

# Publication Productivity Pattern of Malaysian Researchers in Scopus from 1995 to 2015

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## ABSTRACT

**Aim:** This study is to understand and analyze the publication productivity as one of the important scientometric indicators of HEI's performance in Malaysia for duration time of 20 years. **Method:** This study conducted the scientometric analysis of the research productivity performance of Malaysia's researchers from June 1995 to June 2015 using Scopus database. All type' field in the search box where chosen and the chosen keyword is 'Malaysia'. All related papers are extracted, retrieved and compiled into the personal database in Microsoft Excel. Pre-processing task such as data cleaning were done and with total of 290 093 publications records was identified. These publications records included all type of documents such as articles, conference, review paper, book chapter and books. **Result:** The remarkably numbers of publication growth from 1995 to 2015. There are huge development of research happens in these 20 years in Malaysia with only 1,610 publication in 1995 increased to 180,797 publication in 2015. Subject area of pure science dominated the percentage of publication such as engineering with 15% from total and the small percentage with total of 5% comes from pure science as well which are physic and astronomy. **Conclusion:** The increase in publication productivity is a sign of good R&D that is actively happened in this country. This has a positive impact towards Malaysia as well as the related institutions in order to introduce and stamp their name to the world. Therefore, the numbers of collaboration with others countries especially with European countries and America is worth to emphasize. Nonetheless, we understand that there are numbers of factors that associated in producing the publication that can be barriers to the authors such as personal factors, environment factors and behavioral factors. **Keywords:** Publication Productivity, Scientometric, Malaysia, Peer Review, University Evaluation.

## INTRODUCTION

Publication productivity is one of the important aspect for every Higher Education Institution (HEI) to be noticeable and to get attention by others internal or external institutions. Publish or perish is the most common phrase that we heard in the current situation that can be related to academic staff's performance in an institution.<sup>[1]</sup> The performance of every academic staff is based on the research grants to conduct research projects and to publish research

articles. Today, the research publication of an HEI's academician has become one of an evidence for research activities to be assessed for Key Performance Index (KPIs).<sup>[2]</sup> Publication is considered more important in tenure and promotion decision. After all, publication productivity links to R&D and is a serious concern at individual, institution and country levels.<sup>[3]</sup> Many research studies has been conducted focusing on the publication productivity of India,<sup>[4]</sup> Africa,<sup>[5,6,7]</sup> United States of America,<sup>[8,9]</sup> middle east,<sup>[10]</sup> Pakistan,<sup>[11]</sup> Russian,<sup>[12]</sup> United Kingdom<sup>[13]</sup> or combination of several countries.<sup>[14]</sup> There are many studies in Malaysia on Scientometric research too. These were focused on several subject area as well as other area such as computer science,<sup>[15]</sup> Engineering,<sup>[16]</sup> Clinical,<sup>[17]</sup> Medicine,<sup>[18]</sup> Library and Information Science (LIS),<sup>[19]</sup> Malaysia's journal,<sup>[20,21]</sup> collaboration research,<sup>[22]</sup> research productivity by returnees,<sup>[23]</sup> citation analysis,<sup>[24]</sup> ethnic research<sup>[25]</sup> and toxicology.<sup>[26]</sup> There are also studies conducted by Ministry of Science, Technology and Innovation (MOSTI) about the research productivity periodically.<sup>[27-30]</sup> In MOSTI report's, there are only number of publication been published, citation analysis and patent that been made until 2014.<sup>[31]</sup> There are no details study been

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made in MOSTI's study which present author's productivity, countries and others. Therefore, this can be considered as an extension to MOSTI studies to understand the patterns and publication productivity here in Malaysia in term of extended years from the existing reports which is from 1995 to 2015 and more details analysis reports in terms of authors, collaboration between countries and journals that frequently become of choice for researchers in Malaysia. Before this study move much further to method and analysis, next section will elaborate more regarding bibliometric analysis and utilization as well as the indicators which will be used in the analysis and result section.

The objective of the analysis is to study the performance of productivity in Malaysia's environment in twenty years. Education in Malaysia already gone through a lot of changes and there are many new institution are emerge in this twenty years. Since research and development become center of attention in each of institution, numbers of allocation grant from funding bodies and government are increasing too. Another reason is the awarded research university by government body towards the selected institutions. To date, there are five universities become research universities and one of the criteria in sustaining the status is by producing numbers of publication and research. Therefore, the number of publication in these research universities are expectedly increase since 2014 until today. In this study, all institution which located in Malaysia are included.

## Literature review

### Bibliometric analysis

Definition of bibliometric can be vary from one researcher to another, but as for the surface, bibliometric is the medium to analyze scientifically the development of artifacts from researchers by statistical and mathematical.<sup>[32,33]</sup> Besides the regular terminologies of bibliometric which usually appears in papers and articles, there are another term which represent the same environment namely as citation indexing,<sup>[34]</sup> informetric,<sup>[35]</sup> altmetric,<sup>[36]</sup> scientometric<sup>[16]</sup> and webometric.<sup>[37]</sup> Each of terminologies has its own uniqueness in adapt the research situation. There are extensive covered topic related to the several terminologies by<sup>[38,39]</sup> and in order to make the depth understanding in the bibliometric analysis in different databases.

### Bibliometric analysis and the utilization

In this context, the artifacts contain of articles papers, conference papers, journal publication and others which can act as an evidence that is useful to determine the progress of a researcher's effort from the start until recent days. Therefore, it is important for each researchers to publish papers or manuscript that shows their abilities and capa-

