

# Malaysian Scientific Performance in the Web of Science 2001 to 2010

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# Preface

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This study undertaken for this report is made possible through funding provided by an UMRG Grant (RG057 11ICT) obtained from the University of Malaya, Malaysia for the period between 1 September 2011 to 31<sup>st</sup> August 2012 under a larger project entitled “Measuring the Performance, Utility and Influence of Malaysian Journals and Malaysian Scientific Output”. This report is the result of the second phase of the research.

Data for this study was retrieved from both the Web of Science (WoS) and Scopus databases. However, due to the massive amount of data and need to produce a short report in conjunction with the launching of Mycite, the content of this report is mainly based on data from WoS. The time frame of the data was publications published between 2001 and 2010 because the data collection was carried out in 2011 and it is assumed that publication and citation counts would have been reported by 2011.

This report focuses on Malaysian scientific contribution to world literature published in journals that are indexed in WoS and therefore does not boost to be comprehensive. The tabulated data produced are mainly descriptive in the form of total publications counts and total citations received. Testing of findings using bibliometric laws or quality indices is not carried out for this report as that will be carried out and reported in article submissions subsequently as is expected for any funded research.

The collaborators for this research are four (4) professionals from the University of Malaya Library (UML) as we regard the librarians as the database and content experts. Furthermore, UML is experienced enough in understanding the needs of a productivity performance study as the Library is responsible for producing productivity reports related to the University of Malaya publication performances in the WoS annually.

In presenting the performance of Malaysian scientific research this report hopes to highlight areas, persons, institutions of excellence and points to potential collaboration.

# 1. Introduction

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Scientific performance at the country level is becoming necessary so that national performance can be gauged and research strength as well as gaps could be identified. Scientific performance is difficult to measure as the characteristics of disciplines vary and the indicators used to measure performance are also diverse. In most of the studies on research or scientific productivity, the indicators used are productivity and citation counts as well indices such as impact factors and h index. In some countries, reports on scientific research performance are often commissioned by governments to monitor their agencies' performances.

Braun, Glanzel, Schubert (2005) assess UK scientific performance based on publication and citation counts and similar indicators was used by Zhou (2006) for China. The research performance for the Nordic countries for the period 1989 to 2008 was carried out by the Nordic Network on Bibliometrics (Schneider, 2009). Performance was gauged through publication activity and citation impact at both national and field levels. In Germany, Schmoch et al. (2011) studied the performance of German science systems and public non-university research institutes. The scientific productivity of the Maghreb countries, comprising Algeria, Morocco and Tunisia, in Scopus produced between 1996 and 2009 was undertaken by Hammouti (2010) who found that Tunisia's output was higher than both Morocco and Algeria even though the population of Tunisia is only one third that of Morocco and Algeria. Jacobs (2001) studied the publication patterns of scientists in South Africa between 1992 and 1996 focusing particularly on status and funding and found that the highest citation count was received by papers in the fields of medicine, engineering, physics and astronomy, agricultural and biological sciences. Again for Morocco, Bouabid and Martin (2009) in their paper, presented the results of an evaluation of the scientific performance in Morocco for the period 1997–2006 and included a comparison with South Africa, Egypt, Nigeria, Tunisia, Algeria, Portugal and Greece. The indices used were h-index of publications and the mean citation rate per paper and confirmed that the h-index did reflect the importance and the quality of the scientific output of a given researcher.

At the author level, there will always be a need to publish. This is brought about by various factors. Amongst the North American scholars, this need is brought about by “the continual ratcheting up of the productivity culture” (Finnegan and Hyle, 2009), which has placed undue stress on North American academics for the past two decades (Hemmings and Kay, 2010).



Recently, Altbach and Rapple (2012) stated that “In recent years, scholars worldwide have found themselves under increasing pressure to publish more, especially in English language internationally circulated journals that are included in globally respected indices such as the ISI Citations”. They blamed it on the “publish or perish” syndrome and they acknowledged that pressure is being placed on non-English medium academics to publish in English language journals to improve the rankings. Within the literature itself, there has been an increase in the number of publications which presents studies on publication productivity. This can be taken as an indication that the community at large is interested in tracking the publication productivity of authors from the varying subject disciplines.

Similarly, there is a need to look at the publication productivity of Malaysian scholars in the varying fields of research. The Ministry of Science, Technology and Innovation Malaysia (MOSTI) has commissioned such performance report for the year 2008 (MASTIC, 2010). There has been a drastic growth of bibliometric studies published especially in the *Malaysian Journal of Library & Information Science* (MJLIS) published by the Department of Library & Information Science, University of Malaya (<http://www.myjournal.my/public/browse-journal-view.php?id=55>). A search from MyCite (Malaysian Citation Index System, <http://www.mycite.my>) produces 54 bibliometric articles published in MJLIS ranging from studies on the productivity of personalities such as nobel laureate Ahmed Hassan Zewail (Kademani, Kalyane & Kumar, 2001) and Professor Khoo Kay Kim (Tiew, 1999); on journal studies such on *Journal of Natural Rubber Research* (Tiew and Kiran, 2000), internationalization characteristics of *Bulletin of the Malaysian Mathematical Society* and *Malaysian Journal of Computer Science* (Zainab, 2008), mapping of literature on Bose-Einstein condensation (Kademani et al., 2006), the Tsunami (Sagar et al., 2010), energy and fuel (Sombatsompop, et al., 2011), productivity of Malaysian computer scientists (Abrizah and Wee, 2011) and discourses on performance indices such as using diffusion factor as an indicator (Sanni and Zainab, 2011), Lotka’s law (Pulgarin, 2012) and application of k-shells and the h-index (Ye, Zhao and Rousseau, 2011). This diversity of coverage indicates the growth of interests in bibliometrics in Malaysia and the recognition of MJLIS by foreign authors as a source to disseminate bibliometrics-based papers.

This report looks at scientific performance of Malaysian institutions and Malaysian-based authors based on publication and citation counts. We acknowledge that such indicators do not measure the real quality of research but we consider it as a reflection of productivity and impact evidenced by data retrieved from a universal citation database, WoS.

## 2. Objectives and Methods

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The study uses data produced by Malaysian-based authors obtained from the Web of Science database (WoS), specifically the Science Citation Index Expanded (SSIE), Social Sciences Citation Index (SSCI) and Arts and Humanities Citation Index (AHCI). The period covered is from 2001 to 2010 which opens a ten-year window to the publication productivity of Malaysian-based authors and Malaysian institutions. Publications covered include articles, letters and reviews. WoS is a multi-disciplinary citation database covering a wide spectrum of both the sciences, technology, medical (STM) related fields and arts, humanities and social sciences (AHSS). This database was founded by Eugene Garfield for the Institute for Scientific Information (ISI) in Philadelphia, USA and was acquired in 1992 by Thomson Scientific and Healthcare. Unique to WoS is the impact factor or IF which it has been patented. WoS currently has 12,000 journal titles from 256 categories and 150,000 conference proceedings.

Research performance is measured by two types of indicators, research activity and research impact. Research activity is indicated by publication counts for the period 2001 to 2010 and impact measures are shown by citation counts. This report profiles performances from the institutional, author and discipline levels. At all levels the results are displayed in descriptive tables and trendlines.

Data retrieved were cleaned for duplicates and completeness. WoS identifies a wide spectrum of subject categories within its database. In this report the subjects are based on eight broad disciplines following those offered by faculties at Malaysian universities. We found little problems in mapping the subject fields in WoS to broader subject categories to reflect the faculties which are in place at the various Malaysian public universities except for certain field. For example in Malaysia, the field of Library and Information Science (LIS) is placed at the computer science and information technology-based faculties, while WoS categorizes this field in the social sciences. The six broad subject categories are Arts, Humanities and Social Sciences; Dentistry; Engineering; Computer Sciences; Medicine; and Sciences. We notice that the publication and citation activities in the Arts, Humanities and Social Sciences are low and the cut-off point when ranking performance is lower than those used in the Sciences, Technology and Medical fields. For this reason, performance analyses of the Arts, Humanities and Social Sciences fields should be interpreted with caution. This situation may have arisen because of the percentage of journal coverage in the AHSS is also low and bias

towards American journals. Thomson-Reuters (2012), the publisher for WoS acknowledges that the citation patterns in the Arts and Humanities is different from that of the social sciences and natural sciences articles. There is a tendency for the Arts and Humanities journal articles to cite non-journal sources.

The objectives of this study are as follows:

- a) To determine the publication productivity and trends of publications produced by Malaysian-based authors which are indexed in the Web of Science (WoS) databases, specifically the Science Citation Index Expanded, Social Science Citation Index and Arts and Humanities Citation Index. The period covered is from 2001 to 2010.
- b) To determine the total number and average yearly citations obtained by the Malaysian publications as reported in the WoS databases.
- c) To identify the total publication productivity produced by Malaysian-based affiliations. The top 20 most productive institutions are highlighted.
- d) To tabulate publication output of Malaysian-based affiliations by six broad fields of research.
- e) To tabulate the top most active Malaysian-based authors publishing and cited in the WoS databases based on the six broad fields; Science, Engineering, Medicine, Computer Sciences, Dentistry, Arts, Humanities and Social Sciences.

# 3. Findings

This study looks at the publication productivity of Malaysian-based authors in the various institutions in Malaysia. The data is obtained from the Web of Science (WoS) database and covers the period from 2001 to 2010. A total of 24,377 publications from Malaysian-based authors affiliated to various types of institutions were indexed in WoS up to 15<sup>th</sup> July 2011.

### 3.1. Malaysian Publications by Broad Fields of Research

The total number of Malaysian publications indexed in WoS from 2001 to 2010 as of 30<sup>th</sup> June 2011 is 24,297 but the total number given in all the tables presented is 28,996 because when analysing the data, one publication may be assigned to more than one subject area in WoS resulting in a higher total. Table 1 indicates that the bulk of publications indexed in WoS from 2001 to 2010 are from Science (53.96%), followed by Engineering (20.80%) and Medicine (17.43%). The non-science subject categories have a smaller number of publications (4.10%).

Table 1: Malaysian Publications in WoS by Broad Fields, 2001-2010

Fields/ Year	No. of Publications											Total	%	h index
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010				
Arts, Humanities & Social sciences	48	44	54	49	58	82	91	165	259	363	1213	4.10	30	
Computer Sciences	22	36	73	92	101	104	77	106	127	195	933	3.15	26	
Dentistry	12	9	6	6	15	16	13	24	25	37	163	0.55	15	
Engineering	206	251	264	357	395	551	655	761	1169	1544	6153	20.80	60	
Medicine	229	244	229	295	324	372	528	727	993	1216	5157	17.43	60	
Science	684	708	807	946	1130	1226	1523	1893	2952	4093	1,962	53.96	75	
<b>Total</b>	<b>1201</b>	<b>1292</b>	<b>1433</b>	<b>1745</b>	<b>2023</b>	<b>2351</b>	<b>2887</b>	<b>3676</b>	<b>5525</b>	<b>7448</b>	<b>29581</b>	<b>100</b>		
%	4.06	4.37	4.84	5.90	6.84	7.95	9.76	12.43	18.67	25.18	100			

For Science, Engineering and Medicine, there was a gradual increase in publications from 2001 to 2009, followed by a sharp increase in 2010. There was also an increase in publications for the other field categories but it is not as obvious. Overall, the total number of publications published increased from 1,201 (4.06%) in 2001 to 7,448 (25.81%) in 2010 (Figure 1).

