العلـــوم المتقدمـــة
ADVANCED SCIENCES

United Arab Emirates

A DECADE OF SCIENCE

THE STATE OF RESEARCH IN THE UNITED ARAB EMIRATES

ELSEVIER

العلـــوم المتقدمـة
ADVANCED SCIENCES

United Arab Emirates

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EXECUTIVE SUMMARY

This report gives a snapshot of the research ecosystem in the UAE from different viewpoints, in comparison with selected countries. It looks at the last 10 years (2008-2017) to understand the direction of change in various areas. The findings of this report can provide the policy makers and research managers in the country to shape their future strategies for research and as such can also serve as a baseline for future research assessments.

The main body of the report provides the overview and the detailed breakdowns are presented in the appendices to keep the integrity of the main report.

While the public data is limited to only 2014-2016, the investment of UAE into R&D has been increasing, reaching 1% of its GDP in 2016. The investment seems to pay off- the scholarly output of UAE had a compound annual growth rate of 14% in the period of analysis and publication numbers doubled from the first five years to the second. The increase in output is accompanied by quality as well. The field-weighted citation impact (FWCI) and share of outputs in World's top 10% most cited publications are commonly accepted indicators of scholarly impact. While the average FWCI of the UAE was below the global average in 2008-2012, this has increased to 1.13 in the 2013-2017 period, which means that on average, the publications from UAE have 16% more impact than the world average.

There are of course differences in the output and impact of scholarly output. A very large share of UAE publications are in the field of Naturel Sciences (65%) followed by Engineering and Technology (35%) and the impact in these fields, particularly in the latter are high. Social Sciences and Humanities are the two fields that had the slowest growth.

The nature of publications are changing as well- while the first period of analysis indicates a large growth of publications in applied technology, the second period is marked by a high growth of publications in basic science. For developing nations this is a common trend where the initial periods are marked by application and capacity development leads to production of more frontier research in the latter phases. The increase in the publications in basic science could be indicative of the UAE increasing its capacity in conducting more fundamental research.

It is well documented by data that international collaboration in research generally leads to higher quality output. This is no different for the case of UAE where internationally collaborated publications have considerably more scholarly impact. There is a positive news story for the UAE- the share of publications with international collaboration increased from over 56% in the first period to over 64% in the second period. It should be added that since publications with more than 100 authors were excluded from the analyses, the international collaboration numbers point to more targeted ones that go beyond the large global studies.

The share of academic-corporate publications is more limited and declined from the first period to the next, although the absolute numbers grew quite considerably with a rate of over 14%. Although they constitute a rather small share of overall publications, corporate collaboration leads to visibly more impact in UAE should therefore be supported. Two regional entities- ADCO and Hamad Medical Corporation were the top corporate collaborator in both periods in terms of joint output. The composition of partners have changed throughout the period and a concentration on oil & gas sector is visible for the second period.

Finally, the topics of prominence analysis gives a good indicator of whether the UAE is publishing in the topics that have the highest momentum globally. Over half of the top 20 topics in which UAE published most in have a prominence percentile over 90, indicating that the UAE is publishing in topics that are having a high momentum. Distillation and desalination; networks (circuits) and design and hardware and integrated circuits are some of the prominent topics where UAE produces   high quality publications.
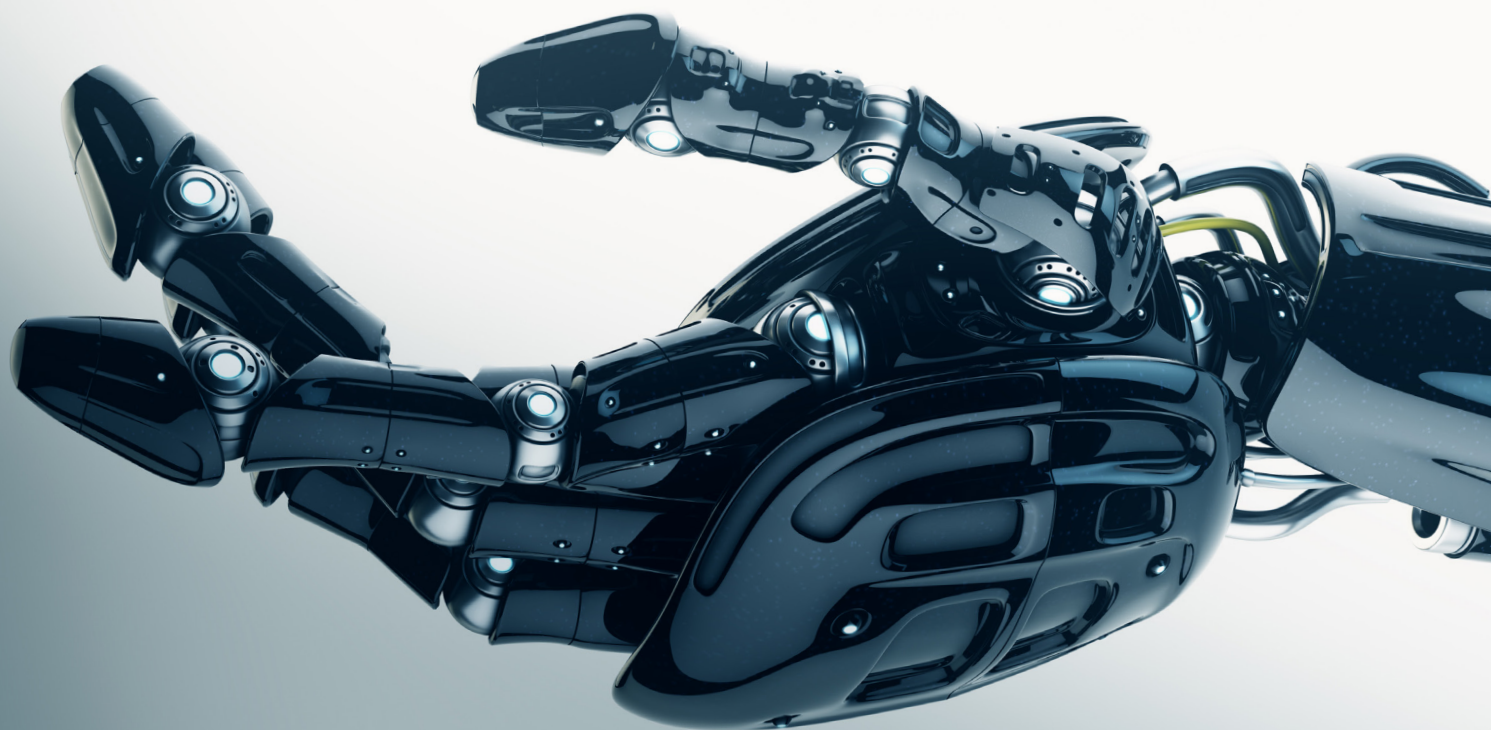
INTRODUCTION

This report has been commissioned by the United Arab Emirates Ministry of State for Advanced Sciences (MOSAF) to undertake an evidence-based assessment of the performance of UAE's Scientific Research Base compared with other selected nations. While the report was commissioned by MOSAF, the report has been independently produced by Elsevier without any interference from the ministry.

The report presents a multifaceted view of UAE's research performance through analyses based on several indicators. The aim of the comparative analyses is not to rank UAE, but to set a context that would enable to make policy decision in steering the country towards desired aims by providing insights.

The formal and systematic dissemination of original and innovative research leads to the furtherance of knowledge. Scholarly communication in the form of research outputs has long been a key academic measure of assessment and evaluation, and can be defined in many ways, including articles in journals, books and monographs, as well as non-textual media such as music and art. In this report, the focus is on the publication of research findings in journals, as the analysis of journal articles can provide useful insight into the comparative performance of a country's research base - though journal article and citation-based indicators capture the research performance better in some fields than in others.

Another point that should be noted is that the analyses presented in this chapter and the rest of the report consider citation impact, which is an important proxy indicator for scholarly impact. This indicator has been long established in the field of bibliometrics and allows for a consistent comparison among different entities and for trends analyses. Nevertheless, we do acknowledge that citations measures are only a part of the picture and constitutes only part of impact resulting from research. The indicators presented in this report should be supplemented by qualitative insights whenever possible.

The last years have showed the volatility of oil prices and the adverse effects the prices may have on economies reliant on oil and gas. The importance of the global trends around investment in science, technology and innovation becomes more apparent in such incidents. The UAE government has long seen the importance of investing into a knowledge base as evidenced by the launch of the UAE Vision 2021 among others initiatives.