bilities in perform the research.<sup>[40]</sup> From the published articles and papers, bibliometric analysis used as a medium to assess the progress of the scientist or researcher.<sup>[41]</sup> There are two aspect to assess the progress of bibliometric analysis which is through the pure bibliographical and another other one is by citation impact.<sup>[42]</sup> Pure bibliographical is an analysis of compilation of any type of content based on its creators, editors and time of production or distribution. It is important to know in order to identify the overview of the artifacts and to know the basic information of the artifacts as well as the authors.<sup>[42,43]</sup> Whereas, for citation impact is the analysis to identify the impact of the research, acceptance by other researchers and impact of experiment in the research's environment.<sup>[42]</sup> These two aspect are certainly important to be determine in order to know the development of research. From the bibliometric analysis, there are two main utilization can be assessed through the analysis which is from the individual aspect<sup>[32-44]</sup> and institution aspect.<sup>[45,46]</sup> From the individual aspect, researchers can identify how their research can gives some value information to others. It might give some 'eye-opening' on some topic that been raised in their experiment and can be a trigger medium to other researches to dig deeper on some topic.<sup>[47,48]</sup> Whereas, on institution side, the management can identify the performance of their researchers in terms author's contribution, collaboration between in-house researchers or researchers from other institute, the production of researches in years as well as type of document that frequently become researcher's choice to publish their works.<sup>[45,46]</sup> With these two view of assessment, it can give some overview or indication works that have been done by researches and institution, and it can gives some benefits to government or funding's body to identify which research that catch their attention to give some fund allocation and might have the opportunities to invest some fund towards. From the bibliometric analysis too, the future research can be determine by identify and observe the current development. The current or on-going research and development can give a hint or suggestion on what need to be done in next development or exploration that might have potential to give a good impact to the individual, institution and countries.<sup>[49]</sup> Beside the purpose in identify the movement or progress of publication, bibliometric is used by department or schools in the institution to measure performance of their academic's staff.<sup>[32]</sup> Generally, the implication of measuring the publication by using the bibliometric indicators is closely related to the tenure, performance in scientific researches or reappointment decision at individual level. Although it is not the main medium to use in measuring the performance due to certain subject area can't use bibliometric analysis to measure performance, but it can be one of the criteria to rate the performance. Performance rate, might become feared phrase to each individual and institution as after all exploration, analysis, examine, investigation towards the publication, next task is to rate the publication accordingly. Therefore, been explained before,

nowadays publication are closely related to performance, allocation grant and as well as the impact for certain journal. Some of statistical analysis from the obtained results can be huge influence to ranking whether in journal<sup>[50]</sup> or university ranking.<sup>[51]</sup>

### Indicators in bibliometric analysis

In bibliometric analysis, there are a few indicators that involved in producing the statistical and mathematical analysis. The indicators namely as total numbers of publication,<sup>[52,53]</sup> citation analysis,<sup>[54,55]</sup> h-index,<sup>[56]</sup> g-index,<sup>[57]</sup> years of publication,<sup>[49-58]</sup> collaboration between countries<sup>[59]</sup> and others. Difference indicators can give difference outline and indication towards research. Each indicators have their own criteria and impact towards the performance measurement. Some of indicators are suitable to measure the impact of publication such as citation analysis,<sup>[60]</sup> but some of them more suitable to measure the productivity of publication such as number of publication.<sup>[61]</sup>

Since there are two aspect to assess the progress of bibliometric, as for pure bibliometric the indicators more suitable to measure the productivity performance namely as years of publication, type of document, author's name, affiliation institute or countries whereas to measure the impact of publication namely as h-index or citation analysis. Citation analysis are leaning towards to measure the performance of individual authors as well as the articles itself, whereas for indexes such as H-index or G-index, are more suitable to measure the performance of both productivity and citation impact of publication of researchers. For that reason, in order to assess and evaluate either productivity, performance or impact of publication, the objective of assessment and evaluation is important to determine which indicator is suitable to be use in the study. If the objective of assessment isn't clear, it can threaten the result and analysis of the performance and publication.

Therefore, the criteria to measure the researcher's productivity in this study are from the aspect of total number of publication, most productive authors in these twenty years, type of document that become a choice of researchers to publish their papers, list of journals that frequently publish our Malaysian's researches and list of collaboration countries which frequently do the collaboration with researchers from this country. Another indicators aren't included in this study is due to some of indicators are leaning toward to measure the impact of publication and insufficient source that this study can retrieve from library's subscription and related parties or departments.

First indicator in bibliometric analysis that frequently become a choice of researchers to identify or observe the publication productivity is by calculating the number of publication in certain duration years.<sup>[61,62]</sup> In a measure-

ment, we can identify that there are numbers of research area keep on emerge and evolving in time.<sup>[63]</sup> The expectation to identify a good productivity in publication is high as in every year, funding bodies and government bodies spends huge number on research.<sup>[64,65]</sup> Therefore, the return on investment certainly indeed a demand. When the numbers of publication is increasing by year, certainly shows that the allocation money is spend well towards the research and development. It also shows that the researchers do the experiment and research progressively in their fields.<sup>[66]</sup> The progressive number can be identify by calculating number of publication by certain period of time according to some country development plan such as Malaysia's Plan so we can know the progress between previous plan and current development plan. Certainly, country's development plan is to make sure that all institutions are moving forward and research and development actively done by their researchers. It also can be identify by numbers of publication which produced by institutions such as by calculate number of publication by public and private institution. Therefore, we can recognize which institute has a high number of publication and which institution are still in progressive phase. Thus, each of indicators, need to be used at the right time with the right situation and objective that need to be achieved.<sup>[67]</sup> Consequently, the result from analysis can be used precisely and didn't jeopardize any development of research in any certain way.<sup>[68,69]</sup>

Another indicators that become a choice to measure performance of publication is by identify the most of productive authors who frequently published their papers.<sup>[70]</sup> From this measurement, we can identify which authors from which institutes published amount of publication in certain duration years.<sup>[71,72]</sup>

It can't be simply conclude that by looking higher number of publication by institution, the most productivity authors comes from the institutes.<sup>[73]</sup> Some authors has the determination to publish quite amount of publication despite he or she isn't comes from prestige institutions. Some authors has the opportunities to gain a lot of funds from funding bodies therefore, their researches can contribute a lot of publications.<sup>[74,75]</sup> Career age is another factors too which contribute certain amount of publication.<sup>[76,77]</sup> In can't be denied that senior authors can gain a lot of publication compare young authors.<sup>[77]</sup> Senior author has a lot of experience in publication which most of the times, they know journals demands and needs because of their experience that they have been through.<sup>[73-78]</sup> Reputation is another influence contribute the productivity in publication.<sup>[79,80]</sup> Some authors has a good reputation in publication with produced a lot of good publication, thus, journals put the trust on them and select their papers to be published.<sup>[78-80]</sup>

