor for all papers yearly publication on Nanomanufacturing is presented in Table 3. The table illustrates that the impact factor increased from one year to another except a few years which gets less than its previous years such as 2010 & 2013 as presented in figure 2. In general, Nanomanufacturing got more attention in the last 10 years due to the increasing impact factor. Some critics do not agree with impact factor calculations due to the manipulation and general result because they are using the self-citations(Stonebraker et al. 2012; Baldwin et al. 2018). However, some = studies have been reported this kind of problem and some new techniques that deal with impact factor calculations (Hood and Wilson 2001).

4. An Overview of the Most Productive and Influential Authors

So many contributions have been done by authors in Nanomanufacturing research. Table 4 presents the top 25 authors with the highest number of publications in Nanomanufacturing. The publication number is just indicative only because so many factors could be considered such as co-authorship, paper size, and journal quality. According to the table, BENELLI G is the highest author who has published in Nanomanufacturing with 27 papers, next is

WANG L (18 papers), MONTAZER M (15 papers, and so on for the rest authors as shown in Table 4. The table also presents the most influential authors in Nanomanufacturing according to the total citations, BENELLI G is the most influential author in Nanomanufacturing with more than 388 citations, followed by KIM J who is also received more than 318citations in this field.

Table 4. The most influential authors in Nanomanufacturing research

R	Name	Country	TP-F	TC-F	H-F	H	TP10	TC10	TP	TC
1	BENELLI G	ITALY	27	388	10	26	12	371	150	2,579
2	WANG L	PEOPLES R CHINA	18	254	9	22	14	205	100	1,767
3	MONTAZER M	IRAN	15	274	9	28	5	135	184	3,230
4	MURUGAN K	ITALY	14	168	6	25	6	163	134	1,921
5	LEE JH	SOUTH KOREA	12	223	8	19	9	169	36	994
6	NICOLETTI M	ITALY	11	156	5	25	6	151	172	2,076
7	PANNEERSELVAM C	ITALY	11	154	5	21	5	151	49	989
8	KIM J	SOUTH KOREA	10	318	8	15	7	292	51	853
9	GOVINDARAJAN M	ITALY	9	50	5	22	9	50	80	1,293
10	HUANG Q	USA	9	37	4	11	9	37	43	472
11	LIU Y	PEOPLES R CHINA	9	40	3	14	8	37	125	730
12	MISHRA S	INDIA	9	174	7	13	6	81	66	643
13	WANG X	PEOPLES R CHINA	9	37	4	7	6	29	19	29
14	CETINKAYA C	USA	8	116	6	15	1	5	81	753
15	DINESH D	ITALY	8	153	5	17	5	151	36	713
16	LI J	PEOPLES R CHINA	8	22	1	21	8	22	116	1,377
17	MORSALI A	IRAN	8	115	6	43	7	115	556	7,944
18	ATAIE A	IRAN	7	19	2	15	7	19	108	1,055
19	AZIZ A	SAUDI ARABIA	7	56	3	6	3	53	11	97
20	CANALE A	ITALY	7	88	3	19	3	85	62	954
21	LI Y	PEOPLES R CHINA	7	34	5	27	6	24	69	2,418
22	LIDDLE JA	USA	7	109	5	66	7	109	432	44,623
23	SURESH U	ITALY	7	151	5	17	5	151	32	692
24	WANG Y	PEOPLES R CHINA	7	34	4	42	6	29	481	8,360
25	YANG P	PEOPLES R CHINA	7	30	3	19	5	27	183	1,175

5. Analysis by country

Research is an important tool to determine the countries growth in terms of education. The main focus of this part is to analyze the Nanomanufacturing research distribution across different countries. It doesn't matter if researchers moved from one country to another. So, an author may have publications from more than one country. USA and China received the highest number of authors because they have attracted a lot of researchers from all over the world due to good infrastructure for research.

The Table concluded that USA is the most productive country in Nanomanufacturing research. From the top 25countries list, USA has received more than 496 papers in Nanomanufacturing with more than 11,419 citations.

China comes in the second position with 374 articles with more than 5,020citations with lower H-index (35). Furthermore, it can be seen that some of the developing countries like Egypt and Saudi Arabia have also secured positions in the list of top 20 influential countries

Table 5. The most influential countries in Nanomanufacturing research.