One of the six national priorities under the Vision 2021 is a "first-rate education system" and a "competitive knowledge economy". Indeed, the last decade saw more than trebling of the UAE scientific output and citation impact changing from below the global average to above. In order to keep this upward momentum going, it is essential for UAE to monitor its progress and undertake strategic R&D decisions.
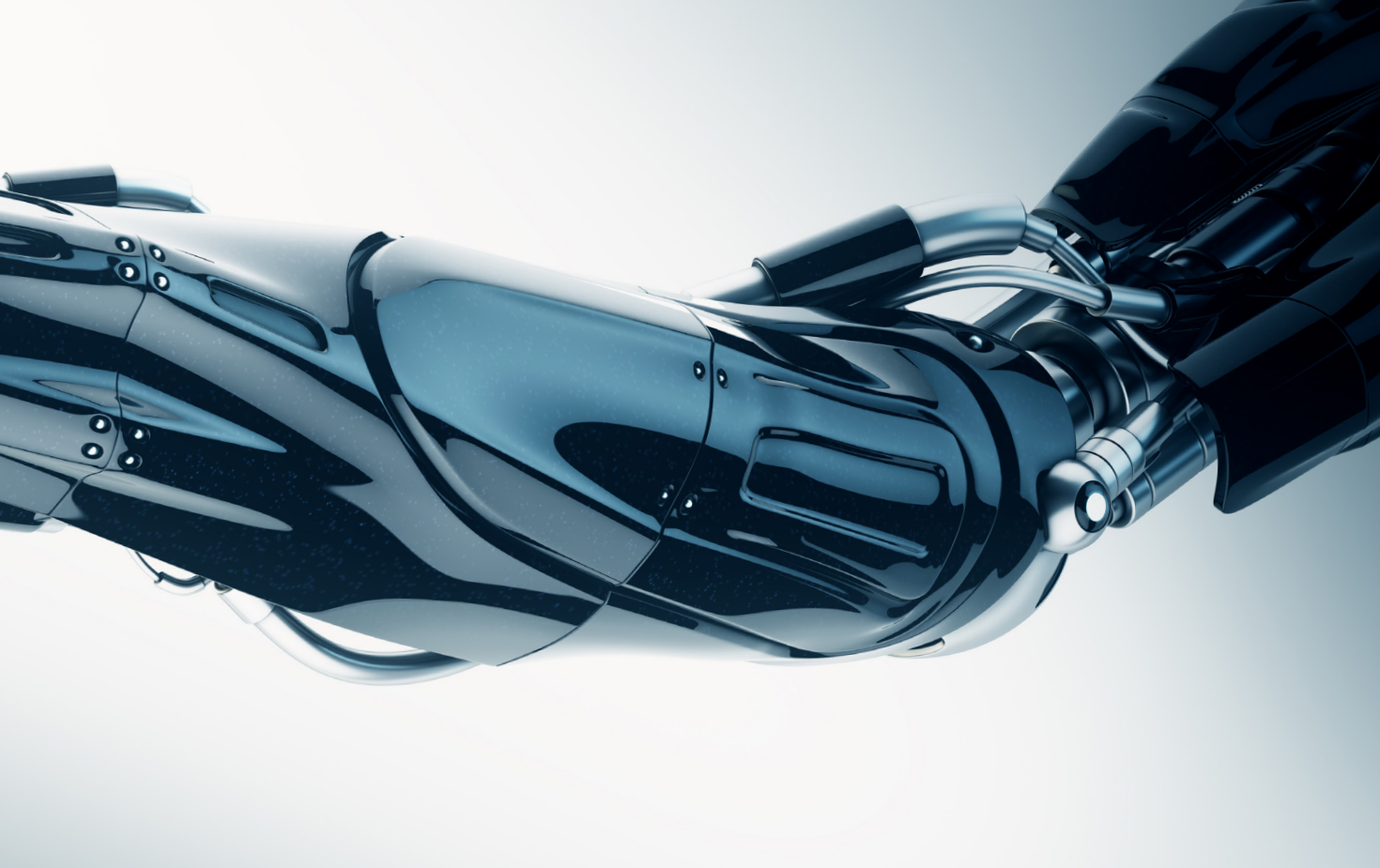
DATA SOURCES

The majority of the data presented in this report are derived from Scopus (bibliometric data)

PERIOD OF STUDY

The majority of this report analyses the 2008-2017 period. At the time this report was commissioned the latest complete data set available for publications and associated data was for 2017. Throughout the report the total period is divided into two: the first period (P1) covering 2008-12 and second period (P2) covering 2013-17 to track changes from one period to the other.

COMPARATORS

In this report, the UAE is compared with the following selected countries: Ireland, New Zealand, Saudi Arabia, Singapore, and Switzerland. These countries were selected according to a number of criteria such as population, size of the economy, and scholarly output to ensure that the benchmarking exercise had meaningful comparatives.

PUBLICATION TYPES

Three types of documents are included as publications in this report: articles, review articles and conference proceedings.

Throughout this report publications with more than 100 authors have been excluded. This is not because these publications are not important but large studies, like CERN or the Global Burden of Disease among others, receive and extraordinary amount of citations, which can distort the statistics, particularly for smaller groups, whether these are nations or subject areas. In order to minimise this effect it was decided to not include these publications in the analyses in this report. Unless stated otherwise, all analyses in this report exclude publications with more than 100 authors (hypercollaboration) and the reasons for this are further explained in Chapter 1.

SUBJECT CLASSIFICATIONS

The subject classification used in this report is are the six areas as defined by the OECD Fields of Science:

1. Natural Sciences
2. Engineering and Technology
3. Medical and Health Sciences
4. Agricultural Sciences
5. Social Sciences
6. Humanities

All publications in Scopus are tagged with one or more subject areas, based upon the journal they're published in. Journals can be assigned to more than one subject area and therefore the publication shares in subject areas do not add up to 100%.

1. OUTPUT AND IMPACT

In this chapter, we analyse UAE's scholarly output, impact, and excellence against five comparator countries. We review research performance data for 2008 – 2017 overall and per subject to uncover UAE's relative strengths and potential areas for improvement.

KEY HIGHLIGHTS

SCHOLARLY OUTPUT 2008-2012

11,268

SCHOLARLY OUTPUT 2013-2017

21,473

GROWTH 2008-2017

14%

CAGR FOR THE PERIOD

GROWTH FROM P1 TO P2

91%

INCREASE IN THE NUMBER OF PUBLICATIONS FROM P1 TO P2.

TOP SUBJECT AREA BY OUTPUT

NATURAL SCIENCES

TOP SUBJECT AREA BY CITATION IMPACT

ENGINEERING AND TECHNOLOGY

1.1 UAE'S SCHOLARLY OUTPUT AND CITATION IMPACT HAS BEEN INCREASING

The formal and systematic dissemination of original and innovative research leads to the furtherance of knowledge. Scholarly communication in the form of research outputs has long been a key academic measure of accomplishments and can be defined in many ways, including journal articles, conference papers, reviews, books, and monographs, as well as non-textual media such as music and art. In this report, the focus is on the publication of research findings in journal articles, conference papers, and reviews. The analysis of these output types can provide useful insight into the comparative performance of a country's research base - though journal article and citation-based indicators capture the research performance better in some fields than in others.

Scholarly output is the most basic of all research performance indicators and in this report refers to (journal) articles, reviews, and conference proceedings. Researchers affiliated to UAE institutions, including universities, corporates and other sectors have produced over 32,000 publications during the 2008-2017 period as captured in Scopus. Annual scholarly output has increased from over 1,600 in 2008 to over 5,000 in 2017 (Figure 1.1). UAE has been showing a steady increasing trend during the analysis period with a compound annual growth rate (CAGR) of 14.4%, which is significantly higher than the World trend of 3.2% (table 1.1)

Among the comparator countries, Switzerland has the largest number of publications and UAE has the least. However, UAE's growth rate over the ten-year period is second only to Saudi Arabia (22.4%). In 2008, Saudi Arabia produced a similar number of publications to UAE, ranking fifth among the comparators, moving up to the second position as of 2017, producing slightly more publications than Singapore.

SAUDI ARABIA	SINGAPORE	SWITZERLAND
22.4%	**5.1%**	**4.0%**
NEW ZEALAND	IRELAND	UNITES ARAB EMIRATES
3.5%	**3.5%**	**14.4%**
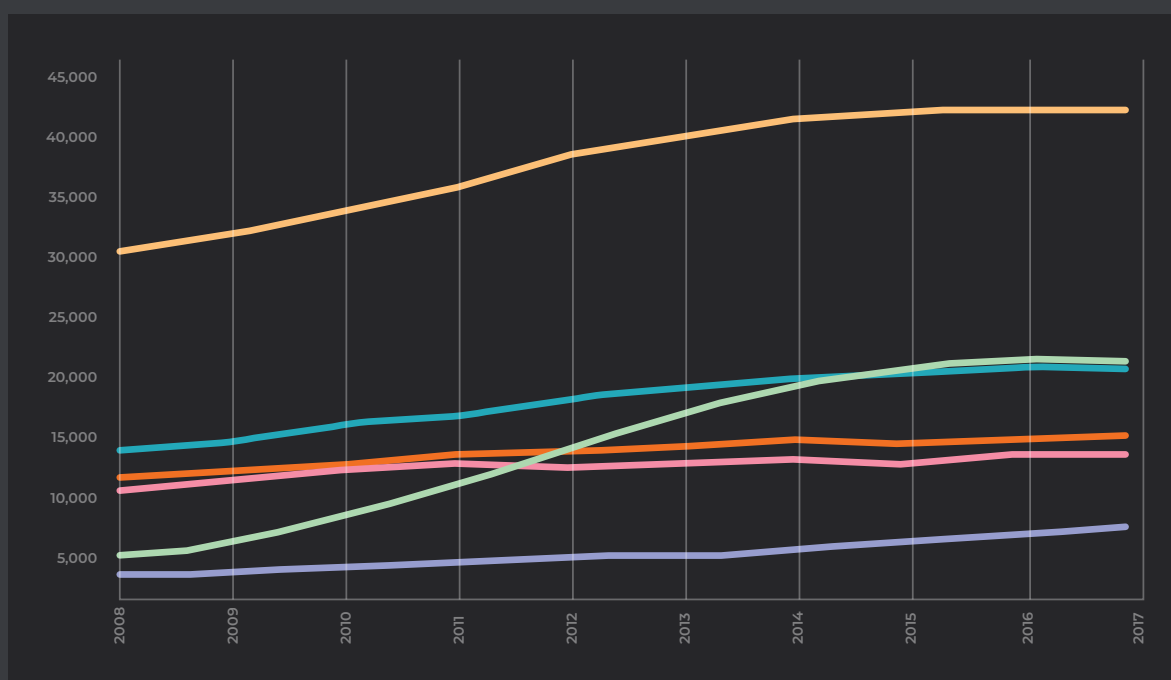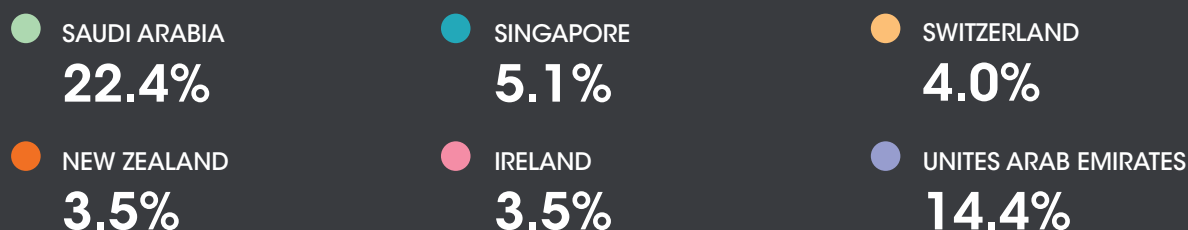
Table 1.1— Scholarly output growth rate for UAE and comparators, 2017-2008. Source: Scopus