When the publication progressively done by researchers, certainly, there are types of document that become a choice for them to publish their research papers. Frequently, the most publish paper is journal articles, and the least is book citation.<sup>[81,82]</sup> Publish a journal articles are easier compare to others document due to the time to publish are much shorter and doesn't consist any chapters which book has. It also become one of medium for other researchers to do the reference and cite the research paper.<sup>[82]</sup> People seldom do book citation because of time factor and thickness factor.<sup>[82]</sup> Sometimes when books are publish to public, time of publication is little behind.<sup>[83]</sup> Normally, citation happens within five years from recent years.<sup>[51]</sup> Some of journal publication and reviewer can accept the citation which more than five years from the current years.<sup>[84]</sup> Unless some pure and core definition of research area or founder of study area which consist in books will be used as a citation. Another choice for researchers is conference papers.<sup>[85,86]</sup> Although conference is happens every year, but percentage number of paper being accepted in the conference is low. Even some of high quality papers are rejected from the conference, sometimes due to overwhelm number of papers or the track isn't suitable for the papers.<sup>[87]</sup> Thus, researchers will opt the first option which is search good, trusted and potential journal to publish their papers.<sup>[88]</sup> Nonetheless, there are conference which doesn't provide the opportunity to index the research paper.<sup>[89]</sup> Hence, it is another reason why researchers choose the journal publication instead of conference publication.<sup>[89]</sup>

From type of documents, there are certain type of journal publication being an aim by researchers.<sup>[90,91]</sup> There are categorization of journal which some gain high level rank and some gain moderate level rank among all journals.<sup>[91]</sup> The most famous and known journal rank among researchers is either journal impact factor (JIF) used by WoS and Scimago journal rank (SJR) used by Scopus. Both are widely applied in bibliometric and scientometric study.<sup>[90]</sup> Certainly, most of researchers dream to publish in high rank journal, but, there are some criteria that indeed need to accomplish before being publish. As for young and moderate researchers, their choices are more to average and moderate rank of journal.<sup>[92]</sup> Each of subject area has their own list of journal. Some journal has multiple subject area since subject area are emerge and evolve, therefore, the coverage area and criteria of journal need to wide too in order to make sure that suitable papers can be published in their journals.<sup>[93]</sup>

Another method to gain more publication among the researchers is by collaboration.<sup>[94]</sup> It is either collaboration with local or international researchers.<sup>[95]</sup> The collaboration happens in several method. Sometimes the collaboration can happens when both parties has the same research interest, some collaboration happens through collaboration project and research between centers and countries.<sup>[96]</sup>

Collaboration between countries can give huge advantage for both parties. The differentiation between countries can be identified namely as the environment of research, participation of nation, problem condition and others.<sup>[96]</sup> The impact from the collaboration certainly can gives some impact towards each countries.<sup>[96,97]</sup> Developing countries has the high interest to do the collaboration with developed countries in order to learn something and be able to transfer knowledge as much as they can.<sup>[98]</sup> Another reason happens in collaboration via allocation student.<sup>[99]</sup> Some countries has their allocation money to allocate their student in certain countries. Researches been done from both researchers definitely can give an advantage for both parties.<sup>[99]</sup>

In determine the performance publication here in Malaysia, all related indicators which explained before will implement in method and analysis section. Therefore, in the next section, comprehensive productivity is presented.

## MATERIALS AND METHODS

In this study, data have been retrieved from Scopus database using permission by University Teknologi Malaysia (UTM) library on 20th June 2016. Scopus is selected as the main database for this study as it is a multidisciplinary database<sup>[100]</sup> and also one of medium for all higher education institutions to monitor the publication productivity of its academics.

Scopus is one of the largest and trustable database for abstract and peer reviewed citation in higher education institutions to acknowledge and monitor the performance and progress in a variety of criteria. It can deliver the most comprehensive overview of research output in various fields, namely as science, technology, medicine, social sciences and also art and humanities. The Scopus provides features such as smart tool to track, analyze and visualize research and it is easy for the user to manipulate the data to make any decision. Scopus database contains more than 60 million record of journals, more than 113000 records of books, over 7.2 million conference papers from over 88800 worldwide events and more than 2.7 million patents that have been recognized by established patent offices in the world.<sup>[100,101]</sup> Scopus is one of the reliable databases to conduct a study of publication performance of HEI's of a particular country.<sup>[100]</sup>

This study is focused on 20 years' time span started from 1995 to 2015. The main objective of this study is to analyze scientific research performance and pattern of publication in Malaysia during 20 years. We used search box in Scopus database. 'All type' field in the search box where chosen and the chosen keyword is 'Malaysia'. All related papers are extracted, retrieved and compiled into the per-