Rank	Name	TP	TC	>100	>50	TP10	TC10	H
1	USA	496	11,419	13	36	337	5,394	50
2	PEOPLES R CHINA	374	5,020	5	14	281	3,396	35
3	INDIA	249	3,244	3	10	171	3,244	29
4	IRAN	155	1,470	2	3	140	1,326	20
5	SOUTH KOREA	131	3,257	3	8	1,841	95	29
6	JAPAN	82	1,596	1	7	44	1,596	23
7	GERMANY	63	1,598	3	7	38	1,598	21
8	ITALY	48	1,598	0	3	29	554	13
9	SAUDI ARABIA	36	354	0	2	19	323	10
10	TAIWAN	35	626	0	4	16	241	16
11	ENGLAND	33	1,016	4	3	24	297	14
12	FRANCE	31	414	0	1	31	414	12
13	SINGAPORE	31	816	1	5	13	693	14
14	AUSTRALIA	30	331	0	1	25	247	11
15	CANADA	27	296	0	0	22	296	11
16	EGYPT	23	279	0	1	19	279	9
17	SWITZERLAND	22	279	3	1	18	279	11
18	SPAIN	21	190	1	0	19	165	9
19	TURKEY	21	171	1	1	16	171	4
20	MALAYSIA	20	225	0	0	18	223	9
21	AUSTRIA	15	223	0	0	13	223	7
22	NETHERLANDS	13	184	0	1	11	168	6
23	RUSSIA	11	79	0	0	9	73	4
24	ROMANIA	10	168	0	0	8	71	6
25	SOUTH AFRICA	10	29	0	0	7	28	2

7. Conclusions

This research has shown a bibliometric overview of Nanomanufacturing research. The results show that the Nanomanufacturing research is receiving progressive attention particularly especially in the last decade. Nanomanufacturing has become one of the most influential topics due to its increasing application in the manufacturing field. The bibliometric results show that the USA is the most influential country in Nanomanufacturing field research followed by China in second place and India in the third. BENELLI G is the highest author who has published in Nanomanufacturing with 27 papers, next is WANG L (18 papers), MONTAZER M (15) papers in this field. The USA has the highest number of influential authors and also it received the highest number of publications and citations among all countries. China comes in the second position according to the number of publications in Nanomanufacturing. Analyses of bibliometric shows that, many developing countries are becoming more influential, because of their significant researches in this area, and some of them including Egypt and Saudi Arabia are already obtaining remarkable results. This study presented a general bibliometric overview of Nanomanufacturing research. The c web of science has been used as the source of

bibliometric indicators and studies that have been reported in the journals not encompassed by WOS would have been neglected. However, the main objective of this study is that the reader can be informative about the Nanomanufacturing research in terms of its impact and influence.

ACKNOWLEDGEMENTS

This work was supported by the Department of Industrial Engineering in King Saud University in the Kingdom of Saudi Arabia. The authors would like to thank all personnel involved in this work.

REFERENCES

Alkahtani, Mohammed. 2018. "Bibliometric Analysis of Abrasive Water Jet Machining Research." Journal of King Saud University - Engineering Sciences, no. March. The Authors:0–9. https://doi.org/10.1016/j.jksues.2018.02.002.

Ameen, Wadea, Atef M Ghaleb, Moath Alatefi, and Hisham Alkhalefah. 2018. "An Overview of Selective Laser Sintering and Melting Research Using Bibliometric Indicators." Virtual and Physical Prototyping 0 (0). Taylor & Francis:1–10. https://doi.org/10.1080/17452759.2018.1489973.

Anwar, Saqib, Fawaz M Abdullah, Bashir Salah, Shafiq Ahmad, and Abdulrahman M Al-ahmari. 2017. "An Overview of Electron Beam Melting Research with Bibliometric Indicators."

Baltagi, Badi H. 2007. "Worldwide Econometrics Rankings: 1989-2005." Econometric Theory, no. 94:1989–2005. https://doi.org/10.1017/S026646660707051X.

Bar-Ilan, Judit. 2008. "Informetrics at the Beginning of the 21st Century-A Review." Journal of Informetrics 2 (1):1–52. https://doi.org/10.1016/j.joi.2007.11.001.