In terms of the World share of publications, UAE's share has doubled from 0.1% to 0.2% as of 2015 (table 1.2). Saudi Arabia had the largest increase, raising its share from 0.2% in 2008 to 1.6% in 2017. New Zealand and Ireland maintained their share of 0.5%. Considering that the leading research nations such as US, UK and Germany have either maintained or declined their world share, UAE's increasing share is encouraging. In the last decade, large developing nations like China, India and Brazil have considerably increased their publication numbers and claimed a larger slice of the pie, resulting in a decline in the world share of publications for several research intensive nations.

Table 1.2— Average share of World publications for all comparators. Source: Scopus.

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
SGP	0.6%	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%	0.8%
CHE	1.5%	1.5%	1.5%	1.5%	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%
SAU	0.2%	0.2%	0.3%	0.4%	0.5%	0.6%	0.7%	0.8%	0.8%	0.8%
NZL	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
IRL	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
UAE	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.2%	0.2%

MEASURING IMPACT:
CITATION WINDOWS AND FIELD-WEIGHTING

Citations accrue to published articles over time, as articles are first read and subsequently cited by other authors in their own published articles. Citation practices, such as the number, type and age of articles cited in the reference list, may differ by research field. As such, in comparative assessments of research outputs, citations must be counted over consistent time windows, and publication and field-specific differences in citation frequencies must be accounted for.

Field-weighted citation impact is an indicator of mean citation impact, and compares the actual number of citations received by an article with the expected number of citations for articles of the same document type (article, review or conference proceeding), publication year and subject field. Where the article is classified in two or more subject fields, the average (or harmonic mean) of the actual and expected citation rates is used. The indicator is therefore always defined with reference to a global baseline of 1.0 and intrinsically accounts for differences in citation accrual over time, differences in citation rates for different document types (reviews typically attract more citations than research articles, for example), as well as subject-specific differences in citation frequencies. It is one of the most sophisticated indicators in the modern bibliometric toolkit.

1.2 UAE'S CITATION REMAINS AROUND GLOBAL AVERAGE

The number of citations received by an article from subsequently published articles is an indicator of the quality or importance of the cited research. However, the total number is affected by the type of publication (review article, conference proceeding or article), the subject area, and the year of publication. Therefore, we use the Field-Weighted Citation Impact (FWCI), which normalizes the citation impact. Please see box "Measuring Impact: Citation windows and Field-Weighting" and Appendix L: "Methodology" for further explanation. Detailed citation data per country, subject and year is provided with the supplementary data accompanying this report.

UAE's citation impact was below the World average during 2008-10 period after which it increased above the global average (Figure 1.2). The increasing trend continued until 2015 and peaked at 1.15 for 2013 and 2014, and started declining after that. Whether the declining trend will remain or change is yet to be seen. However, it is worth understanding deeper why the output growth had increased after 2014 and the impact declined.

Among the comparator countries Switzerland has the largest impact, followed very closely by Singapore. Mirroring the trend in scholarly output, Saudi Arabia's citation impact increased significantly from 0.8 in 2008 to 1.53 in 2017, having a CAGR above 7%, which is higher than any other comparator (table 1.3).
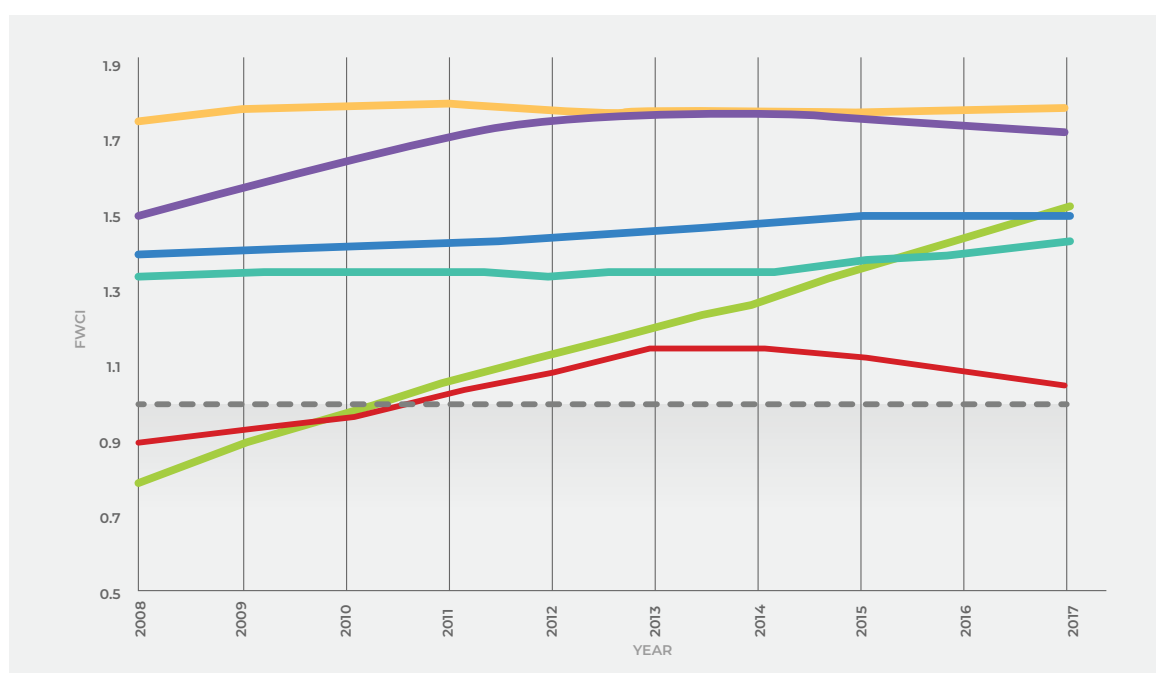
WORLD

Table 1.3— FWCI growth rate for UAE and comparators, 2017-2008. Source: Scopus

SAUDI ARABIA
0.7%

SINGAPORE
0.2%

SWITZERLAND
0.8%

NEW ZEALAND
7.5%

IRELAND
1.5%

UNITED ARAB EMIRATES
1.8%

1.3 UAE'S SHARE OF TOP 10% MOST CITED PUBLICATIONS HAS BEEN INCREASING

Literature shows that citation distribution across articles is highly skewed - a small proportion of all published articles receive most the citations, a larger proportion receives some citations, and a significant portion receives no citations. A closer look at the most cited articles is one of the approaches used in bibliometric analyses to yield further insights, which is why we look at the top 10% most highly cited articles.