Scopus

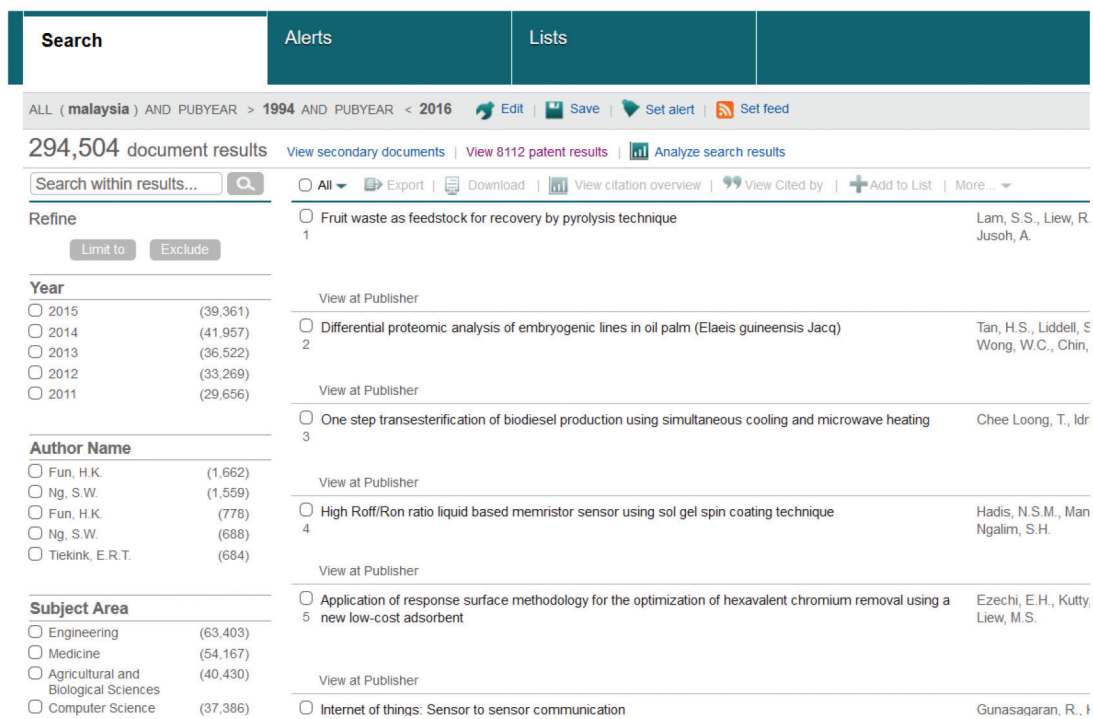


Figure 1: Snapshot from Scopus

sonal database in Microsoft Excel. A total of 294 504 documents was retrieved from Scopus as shown in Figure 1. From the total documents, the pre-processing task such as data cleaning were done. The purpose of data cleaning is to increase the quality of the data that were retrieve from selected database.<sup>[102]</sup> In this study, the retrieved document that published before June, 1995 with total of 148 document and after June, 2015 with total of 2308 were omitted in order to get the real 20 years published document. All documents were checked and any document that were written and publish that unrelated to Malaysian researcher or writer were excluded. The 'undefined author' with total of 1955 document in 'author' field also were excluded too. In retrieve document, the author's sequence in the bibliographic or citation area whether he/she was the first, second or third author were included. Although the sequence played certain role, but there are contribution from each of the authors.<sup>[48]</sup> After data cleaning task were done, next is to analyze the retrieve document.

### Statistical analysis

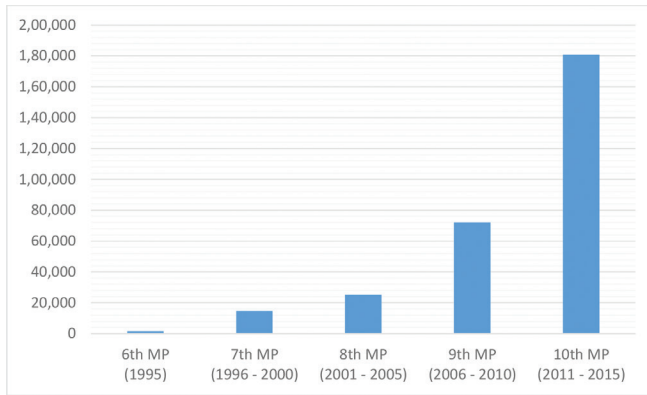
## RESULTS

### Year-wise distribution of publication

After data cleaned task were done, total of 290 093 publications records was identified. These publications records

included all type of documents such as articles, conference, review paper, book chapter and book. There were 5 Malaysia Plan (6th MP to 10th MP) during this twenty years study and this study comprises of the year 1995 to 2015 and covers the five Malaysian plan. In 2016, the newest version of Malaysia Plan called 11th Malaysia Plan that has been introduced by the government to ensure the development in Malaysia is on track and capable to compete with other developing countries.<sup>[103]</sup> Malaysia plan become one of aim for the country to archive the developed country status which has the productive human capital that capable to keep pace with any other developed countries.<sup>[104]</sup>

As a general acknowledgement, in every period of MP, there is a significant growth of publication productivity in Malaysia. However, this growth is more noticeable for the 9th and 10th MP. The increment of from the previous 8th MP (25304 publications) to 9th MP (72121 publications) is about 200%. The peak boost can also be observed in 10th MP (2011–2015). The differences between previous 9th MP with 10th MP was huge as show in Figure 2. The 9th and 10th MPs can be concluded as a massive productivity of publication in Malaysia, because a huge amount of budget was allocated to all Malaysian to continue their for Master and PhD.<sup>[105,106]</sup> One of the strategies to increase the publication in this country is to increase numbers of post-graduate student via MyBrain15 program which started from 9th Malaysia Plan.<sup>[107]</sup> Aspiration is to make most



**Figure 2: Distribution of research paper produced from 6th MP to 10th MP**

of Malaysian citizen to develop the human capital and achieve the professional level as par as our neighbor country, Singapore and consequently help Malaysian growth.<sup>[105,106]</sup> This reason more or less has affected the contribution to number of publication productivity.

### Institute

In Malaysia, there are huge numbers of public and private HEI's. These have very healthy culture of R & D and made the publication productivity and performance even more active and lively in Malaysia. Some of the private institutions gained their fund from the multinational company, whereas public institutions earned their endowment from the government. Table 2 presents a list of Top 20 most productive HEI's of Malaysia.

Nevertheless, in public institution category, two groups are existed. These two groups are Research University (RU) and Non-research University (non-RU). In 9th Malaysia Plan, 4 Malaysian universities were awarded Research University status.<sup>[108]</sup> Opportunities were given to these universities to carry out research, development and innovation (R & D & I) in their own institutions by collaborating either with national/international universities or industries. However, there are limitation for RU, in terms of budget allocation. The prospect in collaboration with the external parties, allocation of budget from government are limited. It is compulsory for awarded RU to gain and search their own budget allocation in order to do the R & D & I and decrease the reliance to the government.<sup>[108]</sup> Other universities which didn't have the opportunity to get the RU status still received their budget allocation to the R & D & I. Still, the budget is not big enough to do the massive development and research.

Research University's is one of the primary drivers of the knowledge economy worldwide.<sup>[109]</sup> The idea in combining research, development and teaching with the higher degree of autonomy and academic freedom in

HEI's brings them to the next level. These universities are become a flagship to other institution. After all, there are a lot of evidences from the previous study proving that RU institutions in both developed and developing country can bring some good impact to the countries.<sup>[110]</sup> Among the first five institutions (Table 2), mostly are Research Universities (RU). There are five public university in Malaysia that have earned the RU status; UniversitiMalaya (UM) in 2006, followed by University Sains Malaysia (USM), UniversitiKebangsaan Malaysia (UKM) and Universiti Putra Malaysia (UPM) and lastly is UniversitiTeknologi Malaysia (UTM) in 2010.