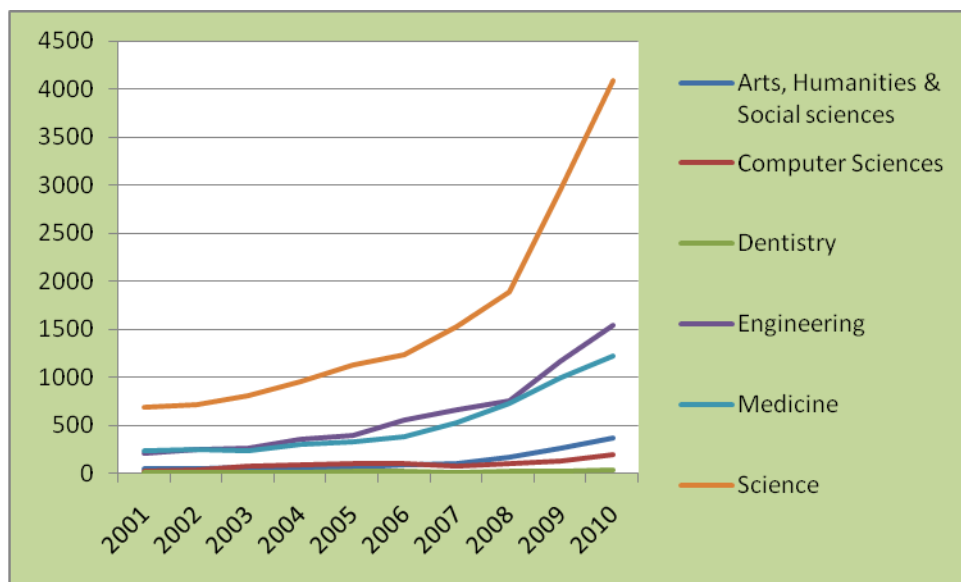


Figure 1: Malaysian Publications in WoS by Broad Fields, 2001-2010

### 3.2 Citations Received by Malaysian Publications

The total number of citations received by Malaysian publications indexed in WoS from 2001 to 2010 is 168,580. Table 2 shows the breakdown for the six broad field categories. Publications in the Science category achieved a total of 99,505 citations (53.95%) which is the highest within the six subject categories.

Table 2: Total Citations for Malaysian Publications by Broad Fields, 2001-2010

Fields / Year	Total Number of Citations										Total	%
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010		
<b>Arts, Humanities &amp; Social sciences</b>	400	466	363	586	321	511	554	543	685	415	4429	2.63
<b>Computer Sciences</b>	393	203	524	534	675	600	348	435	401	273	4113	2.44
<b>Dentistry</b>	157	99	83	56	129	85	63	75	39	16	786	0.47
<b>Engineering</b>	2249	3060	3014	4058	3393	3924	4698	4599	4724	2821	3,719	20.00
<b>Medicine</b>	2943	3247	3697	5549	3583	3476	4237	4021	3831	2263	34584	20.51
<b>Science</b>	8740	8650	8531	10441	9879	10367	11481	10514	12346	8556	90949	53.95
<b>Total</b>	14882	15725	16212	21224	17980	18963	21381	20187	22026	14882	168580	
<b>%</b>	8.83	9.33	9.62	12.59	10.67	11.25	12.68	11.97	13.06	8.83		

Engineering and Medicine fall back considerably contributing 20.00% and 20.51% to the pool respectively. Arts, Humanities and Social Sciences as well as Computer Sciences and Dentistry obtained a very low number of citations to their publications. From 2001 to 2010, the number of citations received by Malaysian publications indexed in WoS goes up and down. It peaks in 2004 and 2007 (Figure 2) and from then on it dips with the lowest in 2010. This pattern is similar for the Science, Medicine and Engineering categories. For the rest, the pattern is lateral with no significant peaks and dips.

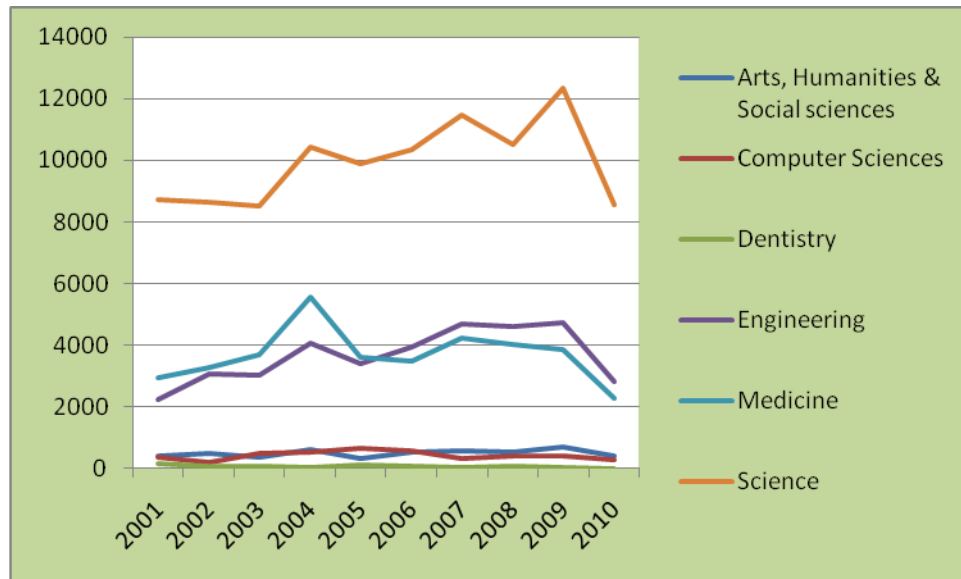


Figure 2: Total Citations for Malaysian Publications by Broad Fields, 2001-2010

The average yearly citations per Malaysian publications published from 2001 to 2010 in the six fields of research is indicated in Table 3 and Figure 3.

Table 3: Average Yearly Citations Received by Malaysian Publications by Broad Fields, 2001-2010

Fields / Year	Average Yearly Citations									
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Arts, Humanities & Social sciences	8.33	10.59	6.72	11.59	5.53	6.23	6.09	3.31	2.78	1.14
Computer Sciences	17.86	5.80	7.18	5.80	6.68	5.77	4.52	4.10	3.16	1.40
Dentistry	13.08	11.00	13.83	9.33	8.60	5.31	4.850	3.12	1.56	0.43
Engineering	10.92	12.24	11.50	11.24	8.53	7.08	7.16	6.04	4.03	1.81
Medicine	12.85	13.31	16.14	18.81	11.06	9.34	8.02	5.53	3.86	1.86
Science	12.78	12.22	10.57	11.04	8.74	8.46	7.54	5.55	4.18	2.09

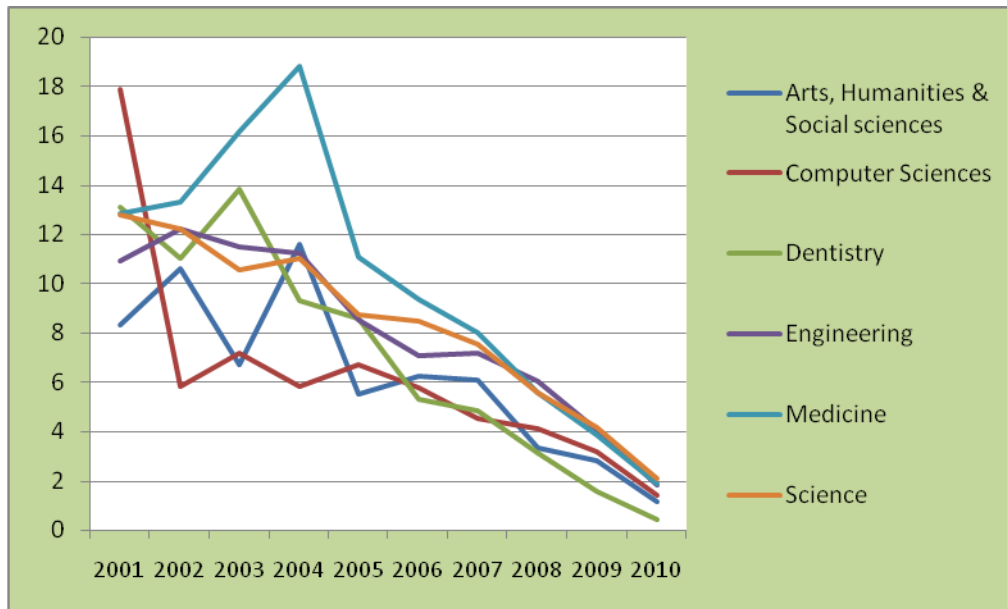


Figure 3: Average Yearly Citations Received by Malaysian Publications by Broad Fields, 2001-2010

Overall, there is a decline of average citations per year for all fields of research (Figure 3) and the dip is especially obvious between the last five years. Average citation is especially low in the fields of Arts, Humanities and Social Sciences, Dentistry and Computer Sciences. This may be a reflection of the citation pattern and behaviours of authors in these disciplines. The results also indicate that citations were higher for items in the earlier years (2001-2005) which may infer that the early publications seems to have higher influence and therefore were cited more.

### 3.3. Publication Output by Malaysian-Based Institutions

All authors affiliate themselves to institutions. Hence authors who are active publishers obtain credit not only to themselves, but also confer credit to the institutions they are affiliated to. In this instance, the information on the affiliation of an author whose article is indexed in the WoS is determined from the publication itself. Each time an institution's name is stated in an author's affiliation, the institution gets a count. Thus, even though the total number of publications indexed in WoS for 2001 to 2010 is 24,377, the total number of affiliation counts is higher that is 28,903. This is attributed to multi-authored papers having multi-affiliations. Table 4 indicates the total publications by affiliation counts and sum of times cited. The institutions of higher learning accounts for 88.88% of total affiliation counts and 85.3% of citations received. Other institutions active in research are government agencies such the hospitals and medical centres (4.9%), research institutions (8.3%) and the Ministerial agencies (1.5%).

Table 4: Malaysian Publications and Citations by Type of Institutions, 2001-2010

No.	Type of Institution	No. of Author Affiliations	%	Sum of Times Cited	%
1.	Public university	22,044	76.27	101,136	74.24
2.	Private university	2,534	8.76	9,176	6.74
3.	International university	780	2.70	4,759	3.49
4.	Private college	211	0.73	699	0.51
5.	University college	120	0.42	373	0.27
6.	<b>Sub-Total</b>	<b>25,689</b>	<b>88.88</b>	<b>116,143</b>	<b>85.25</b>
7.	Research institution	1,947	6.74	11,306	8.30
8.	Hospital / Medical centre	1,101	3.81	6,734	4.95
9.	Ministry	166	0.57	2,042	1.50
	<b>Grand Total</b>	<b>28,903</b>	<b>100</b>	<b>136,225</b>	<b>100</b>

Table 5 highlights the publication performance by the various institutions of higher learning in Malaysia. As expected the research-designated public universities (UM, USM, UPM, UKM and UTM) lead in total publication output and times cited. Universiti Malaya lead in terms of publication output (5,849 titles), followed by Universiti Sains Malaysia (5,603), Universiti Putra Malaysia (3,794), Universiti Kebangsaan Malaysia (2,992) and Universiti Teknologi Malaysia (1,129). These research universities have been enabled by the allocation of substantial research grants allocations and active recruitment of full time researchers both from Malaysia and from abroad to help accelerate research performance and this seems to bear fruit in view of the increasing cumulative publication output from 2006 onwards (Table 1). Among the private universities Multimedia University lead in terms of total publication output (1,199 titles) and times cited (4,823), followed by Universiti Tunku Abdul Rahman, International Medical University and Universiti Tenaga Nasional. It is evident that there is an increase in the number of private universities and colleges as well as an increase in the publication output from foreign universities with Malaysian campuses, such as Monash University Malaysia, University of Nottingham Malaysia, Swinburne University of Technology, Sarawak and Curtin University of Technology, Sarawak.