The share of UAE publications among World's top 10% most cited publications grew by over 3% in the period of analysis,

from 8.5% in 2008 to 11.5% in 2017 (Figure 1.3). With this growth rate, it is second to Saudi Arabia, which increased its share from 5.9% to 14.6% in the period of analysis. In 2012, Singapore took over Switzerland as the country with the largest share of publications in top 10% most cited. For UAE , the largest increase in the share of publications in top 10% most cited was in natural sciences (going up from 8.6% to 12.1%) and engineering and technology field (going up from 11.7% to 14.4%)

Figure 1.3— Share of publications within top %10 most cited publications in the world, for UK nations, 2017-2008. Source: Scopus.
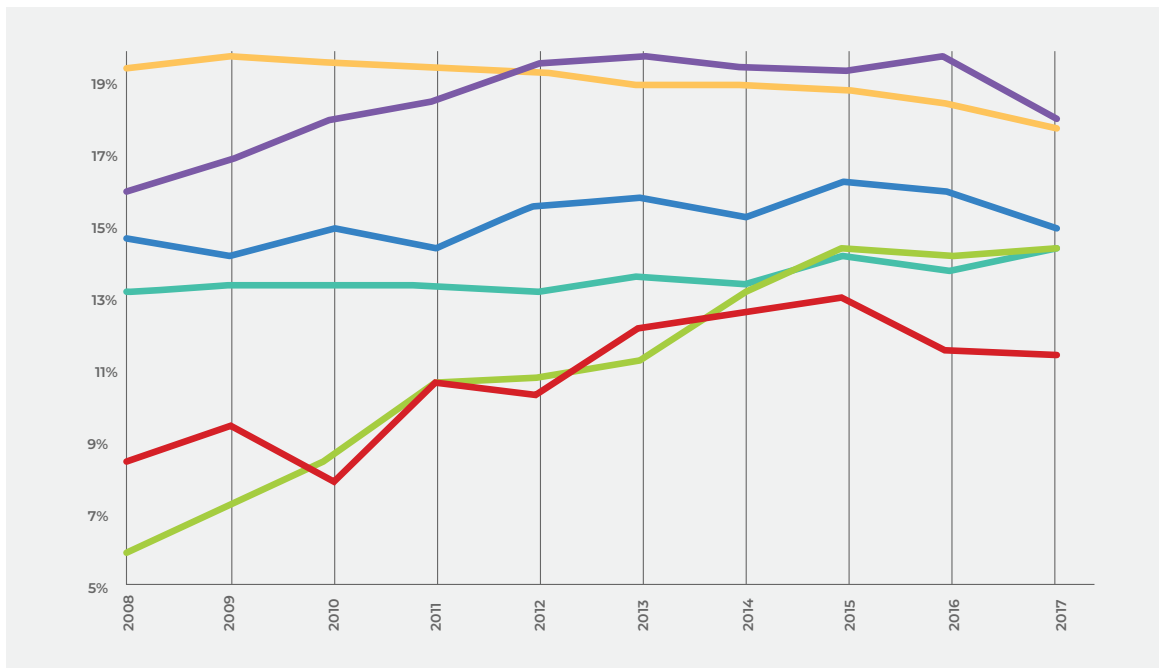
● SAUDI ARABIA	● SINGAPORE	● SWITZERLAND
35.3%	**6.5%**	**2.9%**

● NEW ZEALAND	● IRELAND	● UNITES ARAB EMIRATES
4.6%	**3.8%**	**18.4%**

1.4 MOST OF UAE'S PUBLICATIONS ARE IN NATURAL SCIENCES BUT PUBLICATIONS IN ENGINEERING AND TECHNOLOGY HAVE THE LARGEST IMPACT

To remind again, in this report we're looking at six subject areas based on OECD's Fields of Science:

NATURAL SCIENCES

MEDICAL AND HEALTH SCIENCES

SOCIAL SCIENCES

ENGINEERING AND TECHNOLOGY

AGRICULTURAL SCIENCES

HUMANITIES

Over the period of analysis, 65% of UAE's publications were in Natural Sciences, and 36% in Engineering and Technology. From the first period to the second, share of publications in engineering and technology increased the most with small declines in the share of agricultural sciences, medical and health sciences, and social sciences (table 1.5). In terms of citation impact, UAE publications in Engineering and

Technology achieved average citation impacts over global average throughout the analysis period. While the remaining subjects were all at or slightly below the global average in the first period in terms of citation impact, they've gone above in the second period with only social sciences having a FWCI of 1.00

Table 1.5— Number of publications and FWCI per subject area for UAE, P1 and P2. Percentages in parentheses indicate the share of overall publications. Source: Scopus

Subject	Publications (P1)	Publications (P2)	FWCI (P1)	FWCI (P2)
Agricultural Sciences	508 -4.50%	782 -3.60%	0.89	1.1
Engineering and Technology	3728 -33.10%	7946 -37.00%	1.13	1.27
Humanities	269 -2.40%	564 -2.60%	0.87	1.09
Medical and Health Sciences	2529 -22.40%	4631 -21.60%	1	1.17
Natural Sciences	7105 -63.10%	14157 -65.90%	1	1.12
Social sciences	1955 -17.40%	3527 -16.40%	0.94	1

Table 1.6— Number of publications per subject area for all comparators, P1 and P2. Source: Scopus

	Agricultural Sciences		Engineering and Technology		Humanities		Medical and Health Sciences		Natural Sciences		Social sciences	
	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2
CHE	9,967	13,649	34,175	40,094	3,521	5,554	63,480	80,788	105,156	126,621	14,069	19,979
IRL	4,231	5,031	11,093	12,508	2,103	2,868	18,857	22,788	30,959	32,874	6,692	8,926
NZL	7,769	9,560	8,378	9,947	2,509	3,284	18,754	23,335	30,436	35,626	10,671	12,656
SAU	2,349	5,451	10,362	30,523	228	787	11,292	26,540	23,430	66,468	1,669	4,607
SGP	1,772	2,936	30,113	37,559	1,271	2,053	16,282	23,242	51,278	65,939	7,479	10,324
UAE	508	782	3,728	7,946	269	564	2,529	4,631	7,105	14,157	7,479	10,324

When the changes in the trends are benchmarked with other comparators (table 1.7), we see that the growth rate of UAE publications are ahead of the World average in every single subject. If Saudi Arabia, which has the highest growth rate in each subject, is set aside then UAE has the highest growth in every subject except agriculture, where Singapore has a lead.

Table 1.7— 2008-2017 CAGR of scholarly output per subject area, for all comparators and World. Source: Scopus

Subject	CHE	IRL	NZL	SAU	SGP	UAE	WLD
Agricultural Sciences	5.4%	3.6%	2.5%	22.1%	11.5%	10.7%	4.4%
Engineering and Technology	2.3%	2.3%	3.7%	28.2%	3.8%	17.5%	3.9%
Humanities	9.7%	7.9%	7.0%	26.8%	10.9%	7.6%	5.3%
Medical and Health Sciences	4.6%	4.7%	4.5%	18.1%	7.0%	13.0%	2.3%
Natural Sciences	3.3%	2.4%	2.9%	25.3%	5.0%	15.2%	3.5%
Social sciences	6.8%	5.9%	4.0%	21.7%	5.7%	13.5%	4.2%

In terms of citation impact, none of the comparators other than Saudi Arabia had an increase in the citation impact across all subject areas (table 1.8).

Table 1.8— FWCI for comparators across subject areas, per period. Source: Scopus

	CHE		IRL		NZL		SAU		SGP		UAE	
	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2
Agricultural Sciences	1.65	1.52	1.54	1.62	1.28	1.31	0.80	1.17	1.49	1.27	0.89	1.10
Engineering and Technology	1.83	1.76	1.52	1.46	1.34	1.23	1.13	1.72	1.80	1.97	1.13	1.27
Humanities	1.47	1.44	1.06	1.20	1.55	1.55	0.90	1.33	1.62	1.58	0.87	1.09
Medical and Health Sciences	1.84	1.85	1.54	1.67	1.50	1.56	0.91	1.19	1.63	1.61	1.00	1.17
Natural Sciences	1.78	1.77	1.43	1.49	1.31	1.33	1.06	1.50	1.72	1.83	1.00	1.12
Social sciences	1.55	1.59	1.27	1.28	1.18	1.24	0.88	1.18	1.44	1.42	0.94	1.00

The relative activity index (RAI) represents how concentrated a country's output is in an area relative to the world average and can be used to estimate specialization in a particular field. RAI is calculated by dividing the share of a country's output in a field relative to the share of the world's output in that same field. For instance, 64% of UAE's scholarly output is in Natural Sciences, compared to 61% of the global scholarly output. UAE's RAI in Natural Sciences is therefore 0.64/0.61=1.05

Among UAE publications, social sciences have the largest RAI suggesting that the UAE concentrates more in this field compared to the global average, although this has been declining over the years (Figure 1.4). Engineering and Technology is another area where there is a slight specialisation (table 1.9).