All five Research Universities still own the majority of publications (121845 records). This number is more than half (67.05%) of the total number of publications (Table 2). Other public universities have also contributed good numbers in producing the publication. Total ten non-RU status public universities (Table 2) shared 41285 records (22.72%) for publication productivity. Among private universities, five institution have contributed 18599 records (10.23) namely like UniversitiTeknologi Petronas, Multimedia University, Universiti Tenaga Nasional, Monash University Malaysia and The University of Nottingham Malaysia Campus. The utmost number of articles published by Universiti Malaya (UM) i.e. total of 29525 articles (16.02% of total). According to present study, UM has become a leading university among all public university with their excellent performance as HEI and also has gained much respect from the public due to already achieved successes. UM also ranked as 133 in QS World University Ranking in 2016.<sup>[111]</sup>

The second institution who contributed most of publication is University Sains Malaysia (USM). USM has also contributed quite a large number of 25977 records (14.10% of total). UniversitiTeknologi Malaysia with total of 19447 records (10.55% of total) is the least active RU HEI. Most of higher education institutions in the top 20 list (Table 2) are public universities i.e. total of 15 among all 50 institutions and the rest are from private sector. From the private institution, University Teknologi Petronas contributed (6046; 3.28% of total) quite a large numbers in publication in the top 20 followed by Multimedia University that contributed total of 5290 articles and shared about 2.87% of total. Although, the share of private institutions was small, but it showed that all institutions (public and private) in Malaysia were worked very hard to develop their own institutions in R & D to help government in realizing the vision to increase the human capital.

Promoting research and development that has some impact to publication productivity in this country, would indirectly give some influence in achieving the government vision to increase higher income nation but in the same time preserve world standard human capital in Malaysia as

**Table 1: Total number of Malaysian scientific research productivity**

Malaysia Plan (MP)	Total No. of research paper produced	Cumulative no. research paper	% age of total output	Cumulative % age of total output
6th MP (1995)	1,462	1,462	0.50	0.5
7th MP (1996 - 2000)	14,672	16,282	5.00	5.5
8th MP (2001 - 2005)	25,304	41,586	8.60	14.1
9th MP (2006 - 2010)	72,121	113,707	24.50	38.6
10th MP (2011 - 2015)	178, 489	290 093	61.40	100
TOTAL	290 093		100.00	

**Table 2: Top 20 Public and Private Malaysian Institutions**

No	Affiliation	No of Articles (1995 - 2015)	Percentages (%)	Setara Result	RU Status
1	Universiti Malaya	29525	16.02	5	YES
2	Universiti Sains Malaysia	25977	14.10	5	YES
3	Universiti Kebangsaan Malaysia	25166	13.18	5	YES
4	Universiti Putra Malaysia	24297	13.66	5	YES
5	Universiti Teknologi Malaysia	19447	10.55	5	YES
6	Universiti Teknologi MARA	11739	6.37	5	NO
7	International Islamic University Malaysia	6730	3.65	5	NO
8	Universiti Teknologi Petronas	6046	3.28	5	NO
9	Multimedia University	5290	2.87	5	NO
10	Universiti Malaysia Perlis	5056	2.74	5	NO
11	Universiti Tun Hussein Onn Malaysia	3118	1.69	5	NO
12	Universiti Malaysia Pahang	2913	1.58	5	NO
13	Universiti Teknikal Malaysia Melaka	2604	1.41	5	NO
14	Universiti Malaysia Sabah	2548	1.38	5	NO
15	Universiti Tenaga Nasional	2529	1.37	5	NO
16	Monash University Malaysia	2465	1.34	5	NO
17	Universiti Utara Malaysia	2292	1.24	5	NO
18	The University of Nottingham Malaysia Campus	2269	1.23	5	NO
19	Universiti Malaysia Sarawak	2216	1.20	5	NO
20	Universiti Malaysia Terengganu	2067	1.12	5	NO

stated in 10th Malaysia Plan to bring Malaysia to the next level of developed nation.

### Authors' contribution

Pattern performance of publication wasn't existed without authors. Authors are main player in these publication's productivity game. In this study, there are long list of authors who contributed quite numbers of publication in twenty years. Most of the authors are from public universities. From the long list of authors, there are two person who produce more than 2000 papers from 1995 to 2015. Both are from pure science (physic and chemistry) depart-

ments. The most productive author was from University Sains Malaysia named as Fun, HK. He is now no longer with USM but continues his service as an academics at University of King Saud and already published 2439 articles in Scopus database.<sup>[112]</sup> The second most productive author is Ng. SeikWeng, which already published 2247 articles in twenty years. The author is still with University Malaya who started his publication in 1982. Nevertheless, there are huge gap between second and third most productive authors. The third author also comes from Universiti Malaya as well, namely as Tiekink, E.R.T. He started to get publishing in 1985, and managed to publish 684 of articles to date.