Table 5: Publication and Citation Performance by Malaysian-Based Institutions, 2001-2010

No.	Type of Institutions	No. of Author Affiliations	Sum of the times cited
<b>Public Universities</b>			
1.	Universiti Malaya (UM)	5,849	27,214
2.	Universiti Sains Malaysia (USM)	5,603	27,460
3.	Universiti Putra Malaysia (UPM)	3,794	16,495
4.	Universiti Kebangsaan Malaysia (UKM)	2,992	13,653
5.	Universiti Teknologi Malaysia (UTM)	1,129	5,324
6.	Universiti Teknologi MARA (UiTM)	665	2,227
7.	Universiti Islam Antarabangsa Malaysia (UIAM)	556	1,614
8.	Universiti Malaysia Sabah (UMS)	371	2,316
9.	Universiti Malaysia Sarawak (UNIMAS)	369	2,884
10.	Universiti Malaysia Terengganu (UMT)	219	644
11.	Universiti Malaysia Perlis (UniMAP)	150	572
12.	Universiti Tun Hussein Onn Malaysia (UTHM)	99	146
13.	Universiti Malaysia Pahang (UMP)	80	197
14.	Universiti Utara Malaysia (UUM)	41	67
15.	Universiti Teknikal Malaysia Melaka (UTeM)	40	154
16.	Universiti Pendidikan Sultan Idris (UPSI)	31	81
17.	Universiti Sultan Zainal Abidin (UniSZA)	27	16
18.	Universiti Sains Islam Malaysia (USIM)	22	67
19.	Universiti Malaysia Kelantan (UMK)	4	5
20.	Universiti Pertahanan Nasional Malaysia (UPNM)	3	-
<b>Total</b>		<b>22,044</b>	<b>101,136</b>
<b>Private Universities</b>			
1.	Universiti Multimedia (MMU)	1,199	4,823
2.	Universiti Tunku Abdul Rahman (UTAR)	265	721
3.	Universiti Teknologi Petronas (UTP)	264	937
4.	Universiti Perubatan Antarabangsa (IMU)	247	994
5.	Universiti Tenaga Nasional (UNITEN)	226	668
6.	AIMST University	133	406
7.	Universiti Kuala Lumpur (UniKL)	53	120
8.	Universiti UCSI (UCSI University)	43	122
9.	Malaysia University of Science and Technology (MUST)	34	199
10.	Universiti Selangor (UNISEL)	31	116
11.	Management and Science University (MSU)	16	16
12.	Universiti Terbuka Malaysia (OUM)	14	49
13.	Universiti Terbuka Wawasan (WOU)	5	1

No.	Type of Institutions	No. of Author Affiliations	Sum of the times cited
14.	Universiti Tun Abdul Razak (UniRazak)	3	4
15.	Limkokwing University of Creative Technology	1	-
<b>Total</b>		<b>2,534</b>	<b>9,176</b>
<b>International Universities (Malaysia's Campus)</b>			
1.	Monash University Malaysia (MUSM)	386	2,388
2.	University of Nottingham in Malaysia (UNM)	272	1,874
3.	Swinburne University of Technology (Sarawak Campus)	64	205
4.	Curtin University of Technology Sarawak (Lutong Campus)	58	292
<b>Total</b>		<b>780</b>	<b>4,759</b>
<b>University Colleges</b>			
1.	Kolej Universiti HELP (HUC)	36	61
2.	INTI International University	36	187
3.	Kolej Universiti Sains Perubatan Cyberjaya (CUCMS)	18	45
4.	Taylor's University	11	28
5.	Sunway University	8	32
6.	Kolej Universiti SEGi	4	1
7.	Kolej Universiti TATI	4	17
8.	Binary University Collge of Management and Entrepreneurship (BUCME)	1	1
9.	Kolej Universiti Teknologi Antarabangsa Twintech (IUCTT)	1	-
10.	Kolej Universiti Nilai	1	1
<b>Total</b>		<b>120</b>	<b>373</b>
<b>Private College</b>			
1.	Penang Medical College	18	88
2.	Masterskill College of Nursing and Health	15	9
3.	Kolej Perubatan Manipal Melaka	15	26
4.	Perak Medical College	9	149
5.	MAHSA College	8	6
6.	Putra International College Malacca	7	28
7.	Stamford College	6	5
8.	Island College of Technology	5	1
9.	KDU University College	2	9
10.	Kolej PTPL	1	5
11.	Kolej Han Chiang	1	-
12.	KBU International College (KBU)	1	-
13.	New Era College	1	-
14.	Penang International Dental College	1	-
15.	Asia Pacific Institute of Information Technology (APIIT)	1	-
<b>Total</b>		<b>91</b>	<b>326</b>

### 3.4. Institutional Publication Output by Fields of Research

There are marked differences in publication and citation performances when comparison is made between the two different domains, namely Science, Technology and Medicine (STM) and Arts, Humanities and Social Sciences (AHSS). Technology in this context includes the field of Engineering. Table 6 and Figure 4 ranks and list the top 20 productive institutions based on total author affiliations in the STM fields, which altogether numbered 24,432 and the total number of citations of 145,178. UM with 22.86% has the most number of author affiliations in the publications. This is followed by USM (22.30%), UPM (14.94%) and UKM (11.83%). MMU, a government-linked company or GLC university, is placed fifth with 4.60% and is followed closely by the newly designated research university, UTM with 4.50%. From then on, it is a mixture of public, private as well as GLC universities interspersed with a hospital (HKL) and research-related government institutions (MPOB and IMR).

Table 6: Top 20 Most Productive Malaysian-based Institutions  
In the STM Fields, 2001-2010

No.	Institution	No. of Author		No. of Citations	
		Affiliations	%	Citations	%
1.	Universiti Malaya (UM)	5,585	22.86	32,951	22.70
2.	Universiti Sains Malaysia (USM)	5,449	22.30	33,948	23.38
3.	Universiti Putra Malaysia (UPM)	3,651	14.94	20,651	14.22
4.	Universiti Kebangsaan Malaysia (UKM)	2,890	11.83	16,598	11.43
5.	Universiti Multimedia (MMU)	1,124	4.60	5,563	3.83
6.	Universiti Teknologi Malaysia (UTM)	1,099	4.50	6,633	4.57
7.	Universiti Teknologi MARA (UiTM)	646	2.64	3,100	2.14
8.	Universiti Islam Antarabangsa Malaysia (UIAM)	481	1.97	1,893	1.30
9.	Hospital Kuala Lumpur (HKL)	386	1.58	3,173	2.19
10.	Malaysian Palm Oil Board (MPOB)	354	1.45	2,447	1.69
11.	Universiti Malaysia Sabah (UMS)	340	1.39	2,765	1.90
12.	Monash University Malaysia (MUSM)	328	1.34	2,074	1.43
13.	Universiti Malaysia Sarawak (UNIMAS)	324	1.33	3,418	2.35
14.	Forest Research Institute Malaysia (FRIM)	302	1.24	2,142	1.48
15.	Institute for Medical Research (IMR)	266	1.09	1,583	1.09
16.	Universiti Teknologi Petronas (UTP)	266	1.09	1,279	0.88
17.	Universiti Tunku Abdul Rahman (UTAR)	245	1.00	1,031	0.71
18.	University of Nottingham in Malaysia (UNM)	239	0.98	1,745	1.20
19.	Universiti Perubatan Antarabangsa (IMU)	234	0.96	1,260	0.87
20.	Universiti Tenaga Nasional (UNITEN)	223	0.91	924	0.64
	<b>Total</b>	<b>24,432</b>	<b>100</b>	<b>145,178</b>	<b>100</b>

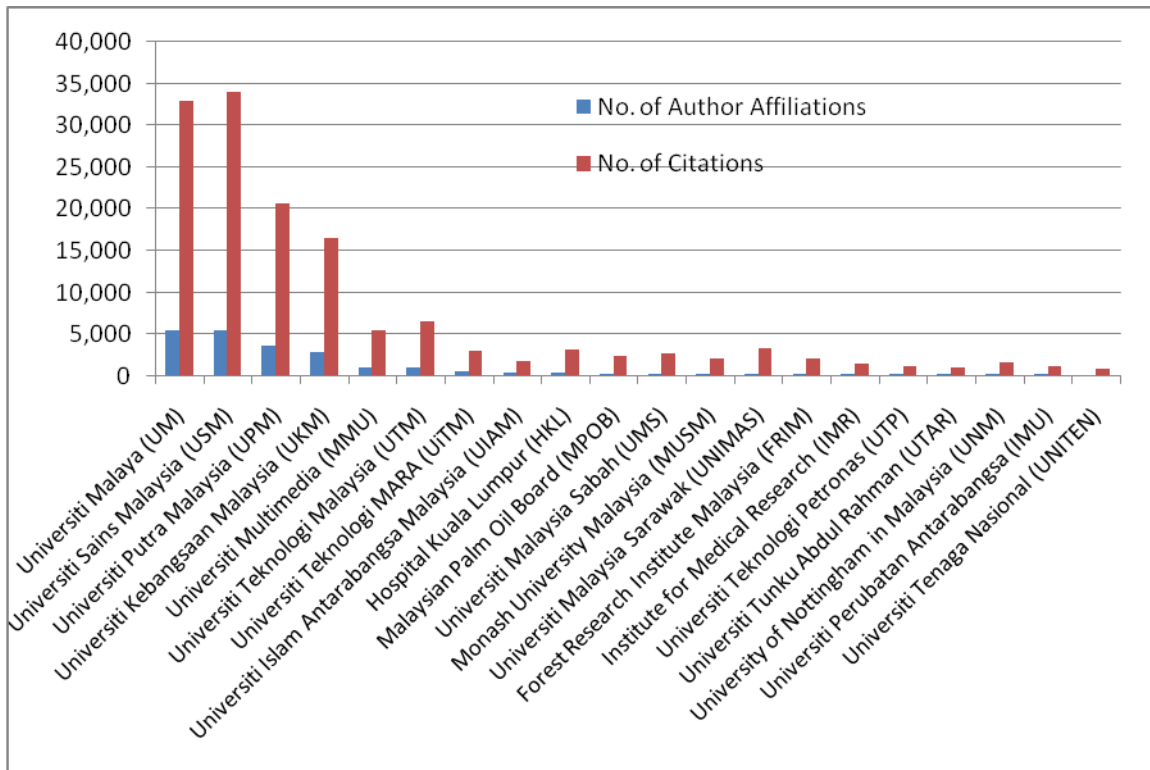


Figure 4: Top 20 Highly Productive Malaysian-based Institutions in the STM Fields, 2001-2010

For the fields of AHSS, the count excludes publications published in the *African Journal of Business Management* since the Ministry of Higher Education has decided to exclude this title from all their ranking exercises. The total number of author affiliations from the top 20 institutions is 1,181 and the total number of citations is 4,442. Similar to the STM fields, the research universities, UM (20.66%), USM (13.04%), UPM (11.77%), UKM (8.81%) are in the lead in terms of publications and citations. UNIMAS (3.64%) is placed in the eighth position together with UiTM (3.64%) and after UTM (3.13%, UMS (2.88%), University of Nottingham in Malaysia (2.79%) and UUM (2.54%).

UM has the most number of author affiliations in the AHSS publications (Table 7 and Figure 5). There is a big gap between the number of author affiliation for STM-based and AHSS-based publications. Taking UM as an example, the number of author affiliation for STM is 5,585 and for AHSS it is 244 with a difference of 5,341. The trend is similar for the rest of the institutions. In terms of number of citations to number of author affiliations, UM has the most number of citations to their publications.