Figure 1.4— RAI of subject areas for UAE for 2008, 2013 and 2017. Source: Scopus
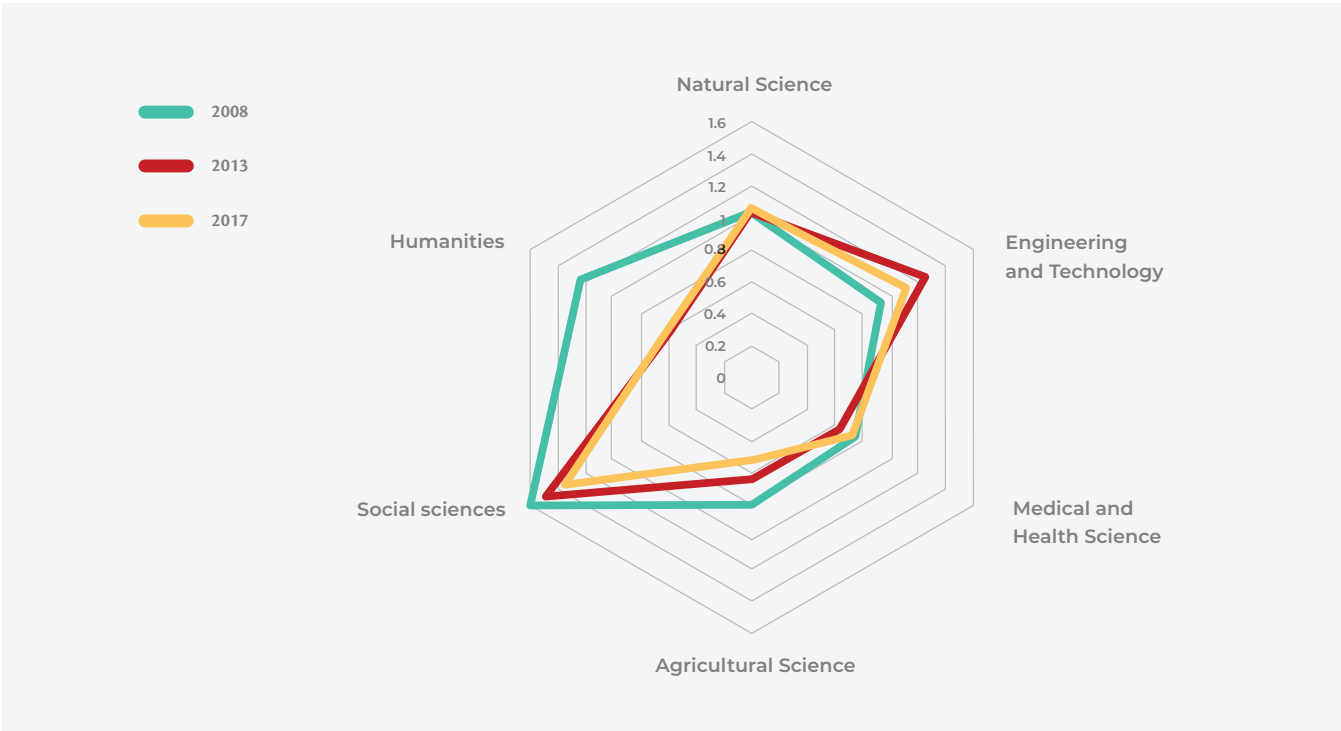
Table 1.9— Relative Activity Index for UAE across subject areas and years, 2008-2017. Source: Scopus

Subject Name	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2008-2017
Natural Sciences	1.04	1.02	1.01	1.05	1.09	1.03	1.10	1.11	1.06	1.08	1.07
Engineering and Technology	0.95	1.12	1.04	1.18	1.18	1.27	1.16	1.20	1.23	1.13	1.17
Medical and Health Sciences	0.75	0.68	0.71	0.70	0.64	0.64	0.69	0.64	0.67	0.72	0.68
Agricultural Sciences	0.79	0.84	0.73	0.74	0.57	0.64	0.56	0.48	0.49	0.53	0.60
Social sciences	1.60	1.54	1.66	1.60	1.39	1.51	1.43	1.39	1.39	1.36	1.47
Humanities	1.23	0.58	0.50	0.72	0.56	0.58	0.68	0.74	0.72	0.59	0.68

1.5 PRODUCTIVITY

The concept of research productivity at a national level is the ability to convert research inputs (R&D expenditure and human capital) into research outputs (including article and citations). Several institutions such as the OECD, UNESCO and Eurostat among others collect and collate data on elements such as researcher numbers and R&D expenditure to track the progress of nations on their investment into science.

Unfortunately, the data on UAE is extremely limited and it is difficult therefore to track progress and conduct meaningful productivity analyses. The same is valid for many the Middle Eastern countries, including Saudi Arabia which is one of the comparators in this report. Considering the goals of the nation on becoming a knowledge-based economy, it is crucial that data on these standard indicators are collected systematically through methodologies identified and agreed upon by global institutions. The OECD's Frascati Manual is such a key guideline outlining data collection methods and indicator definitions among others.

advancement of knowledge, nationally and globally, is critically dependent on the contributions of the researchers within its research infrastructure. Human capital is often measured by the number of total researchers (FTE) and number of total R&D personnel.

The UNESCO statistics provide data on the number of researchers (FTE) per million inhabitants for 2015 and 2016, which are 2,004 and 2,407 respectively. Based on available data from the same source, UAE's researcher per million inhabitant number is the lowest among the comparators (table 1.10). UNESCO data also indicates that over 60% of the researchers are in the business sector, over 30% are in the higher education sector and finally over 5% in the government sector. Based on the available data, UAE has the highest share of researchers in the business sector compared to the other countries in this report (table 1.11).

HUMAN CAPITAL

The most important resource of any country's research base is its researchers, and so a country's contribution to the

Table 1.10— Researchers (FTE) per million inhabitants. Source: UNESCO Institute of Statistics

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016
CHE	3,288	...	...	...	4,456	...	...	5,257	...
IRL	3,230	3,106	3,064	3,275	3,474	3,598	4,423	5,421	5,563
NZL	...	3,724	...	3,689	...	3,962	...	4,052	...
SGP	5,739	6,148	6,312	6,514	6,477	6,720	6,730	...	...
UAE	...	...	...	...	...	...	...	2,004	2,407

Table 1.10— Researchers (FTE) per million inhabitants. Source: UNESCO Institute of Statistics

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016
CHE	41.1	...	...	...	46.4	...	...	50.1	...
IRL	53.7	54.5	55.6	58.9	60.0	64.1	53.9	44.3	42.5
NZL		30.4	...	31.3	...	33.5	...	36.9	
SGP	59.7	53.3	51.5	51.7	50.6	50.9	50.5		
UAE								60.9	62.2

With the amount of missing data it is difficult derive conclusions about productivity per researcher and yet keeping this in mind, table 1.12 shows the output per researchers per million inhabitants for available countries and years:

Table 1.12— Scholarly output per researchers (FTE) per million.

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016
CHE	8.81				8.27			7.70	
IRL	2.69	3.09	3.41	3.38	3.15	3.13	2.60	2.08	2.12
NZL		2.74		3.24		3.14		3.14	
SGP	2.13	2.11	2.28	2.33	2.55	2.58	2.70		
UAE								2.18	2.05

It is not surprising that the limited data suggests that Switzerland is the most productive country among the comparators.

RESEARCH EXPENDITURE

Gross Expenditure on R&D is one of the most common indicators used to assess the level of investment into R&D. This can be further broken down to expenditure by business, government, higher education and so. The limited data on gross expenditure on R&D (GERD) as a share of GDP suggests that the UAE's investment into research is growing fast even if it is yet below the other comparators (table 1.13). While the most recent statistics are missing for Saudi Arabia missing, its expenditure levels seem similar to UAE. Considering that the output and impact of Saudi Arabia has grown vert fast in the period of analysis, it can be argued that the country is more productive compared to the UAE.comparators (table 1.10). UNESCO data also indicates that over 60% of the researchers are in the business sector, over 30% are in the higher education sector and finally over 5% in the government sector. Based on the available data, UAE has the highest share of researchers in the business sector compared to the other countries in this report (table 1.11).

Table 1.13— Gross expenditure on R&D as a percentage of GDP. Source: UNESCO Institute of Statistics for SAU and UAE, OECD Main Science and Technology Indicators for the rest

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016
CHE	2.71	..	..	..	3.19	..	..	3.37	..
IRL	1.39	1.61	1.59	1.55	1.57	1.58	1.53	1.2	1.18
NZL	..	1.25	..	1.23	..	1.15	..	1.26	..
SAU	...	...	...	0.9	0.9	0.8	...	...	...
SGP	2.62	2.16	2.01	2.15	1.99	1.99	2.16	..	..
UAE	...	...	...	0.5	...	...	0.7	0.9	1

Once more the data at hand is limited for making decisive comparisons, but table 1.14 suggest that the productivity of Saudi Arabia is the highest, in that despite having the second least R&D investment as a share of GDP, it has high productivity. For UAE, there is a fluctuating trend in the last three years and hence very difficult to say anything about the productivity.

Table 1.14— Scholarly output per gross expenditure on R&D as a percentage of GDP. Source: Scopus (all), UNESCO Institute of Statistics (SAU and UAE) , and OECD Main Science and Technology Indicators (rest)

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016
CHE	10,690				11,552			12,013	
IRL	6,240	5,958	6,575	7,134	6,968	7,130	7,503	9,378	10,018
NZL		8,168		9,715		10,806		10,090	
SAU				10,209	12,988	18,235			
SGP	4,659	5,999	7,169	7,059	8,296	8,709	8,406		
UAE				5,128			4,983	4,851	4,930

1.6 TOP UAE INSTITUTIONS BY OUTPUT AND IMPACT

In this section we present a list of top 5 institutions by overall output, citation, FWCI and citation percentiles for the two periods of analysis. A detailed breakdown per subject area is provided in Appendix A.

A look at the top 5 publishing institutions in UAE shows that while four of the five universities are the same between P1 and P2, the positions change slightly (tables 1.15 and 1.16). In P1, UAE University was the top institution, accounting for 26% of the national output, where as in P2 it moved to the second place, accounting for 16% of the publications. KU moved to the first place in the second period, accounting for 25% of all publications. However, it should be noted that the merger of the Masdar Institute of Science and Technology, Khalifa University of Science, Technology and Research and Petroleum Institute in 2017 has certainly contributed to this position change. What is also worth noting is that while KU moved up in the ranking by output, its FWCI declined from P1 to P2. In terms of output across different subject areas, there is again a concentration among several institutions, with citation impact improving from P1 to P2.