**Table 3: Top 20 most Productive authors**

No	Author	Start Publication	Total	Percentage	University Affiliation (as the study was made)
		Year		(%)	
1	Fun, H.K	1970	2439	18.16	Universiti Sains Malaysia, School of Physics, Seri Ampangan, Malaysia
2	Ng, S.W	1982	2247	16.73	University of Malaya, Department of Chemistry, Kuala Lumpur, Malaysia
3	Tiekink, E.R.T.	1985	684	5.09	University of Malaya, Department of Chemistry, Kuala Lumpur, Malaysia
4	Ahmad, H.	1992	668	4.97	University of Malaya, Photonics Research Centre, Kuala Lumpur, Malaysia
5	Rusop, M.	2002	661	4.92	Universiti Teknologi MARA, NANO-SciTech Centre, Shah Alam, Malaysia
6	Harun, S.W.	2001	606	4.51	University of Malaya, Department of Electrical Engineering, Kuala Lumpur,
7	Ismail, H.	1994	539	4.01	Universiti Sains Malaysia, School of Materials and Mineral Resources Engineering, Seri Ampangan, Malaysia
8	Sopian, K.	1992	502	3.74	Universiti Kebangsaan Malaysia, Department of Mechanical and Materials Engineering, Bangi, Malaysia
9	Hassan, Z.	1999	499	3.72	Universiti Sains Malaysia, School of Physics, Seri Ampangan, Malaysia
10	Mohamed, Azah	1988	475	3.54	Universiti Kebangsaan Malaysia
11	Ismail, Ahmad Fauzi	1997	483	3.6	Universiti Teknologi Malaysia, Advanced Membrane Technology Research Centre (AMTEC), Skudai, Malaysia
12	Hashim, Uda	1998	463	3.45	Universiti Malaysia Perlis, School of Microelectronic Engineering Kubang Gajah, Malaysia
13	Islam, Mohammad Tariqul Ariqul	2003	469	3.49	Universiti Kebangsaan Malaysia, Department of Electrical, Bangi, Malaysia
14	Ismail, Mahamod Bin	2000	410	3.05	Universiti Kebangsaan Malaysia, Department of Electrical, Bangi, Malaysia
15	Majlis, Burhanuddin Yeop	1993	424	3.16	Universiti Kebangsaan Malaysia, Institute of Microengineering and Nanoelectronics (IMEN), Bangi, Malaysia
16	Masjuki, Haji Hassan	1993	390	2.9	University of Malaya, Faculty of Engineering, Kuala Lumpur, Malaysia
17	Hussain, Aini	1992	359	2.67	Universiti Kebangsaan Malaysia, Department of Electrical, Electronic and Systems Engineering, Bangi, Malaysia
18	Shaari, Sahbudin	1988	356	2.65	Universiti Kebangsaan Malaysia, Institute of Microengineering and Nanoelectrics, Bangi, Malaysia
19	Das, Srijit	2001	402	2.99	Universiti Kebangsaan Malaysia, Department of Anatomy, Bangi, Malaysia
20	Mahdi, Mohd Adzir	1998	354	2.64	Universiti Putra Malaysia, Department of Computer and Communication Systems Engineering, Serdang, Malaysia



**Table 4: Top 15 of type of document that became author choices**

Document Type	Total	Percentage (%)
Article	192 663	66.9071
Conference Paper	63 193	21.4574
Review	14 931	5.0699
Book Chapter	8 209	2.7874
Book	3 348	1.1368
Editorial	1 681	0.5708
Letter	1 659	0.5633
Article in Press	1 495	0.5076
Note	1 253	0.4255
Short Survey	551	0.1871
Business Article	544	0.1847
Erratum	352	0.1195
Conference Review	230	0.0781
Abstract Report	14	0.0048
Total	290 093	100

### Type of documents

In progressively producing publications, there are several type of documents that authors or scholars can contribute. The list of document type is shown in Table 4. As per expectations, the articles (197 044, 66.9 % of total) are the most popular type of document among authors followed by conference paper (63193, 21.45% of total) and review article (14 931, 5.06% of total) during these 20 years.

### Source of journals

From the type of document, the extracted data was grouped into source of journal. All the retrieved journals in Scopus are claimed to be well-known, trustable and established. Acta Crystallographica Section E: Structure Reports Online (4294 records) is the most productive journals. Advance Materials Research gained the second place with total 3517 articles records. Majority of journals in the list are come from the same subject area, which is Engineering and Pure Science. This means that Malaysian authors are more prone towards technical and engineering research.<sup>[113,114]</sup> The dissemination percentage in subject area here in Malaysia are leaning towards engineering which can be observe in table 5. Most of journals are related to engineering and technology. This is the highest percentage among all subject area. This result has similarity with the previous study<sup>[27]</sup> with gain the same analysis result in engineering area. This is might due to the current development happens in Malaysia where this

country is moving forward to be developed country.<sup>[115,116]</sup> Therefore, research and development in engineering area is progressively being done and the affect can be observe by the publication productivity by researchers and engineers. Most of the research are covered current development as well as future development which possibility happens here in Malaysia.<sup>[117,118]</sup> Only two journals have multidisciplinary in subject area which are SainsMalaysian and Journal of Applied Science (Table 5) and both gained 9th and 10th position respectively in this top 10 favorite journal choices by authors. Among all journals listed in Table 7, there are only three journals which are based in Malaysia viz. SainsMalaysiana,<sup>[119,120]</sup> Jurnal Teknologi<sup>[121,122]</sup> and Medical Journal of Malaysia.<sup>[123,124]</sup>

### Collaboration countries

Collaboration with other institutions/countries is a common practice in research publications. Collaboration frequently happens to most of the scholars especially in science and engineering subject area in order to stimulate the productivity in publication.<sup>[125,126]</sup> In science and engineering field, usually there are many members in one team for R&D.<sup>[117,118]</sup> This opportunity commonly attracts some international scholars to work together in ongoing research. Hence, the collaboration with other countries formed. It is good chance for each member in the team to learn and share the knowledge and experience that they have earned in the previous research or studies. Numbers of collaboration with countries from worldwide are growing now. Therefore, in this study, only Top 20 countries were chosen to analyze. Table 6 displays the pattern of collaboration with countries. The most collaborative research was done with the local Malaysian universities or research centers which was carried out by a total of 183174 articles (52.28%), which is quite normal for all countries in the world. Recently, collaboration research or co-authorship with any international institution is encouraged because of the diversity of knowledge and skills that can enhance author's knowledge and experience.<sup>[127]</sup> It's can improvise the writing and revision of publication in order to give some impact for the research that been made as collaboration.<sup>[128]</sup> It is evident from Table 6 that the United States of America has the highest total numbers with total of 27 086 collaborative publication papers. Most of the publication have been collaborated with the United States are in the subject area of Medicine,<sup>[129,130]</sup> Agricultural and Biological Sciences<sup>[131]</sup> and Environmental Science and Biochemistry.<sup>[132]</sup> Second highest total numbers in collaboration publications in twenty years period of time was United Kingdom with 19575 articles and most of the collaboration were in subject area of Medicine,<sup>[133]</sup> Social Science<sup>[133]</sup> and Engineering.<sup>[134]</sup> This is contradicted with the previous study<sup>[27]</sup> that reveals the highest numbers were from UK followed by United Stated of America. But, MOSTI study was consisted of data from Web of Science