Table 7: Top 20 Most Productive Malaysian-based Institutions in the AHSS Fields, 2001-2010

No.	Institution	No. of Author Affiliations	%	No. of Citations	%
1	Universiti Malaya (UM)	244	20.66	756	17.02
2	Universiti Sains Malaysia (USM)	154	13.04	521	11.73
3	Universiti Putra Malaysia (UPM)	139	11.77	520	11.71
4	Universiti Kebangsaan Malaysia (UKM)	104	8.81	528	11.89
5	Universiti Islam Antarabangsa Malaysia (UIAM)	77	6.52	258	5.81
6	Universiti Multimedia (MMU)	75	6.35	203	4.57
7	Monash University Malaysia (MUSM)	67	5.67	340	7.65
8	Universiti Malaysia Sarawak (UNIMAS)	43	3.64	215	4.84
9	Universiti Teknologi MARA (UiTM)	43	3.64	75	1.69
10	Universiti Teknologi Malaysia (UTM)	37	3.13	216	4.86
11	Universiti Malaysia Sabah (UMS)	34	2.88	198	4.46
12	University of Nottingham in Malaysia (UNM)	33	2.79	129	2.90
13	Universiti Utara Malaysia (UUM)	30	2.54	58	1.31
14	WorldFish Centre	23	1.95	180	4.05
15	Kolej Universiti HELP (HUC)	22	1.86	68	1.53
16	Universiti Tunku Abdul Rahman (UTAR)	18	1.52	38	0.86
17	Universiti Perubatan Antarabangsa (IMU)	14	1.19	42	0.95
18	AIMST University	8	0.68	10	0.23
19	Universiti Teknologi Petronas (UTP)	6	0.51	47	1.06
20	Inti International University & Colleges	5	0.42	34	0.77
20	Universiti Malaysia Pahang	5	0.42	6	0.14
	<b>Total</b>	<b>1,181</b>		<b>4,442</b>	

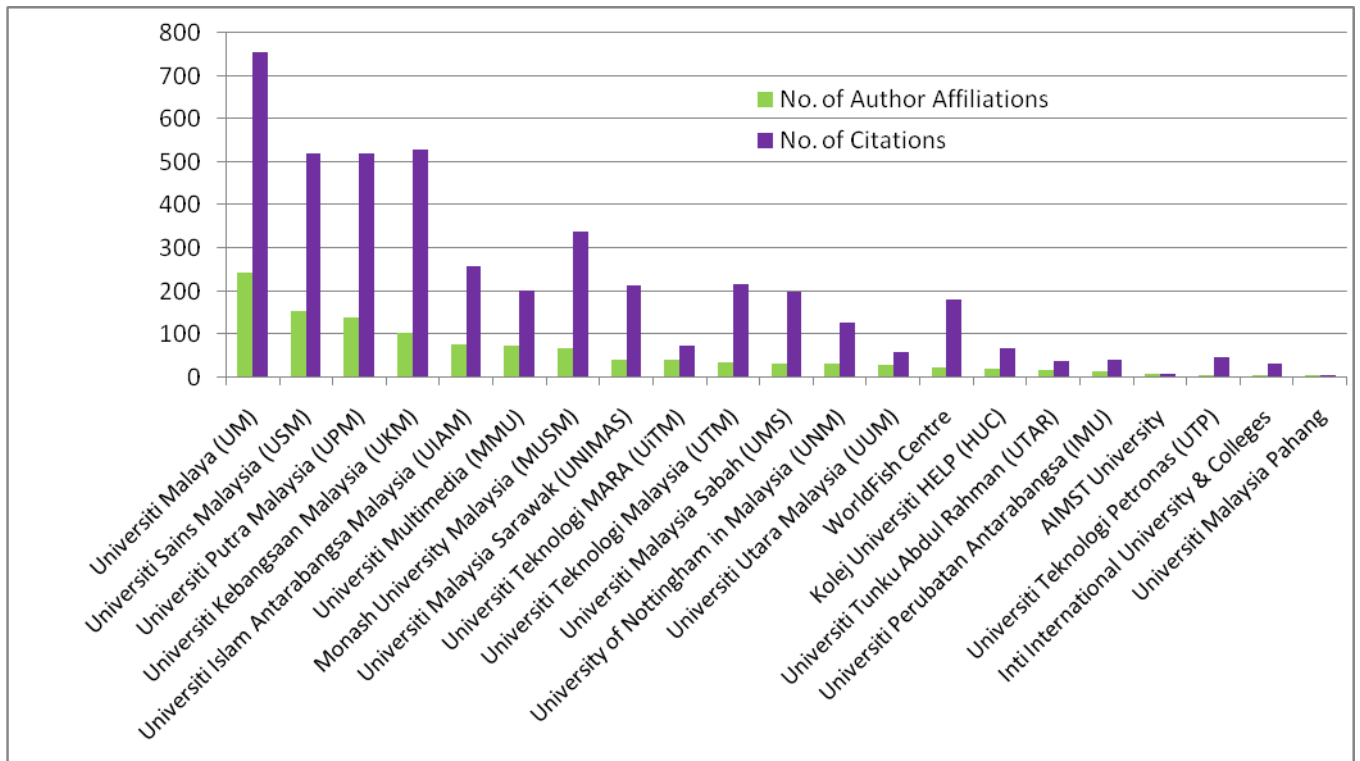


Figure 5: Top 20 Productive Malaysian-based Institutions in the AHSS Fields, 2001-2010

### 3.5. Most Productive Malaysian-based Authors by Broad Fields

The highest Malaysian scientific publication output came from the fields of Science (15,962, 55.05%), followed by Engineering (6,153, 21.22%) and Medicine (5,157, 17.79%) (Table 1). Therefore, it is expected that the number of very active authors similarly represents these subject fields. In the following sections the top 20 most active authors are listed based on the publication productivity within STM and AHSS fields.

#### 3.5.1. Science

Since the highest number of publications is from Science, one would expect that the most prolific and productive authors would similarly be from the Science field. For Science, as at 28<sup>th</sup> February 2012, the total number of publications in WoS by Malaysian-based authors between 2001 and 2010 stands at 15,963 comprising of 15,547 articles, 358 reviews and 58 letters. Nine of the top 20 authors are from USM, five from UM, three from UPM and two from UKM (Table 8). All these universities are research universities. The top author is Ng Seik Weng from UM with 1,496 articles and this is followed by Fun Hoong-Kun (USM, 1,460 articles). Interestingly, both authors are from the field of Chemistry specialising in Crystallography. Edward Richard Tom Tiekink (UM, 228 articles) and Ibrahim Abdul Razak (USM, 214 articles) are

placed third and fourth respectively. Harith Ahmad, from UM is listed fifth and he is the 2010 Merdeka Award recipient for Outstanding Scholastic Achievement and was honoured for his outstanding contribution in research and promoting the development of photonics in Malaysia. Three authors (Abdul Rahman Mohamed, Zainuriah Hassan and Madhukar Hemamalini) with the same number of publications are placed fifteenth. The author with the highest citation per publication is Abdul Rahman Mohamed from USM with only 96 papers which have been cited 1,129 times.

Table 8: Top 20 Most Productive Malaysian-based Authors in Science, 2001-2010

No.	Author	Institution	Record Count	Times Cited	Average Citations per Publication
1.	Ng, Seik Weng	UM	1,496	4,389	2.93
2.	Fun, Hoong-Kun	USM	1,460	6,125	4.2
3.	Edward Richard Tom Tiekink	UM	228	290	1.27
4.	Ibrahim Abdul Razak (213 out of 214 co-author with Fun HK)	USM	214	1,173	5.48
5.	Harith Ahmad	UM	203	1,190	5.86
6.	Bohari Mohd Yamin	UKM	184	785	4.27
7.	Hanafi Ismail	USM	178	1,666	9.36
8.	Anwar Usman (146 out of 146 co-author with Fun HK)	USM	146	936	6.41
9.	Hapipah Mohd Ali	UM	133	313	2.37
10.	Lo, Kong Mun (107 out of 124 co-author with Ng SW)	UM	126	162	1.29
11.	Mohd Adzir Mahdi	UPM	114	689	6.04
12.	Yaakob Che Man	UPM	113	1,000	8.85
13.	Ishak Hashim	UKM	101	1,094	10.83
14.	Yeap, Chin Sing (99 out of 99 co-author with Fun HK)	USM	99	122	1.23
15.	Abdul Rahman Mohamed	USM	96	1,129	11.76
15.	Zainuriah Hassan	USM	96	346	3.6
15.	Madhukar Hemamalini (96 out of 96 co-author with Fun HK)	USM	96	125	1.3
16.	Mahiran Basri	UPM	92	761	8.27
17.	Teoh, Siang Guan (76 out of 89 co-author with Fun HK)	USM	89	279	3.13

Table 8 also indicates the importance of research groups or teams, in helping to boost individual publications of each group members as the practice of including all members' names in any publication produced from the research group is the norm in the science fields. This situation also highlights the importance of the mentor-mentee relations between established professors with younger researchers in research groups. Five of the authors (Ibrahim Abdul Razak, Anwar Usman, Yeap Chin Sing, Madhukar Hemamalini and Teoh Siang Guan) from this list co-authored with Fun Hoong-Kun who is placed second. One author (Lo Kong Mun) co-authored with Ng Seik Weng who is placed first. This clearly indicates co-authorship as a prominent indicator of collaboration in academic science.

### 3.5.2. Engineering

With a total number of 6,199 publications as at 28<sup>th</sup> February 2012, the top 20 authors in the field of engineering is headed by Abdul Latif Ahmad from USM with 119 publications (Table 9). The total number of publications for this subject category consists of 6,061 articles, 118 reviews and 20 letters.

Authors from USM dominate with six being listed, followed by UKM with five authors, UM and UPM with three authors each and UTM, University of Nottingham Malaysia and MMU with one author each. Bassim H. Hameed from USM has the highest number of citations per publication with 1,990 citations to 73 publications. Sulaiman Wadi Harun from UM, who is placed sixth in this list co-authored significantly with Ahmad H or Harith Ahmad from the science discipline. This again reflects the importance of collaborations in the academic scientific disciplines and indicates that members who are systematically tied to strongly connected and well-established research groups may boost their individual scientific productivity.

Table 9: Top 20 Most Productive Malaysian-based Authors in Engineering, 2001-2010

	Author	Institution	Record Count	Times Cited	Average Citations per Publication
1.	Abdul Latif Ahmad	USM	119	1,802	15.14
2.	Subhash Bhatia	USM	102	1,146	11.24
3.	Abdul Rahman Mohamed	USM	92	840	9.13
4.	Ahmad Faris Ismail	UTM	91	1,255	13.79
5.	Hanafi Ismail	USM	82	819	9.99
6.	Sulaiman Wadi Harun (73 out of 74 co-author with Ahmad H)	UM	74	346	4.68
7.	Bassim H. Hameed	USM	73	1,990	27.26



	Author	Institution	Record Count	Times Cited	Average Citations per Publication
8.	Roslinda Nazar	UKM	61	557	9.13
9.	Lee, Keat Teong	USM	60	439	7.32
10.	Salit Mohd Sapuan	UPM	54	282	5.22
11.	Mohd Adzir Mahdi	UPM	51	219	4.29
12.	Foo, Dominic Chwan Yee	University of Nottingham, Malaysia	49	889	18.14
13.	Mandeep Singh Jit Singh	UKM	48	104	2.17
14.	Ishak Hashim	UKM	47	336	7.15
15.	Abdul Kariem Hj Mohd Arof	UM	46	151	3.28
16.	Anuar Ishak	UKM	45	316	7.02
16.	Wan Ramli Wan Daud (42 articles, 1 review, 2 letters)	UKM	45	240	5.33
17.	Masjuki Hj Hassan	UM	44	531	12.07
17.	Chuan, Hean Teik	MMU	44	158	3.59
17.	Haslan Abu Hassan	USM	44	61	1.39

### 3.5.3. Medicine

The total number of publications indexed in WoS for medicine is 5,258 as at 28<sup>th</sup> February 2012 with 4,601 articles, 251 reviews and 356 letters (Table 10). When compared to the other subject categories, Medicine has a larger number of letters as a form of scholarly communication. UM is represented by eight authors in the top 20 list, followed by UPM with seven, UKM and USM has two authors each and the Institute of Medical Research with one author.