Table 1.15— Top 5 UAE institutions by output, 2008-2012. Source: Scopus

Institution	Output	FWCI
United Arab Emirates University	2,917	0.97
Khalifa University of Science and Technology	2,055	1.32
American University of Sharjah	1,220	0.91
University of Sharjah	820	0.77
Zayed University	300	1.21

Table 1.16— Top 5 UAE institutions by output, 2013-2017. Source: Scopus

Institution	Output	FWCI
Khalifa University of Science and Technology	5,326	1.44
United Arab Emirates University	3,487	1.07
American University of Sharjah	1,583	1.00
University of Sharjah	1,492	1.03
NYU Abu Dhabi	1,439	1.61

When the institutions are ranked by citations (tables 1.17 and 1.18) a very similar list is seen. Considering that publications in the first period had more time to accrue citations, it should be considered normal that the overall citation numbers decline from one period to the next. A better indication on the quality of output is the FWCI.

Table 1.17— Top 5 UAE institutions by citations, 2008-2012. Source: Scopus

Institution	Output	Citations	FWCI
United Arab Emirates University	2,917	42,780	0.97
Khalifa University of Science and Technology	2,055	28,779	1.32
American University of Sharjah	1,220	13,394	0.91
University of Sharjah	820	7,964	0.77
Dubai Hospital	192	4,053	0.93

Table 1.18— Top 5 UAE institutions by citations, 2013-2017. Source: Scopus

Institution	Output	Citations	FWCI
Khalifa University of Science and Technology	5,326	33,798	1.44
United Arab Emirates University	3,487	18,971	1.07
American University of Sharjah	1,583	6,397	1.00
University of Sharjah	1,492	4,891	1.03
NYU Abu Dhabi	1,439	10,037	1.61

When we look at the list of institutions ranked by FWCI, with a threshold of minimum 50 publications per period, we see a slightly different list where smaller institutions also appear in top 5, publishing with high citation impact (tables 1.19 and 1.20). It should be noted however that a change in the threshold would also effect the ranking as well.

Table 1.18— Top 5 UAE institutions by citations, 2013-2017. Source: Scopus

Institution	Output	Citations	FWCI
NYU Abu Dhabi	140	2,899	1.89
Sheikh Khalifa Medical City	67	1,780	1.55
Khalifa University of Science and Technology	2,055	28,779	1.32
Zayed University	300	2,920	1.21
Gulf Medical University	94	1,810	1.01

Table 1.20— Top 5 UAE institutions by FWCI, 2013-2017. Source: Scopus

Institution	Output	Citations	FWCI
NYU Abu Dhabi	1,439	10,037	1.61
Ministry of Health United Arab Emirates	55	646	1.54
Mohammed Bin Rashid University of Medicine and Health Sciences	71	263	1.47
Khalifa University of Science and Technology	5,326	33,798	1.44
Emirates College of Technology	57	168	1.21

2. RESEARCH COLLABORATION

In this chapter, we provide insights into research collaboration of UAE and comparator countries and the effects of collaboration on the impact of publications, with a focus on international collaboration.

KEY HIGHLIGHTS

INTERNATIONAL
COLLABORATION 2008-2012

56.3%

INTERNATIONAL
COLLABORATION 2013-2017

64.2%

NATIONAL COLLABORATION
IMPACT 2008-2012

1.20

FWCI OF UAE PUBLICATIONS WITH
INTERNATIONAL COLLABORATION

INTERNATIONAL COLLABORATION
IMPACT 2013-2017

1.30

FWCI OF UAE PUBLICATIONS WITH
INTERNATIONAL COLLABORATION

TOP INTERNATIONAL
COLLABORATOR 2008-2017

USA

3,945 JOINT PUBLICATIONS WITH AN
AVERAGE FWCI OF 1.73

2.1 THE UAE HAS A SIGNIFICANT SHARE OF INTERNATIONAL COLLABORATION

HYPERCOLLABORATION

The terms 'Hypercollaborative co-authorship' and 'hypercollaboration' have been coined to classify the growing phenomenon of articles that have hundreds or even thousands of co-authors. The rise of so-called 'Big Science' – a term used to describe research that requires major capital investment and is often, but not always, international in nature – may be one of the causes of this phenomenon. The frequency of such articles is still relatively small: just 827 articles published between 2010 and 2015 had more than 1,000 authors. Most of these came from CERN's Large Hadron Collider in Switzerland,

and include, in May 2015, the most multi-authored research paper published to date, with 5,154 authors.

While they may represent extreme outliers in co-authorship data and remain proportionally few, such hypercollaborative articles are included throughout the analyses in this chapter. Like other collaborative articles, they are counted as single internationally co-authored articles for each country represented in them, and for each country pairing.

Over the past few decades, collaboration has become the cornerstone of innovation and excellence. It is an inherent and mutually beneficial part of the world of research, crossing borders, disciplines, and communities. The pervasiveness of low-cost travel, high-speed internet connectivity, mobile technology, social media, public engagement, and funding programmes all encourage scholars, communities and policymakers to expand their networks beyond their immediate working environments and traditional spheres of influence.

Research collaboration that is grown out of informal discussions and information sharing can usually be detected from the patterns of coauthorship of published articles or the acknowledgments within them. The single-author articles are slowly becoming less common in the face of the inexorable rise of international collaboration, the latter being measured by the proportion of articles with at least two different countries listed in the authorship by-line - see box "HYPERCOLLABORATION" for the most extreme case of collaboration. While co-authorship is not the only form of collaboration, particularly in fields such as the Social Sciences and Arts and Humanities, it can be quantified with

reasonable robustness and is the basis for the indicators discussed in this chapter.

It is interesting to see the different collaboration patterns. In most mature research nations like UK, Germany or France the international collaboration has risen to a share of more than 50%, countries like Switzerland are even above 60%. Second most relevant collaboration case is mostly national collaboration, followed by institutional collaboration. As mentioned above single authorship is declining across most of the mature research nations. However, this pattern may be different per subject area, e.g., in Social Sciences or Arts & Humanities single authorship is still one of the major types.

The UAE's share of international collaboration was high to begin with and kept on increasing throughout the period of analysis, going from 55% to 67% in ten years. At the same time, the share of single authorship has declined (table 2.1). While the FWCI of publications with international collaboration fluctuated, it has always been higher than other types of collaboration and increased from P1 to P2. (figure 2.1)

Type	Output	Share	FWCI
Single	4,131	12.6%	0.56
Institutional	6,840	20.9%	0.90
National	1,596	4.9%	0.66
International	20,138	61.5%	1.27

Table 2.1— Collaboration types for UAE, for 17-2008. Source: Scopus.