**Table 5: List of journals for publication by authors**

No	Journal	Total	Percentage (%)	Subject Area
1	Acta Crystallographica Section E Structure Reports Online	4294	18.08	Chemistry, Materials Science, Physics and Astronomy
2	Advanced Materials Research	3480	14.65	Engineering
3	Applied Mechanics And Materials	2827	11.90	Engineering
4	Medical Journal Of Malaysia	2807	11.82	Medicine
5	Aip Conference Proceedings	2802	11.80	Physics Astronomy
6	Jurnal Teknologi	1773	7.47	Engineering
7	Plos One	1598	6.73	Agricultural and Biological Sciences, Biochemistry, Genetics and Molecular Biology, Medicine
8	Lecture Notes In Computer Science Including Subseries Lecture Notes In Artificial Intelligence And Lecture Notes In Bioinformatics	1530	6.44	Computer Science, Mathematics
9	Sains Malaysiana	1448	6.10	Multidisciplinary
10	Journal Of Applied Sciences	1188	5.00	Multidisciplinary

**Table 6: List of collaborated countries with Malaysia's authors**

No	Country	Total	Percentage (%)
1	Malaysia	183174	52.28
2	United States	27086	7.73
3	United Kingdom	19578	5.59
4	Australia	15403	4.40
5	India	14367	4.10
6	China	12960	3.70
7	Japan	10662	3.04
8	Iran	8635	2.46
9	Singapore	6810	1.94
10	Germany	6012	1.72
11	Indonesia	5790	1.65
12	Thailand	5756	1.64
13	Canada	5588	1.59
14	France	4758	1.36
15	Saudi Arabia	4696	1.34
16	Taiwan	3959	1.13
17	Pakistan	3918	1.12
18	South Korea	3892	1.11
19	Brazil	3845	1.10
20	Netherlands	3497	1.00

(WoS) which is opposed to this study. Although, total articles are more lean towards to America and European countries, but most of the collaboration happened within Asia region. Almost 55% of total in top 20 collaborations countries came from Asia and followed by European

region (20% of total) as shown at Figure 3. The reason might be transmission Malaysia's student to study abroad in European region as well as Middle East are encouraging since 2012 especially in tertiary education. Report said that the percentage is increasing up to 30 percent from previous years, therefore, it can be one of contributor factor in collaboration in research.<sup>[135]</sup> Scholarship in another contributor on this collaboration.<sup>[106]</sup> Numbers of companies giving away their scholarship to excellent and potential staff or student to study abroad.<sup>[136]</sup> Another contributor factor is collaboration research with universities and research center between Malaysia and other counties. From this collaboration, research and development as well as publication can be increase.<sup>[137]</sup> Therefore, this can be explain on why the percentage collaboration with other countries is pretty huge.

## DISCUSSION AND RECOMMENDATION

The utmost point to emphasize in this study is the gradual increase in numbers of publication. The noticeable increase in publications was started from 2006 onwards. In 9th Malaysia Plan, one of the government's vision was to transformation of nation to a high intellectual society. The focus on education and economy helps to step into the next level. The increase in publication productivity is a sign of good R&D that is actively happened in this country.<sup>[138]</sup>

In 9th Malaysia Plan, there is so much transformation made at national level. Malaysian government wants to ensure that the country in the right path to grow and develop. One of the transformation that been made was to award some of the public universities in Malaysia as RU status. With the title of RU the institutions can play a role of a middle man which becomes a bond to connect all

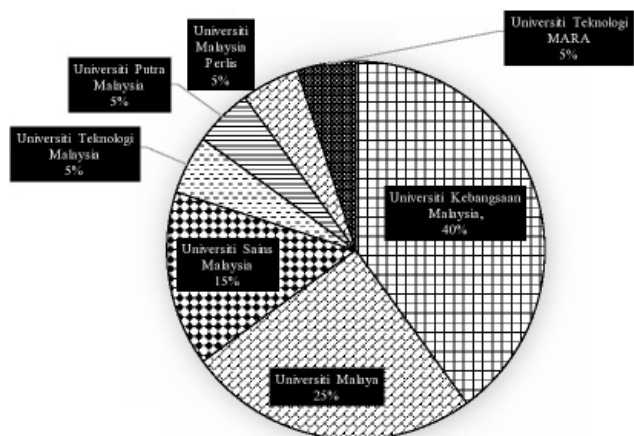


Figure 3: Division of author's affiliation universities

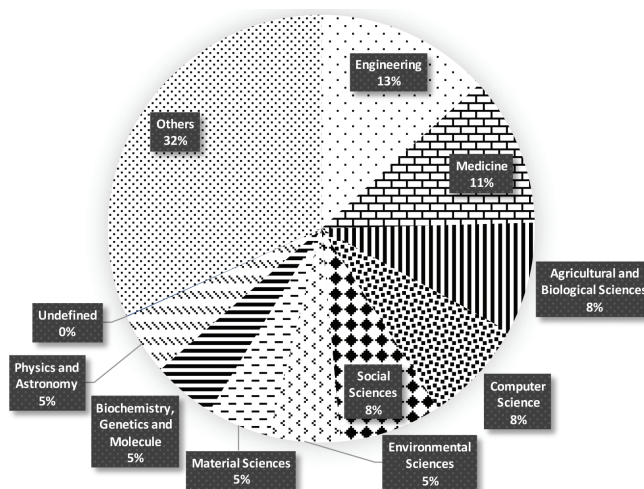


Figure 4: Division of subject area for Malaysia's publication

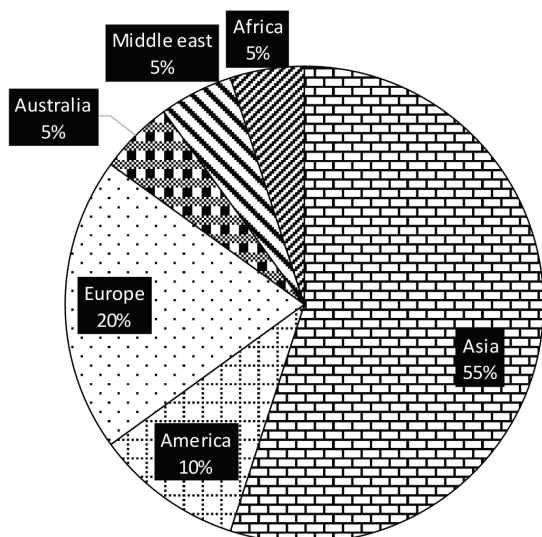


Figure 5: Regional Collaboration Research

internal and external stakeholder, new and old customer, public and private sectors, foreign and national collaborators and competitors.<sup>[139]</sup> Hence the justification and a significant increase in number of publication from these RU have risen sharply since the introduction of 9th Malaysia. This has a positive impact towards Malaysia as well as the related institutions in order to introduce and stamp their name to the world. Therefore, the numbers of collaboration with others countries especially with European countries and America is worth to emphasize. Although most of the authors carried out the collaboration towards Asia region (Figure 5), but still, the numbers of articles collaborated with Westerners as well as Americans are outstanding.