The most productive author in Medicine is Srijit Das with 101 publications, followed by Goh Khean Lee (84 articles) and Adeeba Kamarulzaman (55 articles), both from UM. The highest number of citations is received by Goh Khean Lee with 1,326 citations accrued from his 84 publications getting an average of 15.79 citations per publications. Goh is the 2011 Merdeka Award recipient for Outstanding Scholastic Achievement and was honoured for his outstanding contribution in elevating the study and practice of gastroenterology and hepatology in Malaysia to global standards. Wong Kum Thong (ranked 17<sup>th</sup>) from UM has the most number of citations per publication with 376 citations to 31 papers.

Table 10: Top 20 Most Productive Malaysian-based Authors in Medicine, 2001-2010

No.	Author	Institution	No. of Publications	Times Cited	Average Citations per Publication
1.	Srijit Das (75 articles and 26 letters)	UKM	101	182	1.80
2.	Goh, Khean-Lee (79 articles and 5 letters)	UM	84	1,326	15.79
3.	Adeeba Kamarulzaman (52 articles and 3 letters)	UM	55	839	15.25
4.	Ng, Kwan Hoong (51 articles and 1 letters)	UM	52	144	2.77
5.	Yip, Cheng Har (44 articles and 4 letters)	UM	48	411	8.56
6.	Mohd Roslan Sulaiman	UPM	46	279	6.07
7.	Zainul Aminuddin Zakaria	UPM	43	247	5.74
8.	Tan, Chong Tin (39 articles and 4 letters)	UM	43	523	12.16
9.	Boo, Nem-Yun (33 articles and 5 letters)	UKM	38	223	5.87
10.	Lee, Han Lim	IMR	38	49	1.29
11.	Yuen, Kah-Hay	USM	37	497	13.43
12.	Nordin Hj Lajis	UPM	34	358	10.53
13.	Khatijah Yusoff	UPM	33	302	9.05
14.	Daud Ahmad Israf	UPM	33	323	9.79
15.	Low, Wah Yun	UM	33	169	5.12
16.	Tan, Peng Chiong	UM	32	159	4.97
17.	Wong, Kum Thong	UM	31	548	17.68
18.	Abdul Rahman Omar	UPM	30	180	6.00
19.	Tan, Chin Ping	UPM	29	376	12.97
20.	Naing, Nyi-Nyi	USM	29	88	3.03

### 3.5.4. Computer Sciences

A total of 1,013 publications are indexed in WoS as at 28<sup>th</sup> February 2012 comprising 1,003 articles, nine reviews and one letter. There are 25 authors listed as more than one author occupies the same position since they have the same number of publications (Table 12).

The most prolific author in this field is Andrew Teoh Beng Jin with 36 publications, a former MMU staff, who is now affiliated to Yonsei University.

Institutional-wise, MMU has the highest number of representative with nine authors, followed by UM with four, UKM, UPM, UTM and UTAR with two authors each and the rest (USM, UTM, UTHMN, Corentix Technology Sdn. Bhd and Asian Institute of Finance) have one author each. As in science, two authors (Alwyn Goh and Wee Chong-Yaw) co-authored substantially with two other authors (David Ngo Chek Ling and Paramesran Raveendran) in the list. Paramesran Raveendran from UM, whose areas of expertise are on image processing and computer vision, has the most number of citations per publication with 399 citations to 20 papers. Overall the numbers of publications produced by scientists in the ICT fields are low compared to the other STM fields, except Dentistry.

Table 11: Top 20 Most Productive Malaysian-based Authors in Computer Sciences, 2001-2010

No	Author	Institution	Record Count	Times Cited	Average Citations per Publication
1.	Teoh, Andrew Beng Jin (former MMU staff)	Yonsei Univ	36	370	10.28
2.	Lim, Chee Peng	USM	34	170	5.00
3.	Ngo, David Chek Ling (former MMU staff)	Sunway Uni. College	32	393	12.28
4.	Machavaram Venkata Chalapathy Rao	MMU	27	136	5.04
5.	Paramesran Raveendran	UM	20	399	19.95
6.	Loo, Chu-Kiong	MMU	17	49	2.88
7.	Goi, Bok-Min	MMU	14	88	6.29
7.	Aini Hussain	UKM	14	32	2.29
7.	Mohamed Othman	UPM	14	9	0.64
8.	Goh, Alwyn (10 papers co-author with Ngo DCL)	Corentix Technology S/ B	11	176	16
8.	Heng, Swee-Huay	MMU	11	108	9.82
9.	Pandian Vasant	UTP	10	40	4
10.	Azah Mohamed	UKM	9	23	2.56
10.	Ewe, Hong Tat	UTAR	9	17	1.89
11.	Wee, Chong-Yaw (all co-author with Parameswaran R)	UM	8	66	8.25
11.	Rajawaran Logeswaran	MMU	8	19	2.38
11.	Mustafa Mat Deris	UTHM	8	17	2.12
11.	Ho, Chin Kuan	MMU	8	15	1.88
11.	Marzuki Khalid	UTM	8	14	1.75
11.	Somnuk Phon-Amnuaisuk	MMU	8	11	1.38
11.	Zuwairie Ibrahim	UTM	8	10	1.25
11.	Mohd Ali Borhanuddin	UPM	8	7	0.88

### 3.5.5. Dentistry

The number of publications for Dentistry from Malaysian-based authors is the least when compared to the other STM fields. With a total of only 167 publications as at 28<sup>th</sup> February 2012, 156 of these are articles, five are reviews and six are letters (Table 12).

The highest number of publications comes from Wihaskoro Sosroseno from AIMST with 20 publications. The highest number of citations is received by Siar Chong Huat from UM with 262 citations showing an average of 16.38 citations per publication. Toh Chooi Gait from UM has the highest number of citations per publication with 153 citations to 7 papers. Authors from UM and USM populate the list with 13 authors from UM and five authors from USM. One other institution is UiTM with one author. Two of the authors from USM co-authored significantly with Wihaskoro Sosroseno indicating an active cross-institutional collaboration.

Table 12: Top 10 Most Productive Malaysian-based Authors in Dentistry, 2001-2010

No.	Author	Institution	Record Count	Times Cited	Average Citations per Publication
1.	Wihaskoro Sosroseno	AIMST	20	112	5.6
2.	Siar, Chong Huat	UM	16	262	16.38
3.	Ngeow, Wei Cheong (7 articles & 5 letters)	UM	12	22	1.83
4.	Rosnah Mohd Zain (8 articles & 1 letter)	UM	9	82	9.11
5.	Abdul Rani Samsudin	USM	9	27	3
6.	Ishak Abdul Razak	UM	8	22	2.75
7.	Toh, Chooi Gait	UM	7	153	21.86
8.	Nasruddin Jaafar	UM	6	13	2.17
9.	Norsiah Yunus	UM	5	28	5.6
9.	Mustafa Musa (5 out 5 co-author with Sosroseno W)	USM	5	23	4.6
9.	Manickam Ravichandran (4 out 5 co-author with Sosroseno W)	USM	5	21	4.2
10.	Hashim Yaacob	UM	4	82	20.5
10.	Cheong, Sok Ching (3 articles, 1 letter; 4 out of 4 co-author with Zain, RB)	UM	4	26	6.5

No.	Author	Institution	Record Count	Times Cited	Average Citations per Publication
10.	Abdul Aziz Abdul Razak	UM	4	22	5.5
10.	Chai, Wen Lin	UM	4	21	5.25
10.	M. Fikri Ibrahim (4 out 4 co-author with Sosroseno W)	USM	4	19	4.75
10.	Rashidah Esa	UM	4	17	4.25
10.	Ahmad Sukari Halim	USM	4	14	3.5
10.	Abu Hassan Mohamed Ibrahim	UiTM	4	13	3.25
10.	Mirza Rustum Baig	UM	4	5	1.25

### 3.5.6. Arts, Humanities and Social Sciences

The total number of publications indexed in WoS as at 28<sup>th</sup> February 2012 for this subject category is 711 with 677 articles, 12 reviews and 22 letters (Table 13). Publications from the *African Journal of Business Management* are excluded since the Ministry of Higher Education has decided to drop it from their journal listing for all their ranking exercises.

Only the top 10 authors are listed since the number of publications is less than 1,000. However, since there are numerous authors with same number of publications each, the list has more than ten authors in it. The top author is Ahmad Zubaidi Baharumshah who is affiliated to UPM with 22 publications.

The leading institution is UPM with seven authors, followed by USM with five authors, USM with four and UNIMAS and UTAR with two each. The rest of the institutions (UIAM, UMS, MMU, University of Nottingham Malaysia, Monash University Malaysia and Asian Institute of Finance) lists one author each. Ahmad Zubaidi Baharumshah (UPM) has the most number of citations but Venus Liew Khim-Sen (UNIMAS) has the highest number of citations per publication.

Table 13: Top 10 Most Productive Malaysian-based Authors in Arts, Humanities and Social Sciences for Publications Indexed, 2001-2010

No	Author	Institution	Record Count	Times Cited	Average Citations per Publication
1.	Ahmad Zubaidi Baharumshah	UPM	22	85	3.86
2.	Rajah Rasiah	UM	18	57	2.18

3.	Tang, Tuck Cheong	Monash University, Malaysia	17	62	3.65
4.	Zainab Awang Ngah	UM	13	28	2.15
5.	Liew, Venus Khim-Sen	UNIMAS	12	61	5.08
6.	Muzafar Shah Habibullah	UPM	9	32	3.56
7.	Noraini Mohd. Noor	UIAM	8	52	6.5
8.	Wong, Su Luan	UPM	8	48	6
8.	Mohamed Azali	UPM	8	24	3
8.	Chong, Siong Choy	Asian Institute of Finance	8	21	2.62
8.	Lau, Evan	UNIMAS	8	20	2.5
8.	Abrizah Abdullah	UM	8	13	1.62
8.	Law, Siong Hook	UPM	7	32	4.57
9.	Lean, Hooi Hooi	USM	7	30	4.29
9.	Lim, Kian-Ping	UMS	7	25	3.57
9.	Khoo, Michael Boon Chong	USM	7	18	2.57
9.	Lee, Chew Ging	University of Nottingham, Malaysia	7	4	0.57
9.	Ooi, Keng-Boon	UTAR	6	35	5.83
10.	Murali Sambasivan	UPM	6	30	5
10.	Mohammad Azmi Hassali	USM	6	13	2.17
10.	Fadzlan Sufian	UPM	6	12	2
10.	Lee, Raymond Lai Meng (former UM staff)	UM	6	7	1.17
10.	Saurabh Kumar Mukerji	MMU	6	6	1
10.	Suresh Narayanan	USM	6	3	0.5
10.	Raihanah Abdullah	UM	6	2	0.33
10.	Choong, Chee Keong	UTAR	6	1	0.17

### 3.5.7. Most Productive Authors by All Fields

The authors who have the highest number of publications indexed in WoS from 2001 to 2010 for each eight fields are shown in Table 14. The authors in the STM fields produced a higher number of publications indexed in WoS than the AHSS fields. However, when one looks at the ratio of times cited to the number of publications, the highest is from Engineering followed by Computer Science and Information Technology.

Table 14: Summary of the Most Prolific Malaysian-based Authors in All Fields, 2001-2010

Domain	Authors	Institutional Affiliation	No. of Publications	Times Cited	Average Citations per Publication
Science	Ng, Seik Weng	UM	1,496	4,389	2.93
Engineering	Abdul Latif Ahmad	USM	119	1,802	15.14
Medicine	Srijit Das	UKM	101	182	1.80
Computer Sciences	Teoh, Andrew Beng Jin	MMU	36	370	10.28
Dentistry	Wihaskoro Sosroseno	AIMST	20	112	5.60
Arts, Humanities and Social Sciences	Ahmad Zubaidi Baharumshah	UPM	22	85	3.86

### 3.5.8. Most Cited Malaysian Authors in all Fields

The authors who have the highest number of citations per publication indexed in WoS from 2001 to 2010 for each of the six fields are shown in Table 17. The authors in STM have a higher number of publications indexed in WoS than those in AHSS.