Cooper, Khershed. 2017. "Scalable Nanomanufacturing — A Review." https://doi.org/10.3390/mi8010020.

Deng, Guang Feng, and Woo Tsong Lin. 2012. "Citation Analysis and Bibliometric Approach for Ant Colony Optimization from 1996 to 2010." Expert Systems with Applications 39 (6). Elsevier Ltd:6229–37. https://doi.org/10.1016/j.eswa.2011.12.001.

Fagerberg, Jan, Morten Fosaas, and Koson Sapprasert. 2012. "Innovation: Exploring the Knowledge Base." Research Policy 41 (7). Elsevier B.V.:1132–53. https://doi.org/10.1016/j.respol.2012.03.008.

Genest, C, and M Guay. 2002. "Worldwide Research Output in Probability and Statistics: An Update." Canadian Journal of Statistics-Revue Canadienne De Statistique 30 (2):329–342 ST–Worldwide research output in probabi. https://doi.org/10.2307/3315955.

Hoepner, Andreas G F, Benjamin Kant, Bert Scholtens, and Pei Shan Yu. 2012. "Environmental and Ecological Economics in the 21st Century: An Age Adjusted Citation Analysis of the Influential Articles, Journals, Authors and Institutions." Ecological Economics 77. Elsevier B.V.:193–206. https://doi.org/10.1016/j.ecolecon.2012.03.002.

Holsapple, Clyde W., and Anita Lee-Post. 2010. "Behavior-Based Analysis of Knowledge Dissemination Channels in Operations Management." Omega 38 (3–4). Elsevier:167–78. https://doi.org/10.1016/j.omega.2009.08.002.

Hood, William, and Concepción Wilson. n.d. "No TitleThe Literature of Bibliometrics, Scientometrics, and Informetrics." 2004.

Hsieh, Pao Nuan. 2010. "Addendum to 'an Assessment of World-Wide Research Productivity in Production and Operations Management.'" International Journal of Production Economics 125 (2). Elsevier:335–38. https://doi.org/10.1016/j.ijpe.2009.11.035.

Kovalenko, Volodymyr S. 2006. "Laser Micro- and Nanoprocessing" 1 (2):173–80.

Landström, Hans, Gouya Harirchi, and Fredrik Åström. 2012. "Entrepreneurship: Exploring the Knowledge Base." Research Policy 41 (7). Elsevier B.V.:1154–81. https://doi.org/10.1016/j.respol.2012.03.009.

Leone, Robert P., Larry M. Robinson, Johanna Bragge, and Outi Somervuori. 2012. "A Citation and Profiling Analysis of Pricing Research from 1980 to 2010." Journal of Business Research 65 (7). Elsevier Inc.:1010–24. https://doi.org/10.1016/j.jbusres.2011.04.007.

Liu, John S., Louis Y Y Lu, Wen Min Lu, and Bruce J Y Lin. 2013. "Data Envelopment Analysis 1978-2010: A Citation-Based Literature Survey." Omega (United Kingdom) 41 (1). Elsevier:3–15. https://doi.org/10.1016/j.omega.2010.12.006.

Meijerl, J, K Du, A Gillner, D Hoffmann, V S Kovalenko, T Masuzawa, and A Ostendorfg. n.d. "Laser Machining

by Short and Ultrashort Pulses , State of the Art and New Opportunities in the Age of the Photons."

Merigó, José M., Anna M. Gil-Lafuente, and Ronald R. Yager. 2015. "An Overview of Fuzzy Research with Bibliometric Indicators." Applied Soft Computing Journal 27. Elsevier B.V.:420–33. https://doi.org/10.1016/j.asoc.2014.10.035.

Podsakoff, P. M., S. B. MacKenzie, N. P. Podsakoff, and D. G. Bachrach. 2008. Scholarly Influence in the Field of Management: A Bibliometric Analysis of the Determinants of University and Author Impact in the Management Literature in the Past Quarter Century. Journal of Management. Vol. 34. https://doi.org/10.1177/0149206308319533.