In comparison with other countries, UAE ranked third in P2 in terms of share of international collaboration but benefits the least compared to the other countries (figure 2.2). Saudi Arabia showed the largest leap in both the share and impact with all other countries increasing their share too. The only country which had a decline in the impact resulting from international collaboration has been Switzerland.
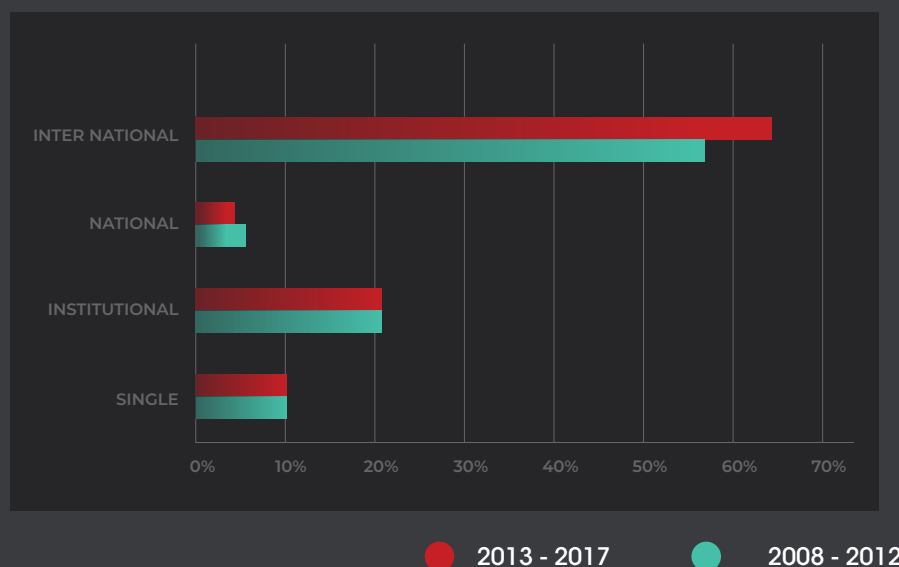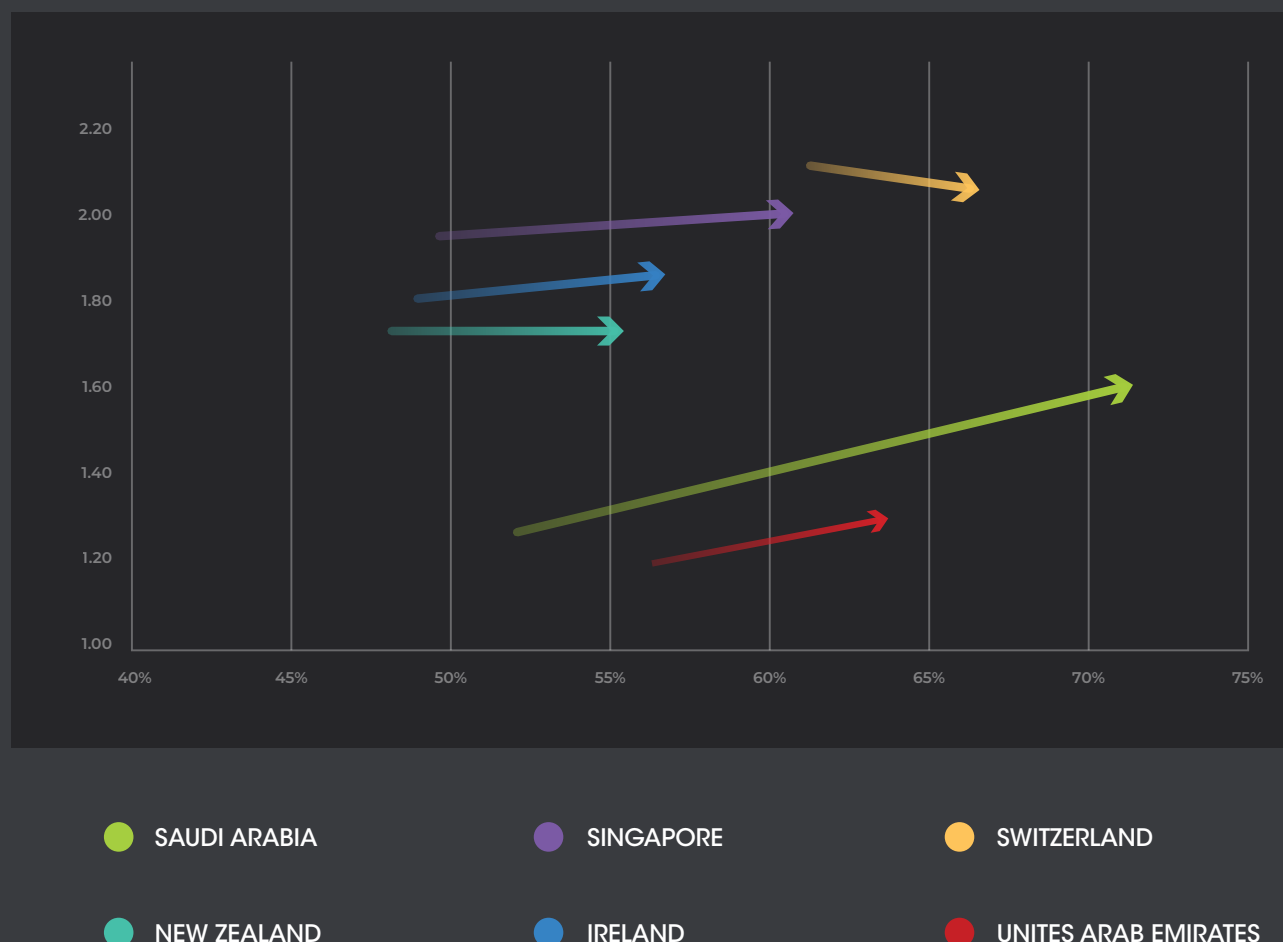
Appendix D gives a detailed breakdown on the share and impact of international collaboration of UAE and the comparators across different subject areas. For UAE the fields with largest share of international collaboration are medical sciences and agricultural sciences- 68% for both for the 2008-2017 period (table 2.2). Agricultural sciences is also the field with largest share of international collaboration for other comparators too. On the other hand, for UAE, publications in social sciences had the largest growth in the share of international collaborations, going from 31% to 58% in the ten-year period, with a CAGR of 7%. The only other country with a similar share of growth in social sciences was Saudi Arabia (7.7%). In terms of impact, publications with international collaboration in medical sciences had the largest impact in both periods, followed by engineering and technology.

Table 2.2— Share and impact of international collaboration for UAE, per period and subject. Source: Scopus

Subject	Publication share Publications (P2)		FWCI	
	2008-2012	2013-2017	2008-2012	2013-2017
Agricultural Sciences	61.4%	75.1%	1.15	1.19
Engineering and Technology	60.2%	63.3%	1.31	1.41
Humanities	32.0%	40.2%	1.22	1.51
Medical Sciences	62.4%	75.2%	1.28	1.36
Natural Sciences	58.9%	65.1%	1.21	1.27
Social Sciences	43.4%	54.4%	1.22	1.21

2.2 UAE'S TOP COLLABORATION PARTNERS

Although the relationship between international collaboration and citation impact is clear, as discussed in the last section, what cannot be determined from the data alone is whether countries that frequently engage in international collaboration achieve high-impact results because (a) the countries systematically select the best partners to work with or (b) countries that are likely to produce high-impact research outputs are actively solicited by other countries for collaborative   partnerships.

Although it is difficult to assess whether (a) countries systematically select the best partners to work with, or if (b) it is the best countries that collaborate with one another, it is possible to investigate which international partnerships are associated with higher citation impact.

Figure 2.3 demonstrates how collaborations between countries are associated with increased FWCI for both partners, for

– +
Beneficial for partner only

+ +
Mutually beneficial collaboration

0   1,1

– –
Beneficial for partner none

+ –
Beneficial for subject only

0
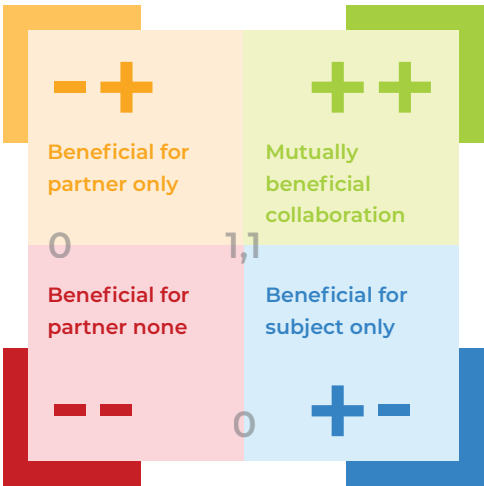
one, or none. The horizontal axis measures the impact of the collaboration, using FWCI, between UAE and a partner ("Country A") compared to the collaboration between UAE and all of its international partners. If the FWCI of collaboration between UAE and Country A is larger than that of all UAE's international collaborations, collaborating with Country A is associated with higher FWCI for UAE, i.e., the collaboration is in the right two quadrants in Figure 2.3a. If it were less, it would be in one of the two quadrants on the left.

The vertical axis measures the citation impact of the collaboration between UAE and Country A compared to the publication impact of Country A. If the FWCI of collaboration between UAE and Country A is higher than that of all Country A's international collaborated publications, collaborating with UAE is associated with higher FWCI for Country A, i.e., the collaboration is in the upper two quadrants in Figure 2.3. If it were less, it would be in one of the two lower quadrants.

Figure 2.4 below shows the collaboration quadrant analysis for UAE whereby it can be seen all collaborations with top 20 international partners show a beneficial result for UAE, except for Jordan. In a similar way, partner countries also

benefit from collaborating with UAE, except for Qatar. While most of the collaborations are with USA and the UK, the figure below shows that most mutually beneficial collaborations are with China and Japan. Germany, Austria and Netherlands are other countries with which UAE benefits considerably from collaborating.

Table 2.3 shows the number of joint publications and resulting impact for the top partners for the 2008-2017 period. If we look at a period view, the top three partners remain the same across the periods: USA, United Kingdom and Canada. A visible change is Saudi Arabia, which ranked 9th as a collaboration partner in P1 and was the 4th most collaborated country for UAE during P2. Pakistan, Greece, Tunisia, Iran and Brazil are the countries that were not among the top 20 partners in P1, but moved into top 20 in P2. Appendix E gives a breakdown of top 20 partners for UAE per subject and period.

Table 2.3— Top 20 international collaborators for UAE indicating the number of joint publications and the resulting citation impact, 2008-2017 Partner FWCI refers to the FWCI of all internationally collaborated publications of the partner (with all countries). Source: Scopus