Table 15: Summary of the Most Cited Malaysian-based Authors by All Fields, 2001-2010

Domain	Authors	Institutional Affiliation	No. of Publications	Times Cited	Average Citations per Publication
Science	Abdul Rahman Mohamed	USM	96	1,129	11.79
Engineering	Bassim H. Hameed	USM	73	1,990	27.76
Medicine	Wong, Kum Thong	UM	31	548	17.68
Computer Sciences	Paramesran Raveendran	UM	7	153	21.86
Dentistry	Toh, Chooi Gait	UM	20	112	5.60
Arts, Humanities and Social Sciences	Liew, Venus Khim-Sen	UNIMAS	12	61	5.08

### 3.6. Most Cited Publications of Malaysia-based Authors by Broad Fields

The data on the most cited publications in all six fields allow us to track the performance of our Malaysian-based authors. The top 10 most cited publications for every field indirectly gives us a view of the research area that is conducted by Malaysian scientists that are of interest enough to trigger high citations. However, since WoS allows for one publication to be placed under a number of subject categories, one would expect an overlap in the fields especially for Science and Engineering. For this study, if a publication has appeared in one list, it will not appear in another.

### 3.6.1. Science

The highest number of citations to a publication in Science authored by a Malaysian is 327 citations and this particular publication takes the form of an article written by a group of scientists. In Science, all the top 10 most cited publications were multi or mega (more than 10) authored with the exception of two, and most of the co-authors are from abroad. The identity of the Malaysian authors involved is given in square bracket. The range of citations between the first and the tenth publication is 128. All the publications are articles published in international journals with two from the high-impact *Science* and the year of publication ranges from 2002 to 2008. The most cited publication was published in 2004.

Table 16: Top 10 Most Cited Publications in Science  
\* [Malaysian authors]

No.	Author(s) and Title	Source	Year of Publication	Sum of Times Cited
1.	Kannan K; Corsolini S; Falandysz J; et al. [Mustafa Ali Mohd] Perfluorooctanesulfonate and related fluorochemicals in human blood from several countries	ENVIRONMENTAL SCIENCE & TECHNOLOGY, 38 (17)	2004	327
2.	Bickford David; Lohman David J.; Sodhi Navjot S.; et al. [Indraneil Das] Cryptic species as a window on diversity and conservation	TRENDS IN ECOLOGY & EVOLUTION, 22 (3)	2007	325
3.	Chen H; Smith GJD; Li KS; et al. [S.S. Hassan] Establishment of multiple sublineages of H5N1 influenza virus in Asia: Implications for pandemic control	PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA, 103 (8)	2006	323
4.	Brudey Karine; Driscoll Jeffrey R.; Rigouts Leen; et al. [Cheong, Soonfatt] Mycobacterium tuberculosis complex genetic diversity: mining the fourth international spoligotyping database (SpolDB4) for classification, population genetics and epidemiology	BMC MICROBIOLOGY, 6 (23)	2006	284
5.	Macaulay V; Hill C; Achilli A; et al. [Adi Taha, Norazila Kassim Shaari, Joseph Maripa Raja, Patimah Ismail] Single, rapid coastal settlement of Asia revealed by analysis of complete mitochondrial genomes	SCIENCE, 308 (5724)	2005	260



6.	van Schaik CP; [Ancrenaz M]; Borgen G; et al. Orangutan cultures and the evolution of material culture	SCIENCE, 299 (5603)	2003	255
7.	[Gaya Umar Ibrahim; Abdullah Abdul Halim ] Heterogeneous photocatalytic degradation of organic contaminants over titanium dioxide: A review of fundamentals, progress and problems	JOURNAL OF PHOTOCHEMISTRY AND PHOTOBIOLOGY C- PHOTOCHEMISTRY REVIEWS, 9 (1)	2008	249
8.	Balasundram N; Sundram K; Samman S [Nagendran Balasundram, Kalyana Sundram] Phenolic compounds in plants and agri-industrial by-products: Antioxidant activity, occurrence, and potential uses	FOOD CHEMISTRY, 99 (1)	2006	206
9.	Pandi-Perumal S. R.; [Srinivasan V.]; Maestroni G. J. M.; et al. Melatonin - Nature's most versatile biological signal?	FEBS JOURNAL, 273 (13)	2006	204
10.	[Nasef MM]; Hegazy ESA Preparation and applications of ion exchange membranes by radiation-induced graft copolymerization of polar monomers onto non-polar films	PROGRESS IN POLYMER SCIENCE, 29 (6)	2004	199

### 3.6.2 Engineering

The most cited publication in Engineering has 201 citations. The gap between the first and the tenth is only 86. As expected, all publications are co-authored works and most co-authorship was with international authors. The publications were published from 2001 to 2008 and all source journals are international journals.

As a first named author, Ngah WSW or Ngah W.S.Wan has two publications in the top most cited publication in Engineering with 201 and 134 citations respectively. His most cited publication was published in 2002 and the other was published in 2008.

Table 17: Top 10 Most Cited Publications in Engineering  
\* [Malaysian authors]

No.	Author(s) and Title	Source	Year of Publication	Sum of Times Cited
1.	[Ngah WSW; Endud CS; Mayanar R] Removal of copper(II) ions from aqueous solution onto chitosan and cross-linked chitosan beads	REACTIVE & FUNCTIONAL POLYMERS, 50 (2)	2002	201

No.	Author(s) and Title	Source	Year of Publication	Sum of Times Cited
2.	Dighe PA; Mallik RK; [Jamuar SS] Analysis of transmit-receive diversity in Rayleigh fading	IEEE TRANSACTIONS ON COMMUNICATIONS, 51 (4)	2003	190
3.	Bikondoa O; Pang CL; Ithnin R; et al. [Roslinda Ithnin] Direct visualization of defect-mediated dissociation of water on TiO <sub>2</sub> (110)	NATURE MATERIALS, 5 (3)	2006	177
4.	[Ismail AF; David LIB] A review on the latest development of carbon membranes for gas separation	JOURNAL OF MEMBRANE SCIENCE, 193 (1)	2001	174
5.	[Ngah W. S. Wan; Hanafiah M A KM] Removal of heavy metal ions from wastewater by chemically modified plant wastes as adsorbents: A review	BIORESOURCE TECHNOLOGY, 99 (10)	2008	134
6.	[Saufi SM; Ismail AF] Fabrication of carbon membranes for gas separation - a review	CARBON , 42 (2)	2004	127
7.	Zakaria MP; Takada H; Tsutsumi S; et al. [Mohamad Pauzi Zakaria] Distribution of polycyclic aromatic hydrocarbons (PAHs) in rivers and estuaries in Malaysia: A widespread input of petrogenic PAHs	ENVIRONMENTAL SCIENCE & TECHNOLOGY, 36 (9)	2002	125
8.	[Manan ZA; Tan YL; Foo DCY] Targeting the minimum water flow rate using water cascade analysis technique	AIChE JOURNAL, 50 (12)	2004	123
9.	[Hashim MA]; Chu KH Biosorption of cadmium by brown, green, and red seaweeds	CHEMICAL ENGINEERING JOURNAL, 97 (2-3)	2004	119
10.	[Chuah TG; Jumasiah A; Azni I; Katayon S; Choong SYT] Rice husk as a potentially low-cost biosorbent for heavy metal and dye removal: an overview	DESALINATION, 175 (3)	2005	115

### 3.6.3. Computer Sciences

The most cited publication for Computer Sciences is a co-authored work with 157 citations made to it. The number of citations decreases rather rapidly when one moves from the first to the tenth publication with a range of 108. There is no Malaysian journal listed as a source journal and four of these are from the *IEEE Transactions* group. Mukadan R and Ong SH have two publications each in the list and two publications are single-authored. The year of publication ranges from 2001 to 2006.

Table 18: Top 10 Most Cited Publications in Computer Sciences  
\* [Malaysian authors]

No.	Author(s) and Title	Source	Year of Publication	Sum of Times Cited
1.	[Mukundan R; Ong SH; Lee PA] Image analysis by Tchebichef moments	IEEE TRANSACTIONS ON IMAGE PROCESSING, 10 (9)	2001	157
2.	[Yap PT; Paramesran R; Ong SH] Image analysis by Krawtchouk moments	IEEE TRANSACTIONS ON IMAGE PROCESSING, 12 (11)	2003	106
3.	[Zomaya AY; Teh YH] Observations on using genetic algorithms for dynamic load-balancing	IEEE TRANSACTIONS ON PARALLEL AND DISTRIBUTED SYSTEMS, 12 (9)	2001	89
4.	[Chong CW; Raveendran P]; Mukundan R A comparative analysis of algorithms for fast computation of Zernike moments	PATTERN RECOGNITION, 36 (3)	2003	87
5.	[Wong KY] Critical success factors for implementing knowledge management in small and medium enterprises	INDUSTRIAL MANAGEMENT & DATA SYSTEMS, 105 (3-4)	2005	84
6.	[Teoh Andrew B. J.; Goh Alwyn; Ngo David C. L.] Random multispace quantization as an analytic mechanism for BioHashing of biometric and random identity inputs	IEEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE , 28 (12)	2006	71
7.	[Connie T; Jin ATB; Ong MGK; Ling DNC] An automated palmprint recognition system	IMAGE AND VISION COMPUTING, 23 (5)	2005	66
8.	[Ahmad S]; Gromiha MM [Shandar Ahmad] NETASA: neural network based prediction of solvent accessibility	BIOINFORMATICS , 18 (6)	2002	59
9.	[Teo J] Exploring dynamic self-adaptive populations in differential evolution	SOFT COMPUTING , 10 (8)	2006	55
10.	Harding JA; Popplewell K; Fung RYK; [Omar AR] An intelligent information framework relating customer requirements and product characteristics	COMPUTERS IN INDUSTRY, 44 (1)	2001	49

### 3.6.4. Medicine

The most number of citations to any one publication in all six fields is from Medicine. An article in *Lancet*, which was published in 2004 garnered 1,067 citations. The gap between the publication placed first and second is 795. All

the publications listed in the top 10 most cited list are multi-authored works. Interestingly, an article by Weening JJ's group was published in two different journals but received nearly the same number of citations and is placed second and third in the top 10 list. None of the source journals are from Malaysia.