Seggie, Steven H, and David a Griffith. 2009. "What Does It Take to Get Promoted in Marketing Academia? Understanding Exceptional Publication Productivity in the Leading Marketing Journals." Journal of Marketing 73 (1):122–32. https://doi.org/10.1509/jmkg.73.1.122.

Wagstaff, Adam, and Anthony J. Culyer. 2012. "Four Decades of Health Economics through a Bibliometric Lens." Journal of Health Economics 31 (2). Elsevier B.V.:406–39. https://doi.org/10.1016/j.jhealeco.2012.03.002.

Yin, Mu-Shang. 2013. "Fifteen Years of Grey System Theory Research: A Historical Review and Bibliometric Analysis." Expert Systems with Applications 40 (7). Elsevier Ltd:2767–75. https://doi.org/10.1016/j.eswa.2012.11.002.

Alonso, Sergio, Francisco Javier Cabrerizo, Enrique Herrera-Viedma, and Francisco Herrera. 2009. 'h-Index: A review focused in its variants, computation and standardization for different scientific fields', Journal of informetrics, 3: 273-89.

Baldwin, James, Omar MK Alhawi, Simone Shaughnessy, Alex Akinbi, and Ali Dehghantanha. 2018. 'Emerging from the cloud: A bibliometric analysis of cloud forensics studies.' in, Cyber threat intelligence (Springer).

Gee, James Paul. 1999. 'Critical issues: Reading and the new literacy studies: Reframing the national academy of sciences report on reading', Journal of Literacy Research, 31: 355-74.

Hood, William W, and Concepción S Wilson. 2001. 'The literature of bibliometrics, scientometrics, and informetrics', Scientometrics, 52: 291.

Martínez, MA, Manuel Herrera, Javier López-Gijón, and Enrique Herrera-Viedma. 2014. 'H-Classics: Characterizing the concept of citation classics through H-index', Scientometrics, 98: 1971-83.

Stonebraker, Jeffrey S, Esther Gil, Craig W Kirkwood, and Robert B Handfield. 2012. 'Impact factor as a metric to assess journals where OM research is published', Journal of Operations Management, 30: 24-43.

★★★

Biography

Ali Al-Marfadi is a PhD student at the Industrial Engineering department, King Saud University. He completed bachelor degree in Industrial Engineering from King Khalid University (KKU) and master degree from King Saud University. Al-Marfadi has successfully completed the training program for Six Sigma Green Belt. Al-Marfadi's research interests include additive manufacturing, manufacturing systems, material science and design programs. His teaching interests include basic courses in material manufacturing as well as manufacturing process.

Fawaz M. Abdullah is a PhD Student in the Industrial Engineering department, King Saud University. He completed his Bachelor's degree (2013) in manufacturing engineering from International Islamic University Malaysia (IIUM) and a Master of Science in industrial engineering (Manufacturing systems) at King Saud University. He has participated in various manufacturing research which has been published. His teaching experience as a tutor are manufacturing processes and manufacturing materials. Fawaz's interested research areas are Manufacturing & Mechanical engineering. He's interested in the following research areas manufacturing processes, additive manufacturing, advanced manufacturing, CNC turning & milling, and petri nets.

Prof. Abdulrahman M. Al-Ahmari is the Dean of Advanced Manufacturing Institute, Executive director of CEREM, and Supervisor of FARCAM. He was Chairman of Industrial Engineering Department at King Saud University (2004-2008). He received his Ph.D. (Manufacturing Systems Engineering) in 1998 from University of Sheffield- UK. His research interests are in analysis and design of manufacturing systems; CIM; optimization of manufacturing operations. He obtained Stanford Innovation and Entrepreneurship Certificate, February 2016. And Six Sigma Black Belt, June, 2006.

Dr. Wadea is an Assistant Professor in the faculty of Engineering and Architecture, Industrial Engineering Department, University of Alyamamah, Kingdom of Saudi Arabia. He earned MSc and Ph.D. degrees from King Saud University, Saudi Arabia. His research interests are in additive manufacturing; CAD /CAM and product, design analysis, and design of manufacturing systems; optimization of manufacturing processes.
Galal M. Muthana is a master student in collage of social and applied science, Administered Department. He completed his Bachelor degree in electrical engineering (2005) in University of Aden. Galal's has 15 Years' experience on the maintenance and construction.