Although, the numbers of articles produced in collaboration with other countries are growing, but most of the

authors who produced huge numbers of the article are mostly came from the veteran category which owns more than 2000 publication in twenty years. Only two authors who have really impressive records in producing big numbers of articles, but the rest of the authors didn't give a huge impact. In Malaysia, there are almost 14 public universities and huge numbers of private universities that were built and growth, but still, the numbers of publication by individual are still low. Nonetheless, we understand that there are numbers of factors that associated in producing the publication that can be barriers to the authors such as personal factors, environment factors and behavioral factors.<sup>[2]</sup> Nonetheless, to increase the individual publication, it is indeed extra effort needed from authors themselves as well as from the institution. One of possibility to increase the number of publication is by doing the collaboration between in-house institutes. In-house institutes is the institutes were developed by the institutions itself such as big data center, entre for artificial intelligent and robotics or any other center that really focus on research and development. Certainly, these center are equipped by complete and advance facilities due huge numbers of fund received every year in order to support the research and development. Definitely, the opportunities to learn any advance or do the collaboration with these center are huge. It is author's responsible to approach these center and looking forward the collaboration between each other. Another possibility to increase number of publication is by doing the collaboration between departments or faculties in the institution. Currently, each of field already started to become interdisciplinary or multidisciplinary. This can be a huge chances for authors in each of department to works together in research. Although difference field has difference research area and interest, nonetheless, there must be a space for a collaboration. Authors need to be creative to meet and to seek the opportunities with another research-

ers. This collaboration isn't only for research and publication but, it is one of ways for spread their connection.

Another way to increase the publication and research is do collaboration with the industries.<sup>[140]</sup> These type of research are frequently happens at the other countries,<sup>[141,142]</sup> but low numbers in this country, Malaysia. In industries, research and development are frequently happens in the inside, but there are not many of them convert the research into a publication.<sup>[143]</sup> Therefore, sometimes we didn't acknowledge what kind of research is happening in the industries.<sup>[144]</sup> There is issues regarding research that produce in the academic environment aren't parallel in what has happen in the industries. This is because of people in academic and industries do not share the research information with each other.<sup>[145,146,147]</sup> Another issues is lack of skills in written in academic publication for industries' people because of industries people doesn't has high interest in publication.<sup>[146-149]</sup> Industrial report and academic writing are two different publications. Technical writing is simpler and straight forward without any supporting document or previous research, but in academic writing the approach is different. To raise the interest in produce academic writing by industries people might be takes a little time, therefore, here is where the academic people can helps. By gather all important material, information, data, and resource that industries' people can provide, articles and publication can be produce by academic's people. This symbiosis approach is beneficial to each other. Both parties can gain the same advantage and own the publication together. There are many ways to increase the publication. Authors need to have creativity and 'bird-eye view' to seek the opportunities in order to do the publication. As we know, most of the author are academician, and one of the criteria that being assess in yearly assessment. Thus, to have the idea in doing the writing is crucial and to produce a publication even more important.

Remarkably, by observing the productivity of publication in these twenty years, there is an optimistic impact from all institution. Nevertheless, although the publication productivity shows some good sign for all institutions and authors in Malaysia, but it doesn't play any role when it comes to understanding our own Malaysia ranking of the university – SETARA, which is alluding to peer review.<sup>[15]</sup> SETARA is Malaysia's national ranking where the main objective is to measure the productivity and performance of teaching and learning quality for higher learning institutions.<sup>[149]</sup> The approach that SETARA used to do the measurement and assessment towards the higher learning institution was peer review approach. The implementation of peer review approach was by hired numbers of expert panel to do the assessment, but there are numbers of unsatisfied studies that gives peer review approach a bad reputation.<sup>[150,151,152,153]</sup> Another national assessment exists in Malaysia is Malaysia research assessment, called

MyRA.<sup>[154]</sup> MyRA is an assessment that involves a number of institutions and measures their research, development and innovation (R & D & I) and contradict with SETARA, MyRA is leaning towards mixed approach whereby bibliometric analysis combined with peer review assessment.<sup>[154,155]</sup> Combination of both assessment has an advantages and disadvantages.<sup>[156,157]</sup> Here an important question and argument arises that we need to take seriously. Is it possible for Malaysia to have an institutional ranking that really emphasize on publication – Bibliometrics as one of the focus point, and not totally depending on the peer reviews.

Further we have studied the effectiveness of bibliometric to be one of measurement to evaluate each of Higher Education Institutions here in Malaysia. Bibliometric is already be one of measurement for each of institution for the United Kingdom in their new framework called Research Excellence Framework (REF), which focuses more on the research quality and less use of the expert views. Bibliomining as one of the approaches that needs to give attention for future research to determine the accuracy of publication productivity as well as a citation from all author in HEI's.

## CONCLUSION

As the conclusion, from the output produced from this report, we can acknowledge that the progress in publication as well as in research and development are keep on growing and developing. By the number of publication, we know that our researchers and scientists are working so hard in these years to help the nation as well as this country to grow. All allocation grant and budget from funding body either from government or private bodies are wisely spend for research and development. As we know, to produce remarkable research, development and innovation as well as to publish the good publication which will give some benefits and impact to another researchers and readers isn't easy. Therefore, efforts from researchers and scientist which sacrifice their time and energy as well as their passion towards research and development should be praise and become an example for younger researchers. The growth number of publication in these 20 duration year's shows that Malaysia are very serious to develop their nation and country to become one of the development country. Endeavor of Malaysian's government to make sure this country always in development track such as the establishment of research universities or allocation scholarship for Malaysian's citizen showing good and impressive impact towards this country and our nation.

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### CONFLICT OF INTEREST

Nil.

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