Table 19: Top 10 Most Cited Publications in Medicine  
\* [Malaysian authors]

No.	Author(s)and Title	Source	Year of Publication	Sum of Times Cited
1.	Barba C; Cavalli-Sforza T; Cutter J; et al. [Mohamed Ismail Noor] Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies	LANCET, 363 (9403)	2004	1,067
2.	Weening JJ; D'Agati VD; Schwartz MM; et al. [Kong NC; Looi LM] The classification of glomerulonephritis in systemic lupus erythematosus revisited	JOURNAL OF THE AMERICAN SOCIETY OF NEPHROLOGY, 15 (2)	2004	272
3.	Weening JJ; D'Agati VD; Schwartz MM; et al. [Kong NC; Looi LM] The classification of glomerulonephritis in systemic lupus erythematosus revisited	KIDNEY INTERNATIONAL, 65 (2)	2004	252
4.	Liaw YF; Leung N; Guan R; et al. [Merican I] Asian-Pacific consensus statement on the management of chronic hepatitis B: a 2005 update	LIVER INTERNATIONAL, 25 (3)	2005	212
5.	[Balasundram N; Sundram K]; Samman S Phenolic compounds in plants and agri-industrial by-products: Antioxidant activity, occurrence, and potential uses	FOOD CHEMISTRY, 99 (1)	2006	206
6.	[Singh B; Sung LK; Matusop A; Radhakrishnan A; Shamsul SSG; Cox-Sing J] et al. A large focus of naturally acquired Plasmodium knowlesi infections in human beings	LANCET, 363 (9414)	2004	187

No.	Author(s)and Title	Source	Year of Publication	Sum of Times Cited
7.	Marre M.; Shaw J.; Braendle M.; et al. [Bebakar WMW; Kamaruddin NA] Liraglutide, a once-daily human GLP-1 analogue, added to a sulphonylurea over 26 weeks produces greater improvements in glycaemic and weight control compared with adding rosiglitazone or placebo in subjects with Type 2 diabetes (LEAD-1 SU)	DIABETIC MEDICINE, 26 (3)	2009	176
8.	Lai CL; [Rosmawati M]; Lao J; et al. Entecavir is superior to lamivudine in reducing hepatitis B virus DNA in patients with chronic hepatitis B infection	GASTROENTEROLOGY , 123 (6)	2002	171
9.	[Chua KB; Koh CL; Hooi PS; Wee KF; Khong JH; Chua BH; Chan YP; Lim ME; Lam SK] Isolation of Nipah virus from Malaysian Island flying-foxes	MICROBES AND INFECTION, 4 (2)	2002	164
10.	Nicolosi A; Moreira ED; Shirai M; et al. [Tambi MIB] Epidemiology of erectile dysfunction in four countries: Cross-national study of the prevalence and correlates of erectile dysfunction	UROLOGY, 61 (1)	2003	153

### 3.6.5. Dentistry

Within the science-based fields, Dentistry has the smallest number of citations to their publications with the topmost having only 50 citations made to it. The range between the first and the tenth is 26 and all the publications were published between 2001 to 2008.

As in the other science-based fields, most of the publications are co-authored with only one publication from Zain RB being single-authored. Four publications are from Romanos GE, Toh CG, Siar CH and their team. Siar CH co-authored in another publication and therefore has five publications in the top 10 list. None of the source journals are from Malaysia.

Table 20: Top 10 Most Cited Publications in Dentistry  
\* [Malaysian authors]

No.	Author(s) and Title	Source	Year of Publication	Sum of Times Cited
1.	Romanos GE; [Toh CG; Siar CH; Swaminathan D; Ong AH] Histologic and histomorphometric evaluation of peri-implant bone subjected to immediate loading: An experimental study with <i>Macaca fascicularis</i>	INTERNATIONAL JOURNAL OF ORAL & MAXILLOFACIAL IMPLANTS, 17 (1)	2002	50
2.	Romanos G; [Toh CG; Siar CH; Swaminathan D; Ong AH; Yaacob H] et al. Peri-implant bone reactions to immediately loaded implants. An experimental study in monkeys	JOURNAL OF PERIODONTOLOGY, 72 (4)	2001	48
3.	[Zain RB] Cultural and dietary risk factors of oral cancer and precancer - a brief overview	ORAL ONCOLOGY, 37 (3)	2001	44
4.	[Isa ZM]; Schneider GB; Zaharias R; et al. Effects of fluoride-modified titanium surfaces on osteoblast proliferation and gene expression	INTERNATIONAL JOURNAL OF ORAL & MAXILLOFACIAL IMPLANTS, 21 (2)	2006	43
5.	[Ram S; Siar CH] Chemiluminescence as a diagnostic aid in the detection of oral cancer and potentially malignant epithelial lesions	INTERNATIONAL JOURNAL OF ORAL AND MAXILLOFACIAL SURGERY, 34 (5)	2005	35
6.	[Siar CH; Toh CG]; Romanos G; [Swaminathan D; Ong AH; Yaacob H]; et al. Peri-implant soft tissue integration of immediately loaded implants in posterior macaque mandible: A histomorphometric study	JOURNAL OF PERIODONTOLOGY, 74 (5)	2003	28
7.	Nash David A.; Friedman Jay W.; Kardos Thomas B.; et al. [Nasruddin J] Dental therapists: a global perspective	INTERNATIONAL DENTAL JOURNAL, 58 (2)	2008	28
8.	Gilthorpe MS; [Zamzuri AT]; Griffiths GS; et al. Unification of the "burst" and "linear" theories of periodontal disease progression: A multilevel manifestation of the same phenomenon	JOURNAL OF DENTAL RESEARCH , 82 (3)	2003	26
9.	Romanos GE; [Toh CG; Siar CH; Yaacob H]; et al. Bone-implant interface around titanium implants under different loading conditions: A histomorphometrical analysis in the <i>Macaca fascicularis</i> monkey	JOURNAL OF PERIODONTOLOGY, 74 (10)	2003	25
10.	Divaris K.; Barlow P. J.; Chendea S. A.; et al. [Cheong WS] The academic environment: the students' perspective	EUROPEAN JOURNAL OF DENTAL EDUCATION, 12	2008	24

### 3.6.6. Arts, Humanities and Social Sciences

When comparing the top 10 most cited publications for Arts, Humanities and Social Sciences with the science-based fields, the number of citations received by the publications are small. The top most cited publication has 86 citations made to it and the tenth in the list only has 51. Interestingly, four of these publications are from journals in Psychology with two of these from the *Journal of Cross-Cultural Psychology*.

Table 21: Top 10 Most Cited Publications in Arts, Humanities & Social Sciences  
\* [Malaysian authors]

No.	Author(s) and Title	Source	Year of Publication	Sum of Times Cited
1	[Pornpitakpan C.] The persuasiveness of source credibility: A critical review of five decades' evidence	JOURNAL OF APPLIED SOCIAL PSYCHOLOGY, 34 (2)	2004	86
2	Bond MH; Leung K; Au A; et al. [Odusanya JOT; Ahmed ZA; Ismail R] Culture-level dimensions of social axioms and their correlates across 41 cultures	JOURNAL OF CROSS-CULTURAL PSYCHOLOGY, 35 (5)	2004	74
3	Barker Graeme; Barton Huw; Bird Michael; et al. [Datan I] The 'human revolution' in lowland tropical Southeast Asia: the antiquity and behavior of anatomically modern humans at Niah Cave (Sarawak, Borneo)	JOURNAL OF HUMAN EVOLUTION, 52 (3)	2007	74
4	Wang Catherine L.; [Ahmed Pervaiz K.] Dynamic capabilities: A review and research agenda	INTERNATIONAL JOURNAL OF MANAGEMENT REVIEWS, 9 (1)	2007	61
5	[Hashim I.; Abdulaziz O.; Momani S.] Homotopy analysis method for fractional IVPs	COMMUNICATIONS IN NON-LINEAR SCIENCE AND NUMERICAL SIMULATION, 14 (3)	2009	59
6	Schmitt DP; Diniz G; Alcalay L; et al. [Jaafar, J] Patterns and universals of adult romantic attachment across 62 cultural regions - Are models of self and of other pancultural constructs?	JOURNAL OF CROSS-CULTURAL PSYCHOLOGY, 35 (4)	2004	54
7	Liu JH; Lawrence B; Ward C; et al. [Abraham S] Social representations of history in Malaysia and Singapore: On the relationship between national and ethnic identity	ASIAN JOURNAL OF SOCIAL PSYCHOLOGY, 5 (1)	2002	52
8	[Choong ST]; Cole MH; Kutanoglu E Empty container management for intermodal transportation networks	TRANSPORTATION RESEARCH PART E-LOGISTICS AND TRANSPORTATION REVIEW, 38 (6)	2002	52

No.	Author(s) and Title	Source	Year of Publication	Sum of Times Cited
9	Van Doorslaer Eddy; O'Donnell Owen; Rannan-Eliya Ravindra P.; et al. [Ng CW] Catastrophic payments for health care in Asia	HEALTH ECONOMICS, 16 (11)	2007	52
10	[Nor SM] Elevational diversity patterns of small mammals on Mount Kinabalu, Sabah, Malaysia	GLOBAL ECOLOGY AND BIOGEOGRAPHY, 10 (1)	2001	51

### 3.6.7. Most Cited Publication in all Fields

Table 20 indicates that the science-based fields have the most number of citations to their publications with medicine in the lead.

Table 22: Most Cited publications in all Fields

Domain	Author(s), Title and Source	Year of Publication	Sum of Times Cited
<b>Science</b>	Kannan K; Corsolini S; Falandysz J; et al. [Mustafa Ali Mohd] Perfluorooctanesulfonate and related fluorochemicals in human blood from several countries ENVIRONMENTAL SCIENCE & TECHNOLOGY, 38 (17)	2004	327
<b>Engineering</b>	[Ngah WSW; Endud CS; Mayanar R] Removal of copper(II) ions from aqueous solution onto chitosan and cross-linked chitosan beads REACTIVE & FUNCTIONAL POLYMERS, 50 (2)	2002	201
<b>Information and Communications Technology</b>	[Mukundan R; Ong SH; Lee PA] Image analysis by Tchebichef moments IEEE TRANSACTIONS ON IMAGE PROCESSING, 10 (9)	2001	157
<b>Medicine</b>	Barba C; Cavalli-Sforza T; Cutter J; et al [Mohamed Ismail Noor] Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies LANCET, 363 (9403)	2004	1067
<b>Dentistry</b>	Romanos GE; [Toh CG; Siar CH; Swaminathan D; Ong AH] Histologic and histomorphometric evaluation of peri-implant bone subjected to immediate loading: An experimental study with Macaca fascicularis INTERNATIONAL JOURNAL OF ORAL & MAXILLOFACIAL IMPLANTS, 17 (1)	2002	50
<b>Arts, Humanities and Social Sciences</b>	[Pornpitakpan C.] The persuasiveness of source credibility: A critical review of five decades' evidence . JOURNAL OF APPLIED SOCIAL PSYCHOLOGY, 34 (2)	2004	86



# 4. Summary of Findings

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The data set retrieved from the Web of Science for this study comprises 24,377 publications published between 2001 and 2010 from Malaysian based authors affiliated to various institutions. To facilitate reporting the data are mapped into six broad field groupings based on disciplines offered by most faculties in Malaysian Universities. The six fields are Science, Medicine, Engineering, Dentistry, Computer Sciences and Arts, Humanities and Social Sciences. This is done to ensure that the performance in all broad fields is fairly reported. The results of the study are summarized as follows.

- a) Overall out of the 24,297 Malaysian publications indexed in Wos from 2001 and 2010, the major contributors are from the Science (53.96%), followed by Engineering (20.80%), Medicine (17.43%), Arts, Humanities and Social Sciences (4.10%) and Computer Sciences (3.15%). The contribution from Dentistry is small (0.55%).
- b) Out of the total 165,850 citations received by Malaysian publications between 2001 and 2010, the highest came from Science (53.95%), Medicine (20.51%), Engineering (20.00%), Arts, Humanities and Social Sciences (2.63%) and Computer Sciences (2.44%). The citations received by publications in Dentistry are small (0.47%).
- c) Overall, there is a decline of average citations per year for all fields of research and the dip is especially obvious between the last five years. The low average citations received in the Arts, Humanities and the Social Science fields as well as in Computer Sciences may be field dependence. Studies on information seeking behaviour indicate that researchers in the AHSS fields mainly cite books (Zainab & Goi, 1997) and those in Computer Sciences tend to cite conference proceedings (Yip, 2009). The results also indicate that citations were higher for items in the earlier years (2001-2005) which may infer that the early publications seems to have higher influence and therefore were cited more.
- d) The research-designated public universities (UM, USM, UPM, UKM and UTM) lead in total publication output and times cited. Universiti Malaya leads in terms of publication output (16.16% of total), followed by Universiti Sains Malaysia (which outnumber UM in terms of times cited). This high contribution by the research universities may be attributed to substantial allocation of grants by the government to enabled and stimulate research activities. This may also be due to endorsement by the Malaysian government to the recruitment of full time equivalent researchers both from Malaysia and from abroad to

help accelerate research performance and this seems to bear fruit in view of the increasing cumulative publication output from 2006 onwards. It is evident that there is an increase in the number of private universities and colleges as well as an increase in the publication output from foreign universities with Malaysian campuses, such as Monash University Malaysia, University of Nottingham Malaysia, Swinburne University of Technology, Sarawak and Curtin University of Technology, Sarawak.

- e) The productive authors especially in the STM fields seem to sustain their productivity due to research group support. Group members mutual cite each other's works and this help boost citation counts. Individual publications productivity of group members also increase as the practice of including all members' names in any publication produced from the research group is the norm in the STM fields. This situation also highlights the importance of the mentor-mentee relations between established professors with younger researchers in research group.
- f) The total publication and citations generated by top authors in all six fields are generally higher in the STM fields compared to the AHSS fields.
- g) The top authors in terms of publication output in WoS are Ng Seik Weng from UM in Science, Abdul Latif Ahmad from USM in Engineering, Srijit Das from from UKM in Medicine, Andrew Teoh Beng Jin from MMU in Computer Sciences, Wihaskoro Sosroseno from AIMST and Ahmad Zubaidi Baharumshah from UPM in the Art, Humanities and Social Sciences.
- h) The authors with the highest number of citations per publication in WoS are Abdul Rahman Mohamed from USM in Science, Bassim H Hameed from USM in Engineering, Wong Kum Thong from UM in Medicine, Paramesran Raveendran from UM in Computer Sciences, Toh Chooi Gait from UM in Dentistry and finally Venus Liew Kim Sen from UNIMAS in Arts, Humanities and Social Sciences.
- i) Citations to the top 10 publications in all the fields are low with the exception of Medicine.
- j) The most cited paper by a Malaysian-based author is in the field of Medicine. The paper is a co-authored paper published in *Lancet* in 2004.
- k) The publications cited are older publications which were published five years ago.

# 5. Limitations

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A number of caveats need to be noted regarding the present study. The main limitations are expressed as follows:

1. We used WoS for including Malaysian publications from 2001 to 2010 in the study. Articles published in non WoS-cited publications were not included, although they contribute to scientific production. The choice of a specific database for scientific performance, will inevitably favor publications from specific subject disciplines such as STM, while being less favorable to other disciplines, such as AHSS.
2. Publication productivity of top authors are reported only once in his specialised field from the six broad fields, namely Sciences, Engineering, Medicine, Computer Sciences, Dentistry and Arts, Humanities and Social Sciences. Some authors published in journals categorized under their specific fields as well as fields in other categories. For example, Harith Ahmad specialises in photonics and publishes in the Science-based publications listed in the Science field. However, his research also crosses over to Engineering field. Therefore, he should appear in the top 20 list for both fields but we choose his specialised field i.e. Science. The same applies to Sulaiman Wadi Harun, who co-authored 73 out of 74 papers with Harith Ahmad. Sulaiman is reported in the Engineering list, which is his specialised field.
3. Publications in WoS are categorised in 22 specific fields, however this study grouped the publications into six broad fields and each publication is reported under only one field. For example, Asian Pacific Journal of Cancer Prevention is listed under Oncology & Oncology is placed under Medicine. We have identified that there are researchers in Dentistry who publish their papers on oral cancer in this journal, and that their publications are captured under Medicine. This might explain why the numbers of publications in pure Dentistry for these researchers are low.
4. This study attributes the same status to all institutions listed in the address field of each publication regardless of primary authorship or total number of authors. We did not use proportional or fractional attribution methods and highlight institutional impact. For example, an article with the primary author and nine authors from Universiti Malaya and one author from Universiti Sains Malaysia treated both universities the same in the article and citation counts.

5. This study exercises due diligence in capturing all possible variant names for authors and link the authors to their affiliated institutions. Naming convention has to be addressed carefully especially for Malay names, as well as for Chinese and Indians with Christian first names. The naming convention is a problem when data mining in WoS and we try to be as exhaustive as possible but we may miss certain names. There are also publications by Malaysian authors that do not carry the name of a Malaysian institution as their affiliated institution, especially for those who are studying, on sabbatical leave or on secondment abroad. This is a possible occurrence where data on publication productivity can be missed. University of Malaya Library (UML) has issued an email advising our academics to use a consistent name as well as their affiliation throughout their writing career.
  
6. In this study, publication and citation-based indicators were applied with the intention to provide with an overview of Malaysia's research publication productivity. As there are no all-purpose indicators, this study was limited to a condensed overview of international visibility as opposed to an exhaustive evaluation of specific national and regional scholarly communication system. In this study, publication and citation indicators are only appropriate for that part of the system that concerns scholarly communication and, thus, the total contribution of national and regional enterprises to the system is not mapped. For instance, it would be misleading to use these indicators alone if the purpose was to map the output of industrial research and technology development, as patents play an important role in that context. Furthermore, the use of global aggregate data (as opposed to national aggregate data) when constructing performance indicators limits the range of interpretation of findings to the national political context of research.

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# 7. Subject Categories

## Subject Categories Used

WoS identifies a wide spectrum of subject categories within its database. In order to standardise the analysis of publications, the subject categories were regrouped to reflect the faculties which are in place at the various Malaysian public universities. A total of six broad subject categories were identified and the various subject categories in WoS were mapped into the broad field categories.

Canadian  
Literature, British Isles  
Management  
Music  
Operations research & management science  
Philosophy  
Planning & development  
Political science  
Psychology  
Psychology, Applied  
Psychology, Developmental  
Psychology, Educational  
Psychology, Experimental  
Psychology, Mathematical  
Psychology, Multidisciplinary  
Psychology, Social  
Public administration  
Religion  
Social sciences, Interdisciplinary  
Social sciences, Mathematical methods  
Social work  
Sociology  
Theater  
Urban studies  
Women's studies

No.	Broad Fields	Subject Categories in WoS
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1.	<b>Arts, Humanities &amp; Social Sciences</b>	Agricultural economics & policy
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1.	<b>Arts, Humanities &amp; Social Sciences</b>	Agricultural economics & policy
		Anthropology
		Archaeology
		Area studies
		Art
		Asian studies
		Behavioral sciences
		Business
		Business, Finance
		Communication
		Demography
		Economics
		Education & educational research
		Education, scientific disciplines
		Education, special
		Ethics
		Ethnic studies
		Family studies
		Film, radio, television
		Folklore
		Geography
		Geography, physical
		History
		History & philosophy of science
		History of social sciences
		Hospitality, leisure, sport & tourism
		Humanities, multidisciplinary
		Industrial relations & labor
		Information science & library science
		International relations
Language & linguistics		
Law		
Linguistics		
Literary reviews		
Literary theory & criticism		
Literature		
Literature, African, Australian,		

2.	<b>Computer Sciences</b>	Computer science, Artificial intelligence
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2.	<b>Computer Sciences</b>	Computer science, Artificial intelligence
		Computer science, Cybernetics
		Computer science, Hardware & architecture
		Computer science, Information systems
		Computer science, Interdisciplinary applications
		Computer science, Software engineering
		Computer science, Theory & methods

3.	<b>Dentistry</b>	Dentistry, oral surgery & oral medicine
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3.	<b>Dentistry</b>	Dentistry, oral surgery & oral medicine
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4.	<b>Engineering</b>	Architecture
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4.	<b>Engineering</b>	Architecture
		Agricultural engineering
		Automation & control systems
		Construction & building technology
		Engineering, Aerospace
		Engineering, Biomedical
		Engineering, Chemical
		Engineering, Civil
		Engineering, Electrical & electronic
		Engineering, Environmental
Engineering, Geological		
Engineering, Industrial		
Engineering, Manufacturing		
Engineering, Marine		

Engineering, Mechanical  
 Engineering, Multidisciplinary  
 Engineering, Ocean  
 Engineering, Petroleum  
 Materials science, Biomaterials  
 Materials science, Ceramics  
 Materials science, Characterization & testing  
 Materials science, Coatings & films  
 Materials science, Composites  
 Materials science, Multidisciplinary  
 Materials science, Paper & wood  
 Materials science, Textiles  
 Mechanics  
 Metallurgy & metallurgical engineering  
 Mining & mineral processing  
 Robotics  
 Telecommunications  
 Transportation

## 5. Medicine

Allergy  
 Anatomy & morphology  
 Andrology  
 Anesthesiology  
 Cardiac & cardiovascular systems  
 Clinical neurology  
 Critical care medicine  
 Dermatology  
 Emergency medicine  
 Endocrinology & metabolism  
 Gastroenterology & hepatology  
 Geriatrics & gerontology  
 Gerontology  
 Health care sciences & services  
 Health policy & services  
 Hematology  
 Imaging science & photographic technology  
 Immunology  
 Infectious diseases  
 Integrative & complementary medicine  
 Medical ethics  
 Medical informatics  
 Medical laboratory technology  
 Medicine, General & internal  
 Medicine, Legal  
 Medicine, Research & experimental  
 Neuroimaging  
 Neurosciences  
 Nursing  
 Nutrition & dietetics  
 Obstetrics & gynecology  
 Oncology  
 Ophthalmology  
 Orthopedics  
 Otorhinolaryngology  
 Parasitology  
 Pathology  
 Pediatrics  
 Peripheral vascular disease  
 Pharmacology & pharmacy  
 Physiology  
 Primary health care  
 Psychiatry

## 6. Science

Psychology, Clinical  
 Public, environmental & occupational health  
 Radiology, nuclear medicine & medical imaging  
 Rehabilitation  
 Respiratory system  
 Rheumatology  
 Social sciences, Biomedical  
 Substance abuse  
 Surgery  
 Toxicology  
 Transplantation  
 Tropical medicine  
 Urology & nephrology  
 Virology

Acoustics  
 Agriculture, dairy & animal science  
 Agriculture, Multidisciplinary  
 Agronomy  
 Astronomy & astrophysics  
 Biochemical research methods  
 Biochemistry & molecular biology  
 Biodiversity conservation  
 Biology  
 Biophysics  
 Biotechnology & applied microbiology  
 Cell & tissue engineering  
 Cell biology  
 Chemistry, Analytical  
 Chemistry, Applied  
 Chemistry, Inorganic & nuclear  
 Chemistry, Medicinal  
 Chemistry, Multidisciplinary  
 Chemistry, Organic  
 Chemistry, Physical  
 Crystallography  
 Developmental biology  
 Ecology  
 Electrochemistry  
 Energy & fuels  
 Entomology  
 Environmental sciences  
 Environmental studies  
 Ergonomics  
 Evolutionary biology  
 Fisheries  
 Food science & technology  
 Forestry  
 Genetics & heredity  
 Geochemistry & geophysics  
 Geology  
 Geosciences, Multidisciplinary  
 Horticulture  
 Instruments & instrumentation  
 Limnology  
 Marine & freshwater biology  
 Mathematical & computational biology  
 Mathematics  
 Mathematics, Applied  
 Mathematics, Interdisciplinary applications  
 Meteorology & atmospheric sciences



Microbiology  
Microscopy  
Mineralogy  
Multidisciplinary sciences  
Mycology  
Nanoscience & nanotechnology  
Nuclear science & technology  
Oceanography  
Optics  
Ornithology  
Paleontology  
Physics, Applied  
Physics, atomic, molecular &  
chemical  
Physics, Condensed matter  
Physics, fluids & plasmas  
Physics, Mathematical  
Physics, Multidisciplinary  
Physics, Nuclear  
Physics, Particles & fields  
Plant sciences  
Polymer science  
Psychology, biological  
Remote sensing  
Reproductive biology  
Soil science  
Spectroscopy  
Sport sciences  
Statistics & probability  
Thermodynamics  
Transportation science & technology  
Veterinary sciences  
Water resources  
Zoology

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