Figure 2.4— Collaboration quadrant analysis for UAE and its Top 20 collaboration partners, 2017-2008. Size of the bubble indicates number of co-authored publications. Source: Scopus.
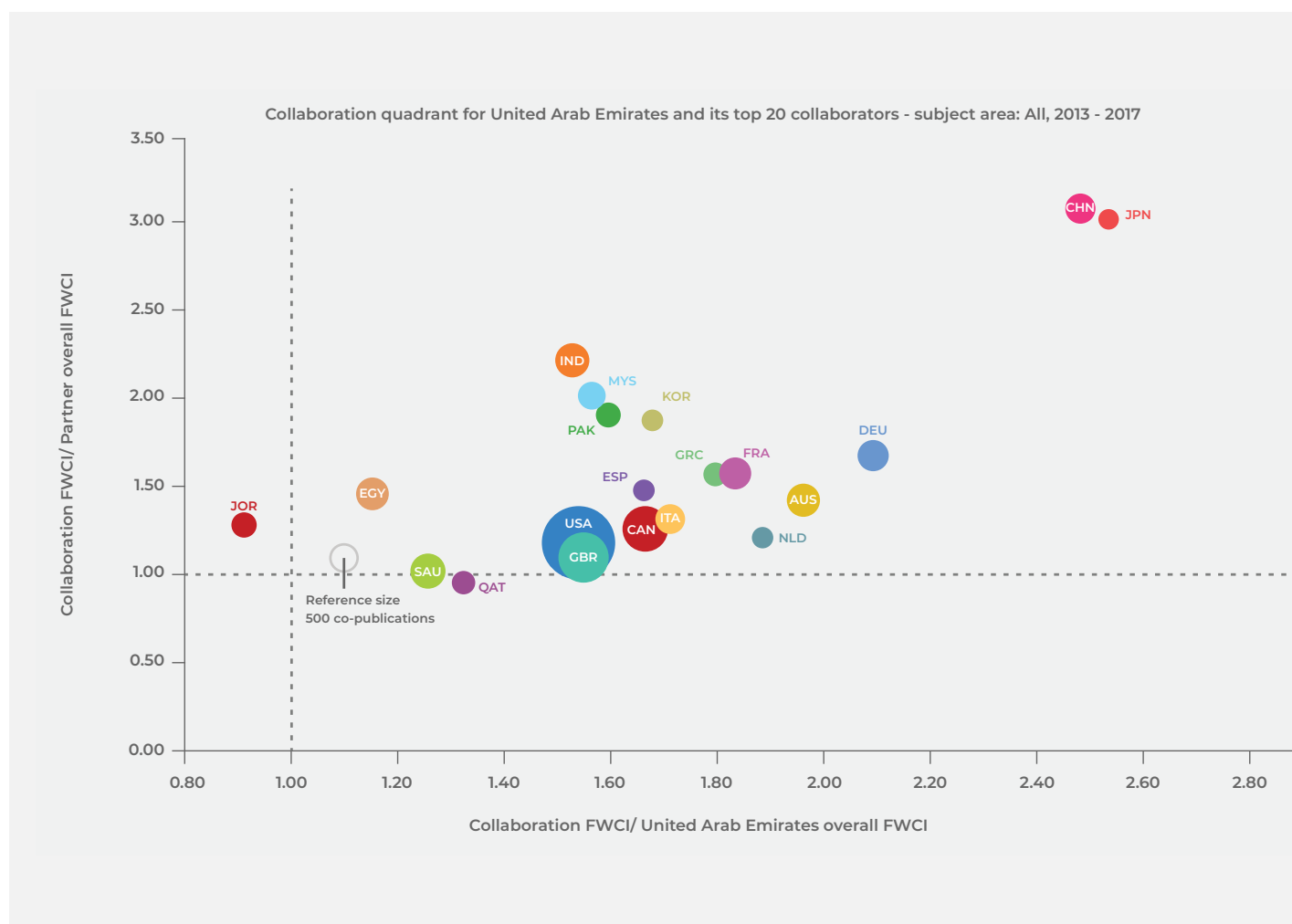
30

Table 2.3— Top 20 international collaborators for UAE indicating the number of joint publications and the resulting citation impact, 2017-2008 Partner FWCI refers to the FWCI of all internationally collaborated publications of the partner (with all countries). Source: Scopus

Rank	Country	Join publications	Joint publication FWCI	Partner FWCI
1	USA	3,945	1.73	1.46
2	GBR	1,844	1.74	1.57
3	CAN	1,599	1.88	1.48
4	SAU	924	1.42	1.38
5	IND	906	1.72	0.77
6	EGY	819	1.30	0.89
7	AUS	809	2.21	1.55
8	FRA	770	2.06	1.31
9	DEU	740	2.36	1.40
10	CHN	719	2.80	0.90
11	ITA	631	1.93	1.46
12	MYS	567	1.76	0.87
13	PAK	494	1.80	0.94
14	JOR	476	1.03	0.80
15	QAT	422	1.49	1.55
16	GRC	397	2.02	1.29
17	KOR	362	1.89	1.00
18	ESP	357	1.87	1.26
19	NLD	334	2.12	1.74
20	JPN	316	2.85	0.94

2.3 TOP INSTITUTIONS WITH INTERNATIONAL COLLABORATION

There are two ways in which institutions can be ranked according to international collaboration- by absolute numbers and by share of international publications. In terms of absolute output, the list of top institutions with international collaboration mirror the overall scholarly output list (table 2.4). For all institutions in the list, publications with international collaboration have, on average, a higher citation impact.

When the list is ranked according to the share of international publications, a different view emerges (table 2.5). The institutions in the lists change considerably from P1 to P2, except for NYU Abu Dhabi, which has increased its share of international collaborations significantly, although this wasn't mirrored by impact. It should also be noted that institution like NYUAD, which have their main campuses in research intensive nations such as US, may benefit from staff members who are associated with both the main campus and the campus abroad.

Appendix F gives a list of top institutions per subject area, for both absolute numbers and shares. As the publication sets become smaller when divided across subject area, the ranking by share starts to lose meaning on its own and is best considered with the list of institutions by absolute numbers. For all subject areas except medical sciences, the leading institutions are like the overall list. However, in medical sciences we can see that more specialist institutions such as the Dubai Hospital take leading positions.

Table 2.4— Top 5 UAE institutions by number of publications with international collaboration, P1 and P2. Source: Scopus

Institution	Period	Output	FWCI	Publication share
United Arab Emirates University	2008-2012	1,547	1.15	53.0%
Khalifa University of Science and Technology	2008-2012	1,396	1.52	67.9%
American University of Sharjah	2008-2012	580	1.06	47.5%
University of Sharjah	2008-2012	412	0.96	50.2%
Zayed University	2008-2012	200	1.35	66.7%

Institution	Period	Output	FWCI	Publication share
Khalifa University of Science and Technology	2013-2017	3,407	1.58	64.0%
United Arab Emirates University	2013-2017	2,250	1.23	64.5%
NYU Abu Dhabi	2013-2017	1,193	1.74	82.9%
University of Sharjah	2013-2017	935	1.18	62.7%
American University of Sharjah	2013-2017	854	1.05	53.9%

Table 2.5— Top 5 UAE institutions by share of publications with international collaboration, P1 and P2. Source: Scopus

Institution	Period	Output	FWCI	Publication share
Sheikh Khalifa Medical City	2008-2012	58	1.71	86.6%
Heriot-Watt University Dubai Campus	2008-2012	32	0.86	82.1%
NYU Abu Dhabi	2008-2012	110	2.08	78.6%
Alhosn University	2008-2012	47	0.63	72.3%
Institute of Management Technology, Dubai	2008-2012	15	1.11	71.4%

Institution	Period	Output	FWCI	Publication share
Emirates College of Technology	2013-2017	51	1.33	89.5%
Mohammed Bin Rashid University of Medicine and Health Sciences	2013-2017	63	1.63	88.7%
NYU Abu Dhabi	2013-2017	1193	1.74	82.9%
Paris Sorbonne University Abu Dhabi	2013-2017	15	1.06	78.9%
Sheikh Khalifa Medical City	2013-2017	101	1.18	77.7%

3. KNOWLEDGE EXCHANGE

In this chapter, we analyse UAE's research through indicators of academic-industry knowledge exchange such as corporate co-authored publications and citations to research in patents.

KEY HIGHLIGHTS

CORPORATE COLLABORATION
OUTPUT 2008-2012

3.53%

SHARE OF ACADEMIC-CORPORATE
COLLABORATIONS FOR UAE

CORPORATE COLLABORATION
OUTPUT 2013-2017

2.72%

SHARE OF ACADEMIC-CORPORATE
COLLABORATIONS FOR UAE

CORPORATE COLLABORATION
IMPACT 2008-2012

1.81

FWCI OF ACADEMIC-CORPORATE
COLLABORATIONS FOR UAE
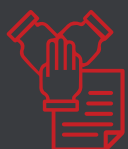
CORPORATE COLLABORATION
IMPACT 2013-2017

1.90

FWCI OF ACADEMIC-CORPORATE
COLLABORATIONS FOR UAE

TOP CORPORATE
COLLABORATOR 2008-2017

ADCO

158 JOINT PUBLICATIONS WITH
AN AVERAGE FWCI OF 0.74

3.1 ACADEMIC-CORPORATE KNOWLEDGE EXCHANGE

Any individual or organization shares ideas and information through the process of knowledge exchange and such exchange are integral to the progress and the success of any research initiative. Since much knowledge resides with people, knowledge is often tacit or difficult to articulate.

This chapter focuses on the academic-industry knowledge exchange that acts as a conduit between investment in research, from both public and private sectors, and its commercialization, leading ultimately to economic growth. Consideration is primarily given here to explicit indicators: academic-corporate co-authorship, patent citations; and top corporate collaborators. Data in Scopus allows identification of affiliations as academic, corporate, government, medical and other and thus gives insight into the publications between different sectors too. In this chapter, we will focus

on academic-corporate publications but an overview of different links is presented in table 3.1.

Academic-government and academic-medical collaborations account for a larger share of publications than academic-corporate publications for UAE. The largest growth was in collaborations between corporate and medical sectors as well those between academic and government sector. On average, academic-corporate publications grew by 13% in the 2008-2017 period, fluctuating between 2.5% and 3% of all publications.

Table 3.1— Co-publications between different sectors for UAE, for P1 and P2. Numbers in parentheses show the share in overall. Source: Scopus

Year	Academic-Corporate	Academic-Government	Academic-Medical	Corporate-Government	Corporate-Medical	Other
2008	51 (3.1%)	95 (5.8%)	113 (6.9%)	9 (.6%)	6 (.4%)	11 (.7%)
2009	61 (3.2%)	125 (6.6%)	121 (6.4%)	11 (.6%)	12 (.6%)	20 (1.1%)
2010	65 (2.9%)	129 (5.8%)	114 (5.1%)	13 (.6%)	12 (.5%)	12 (.5%)
2011	101 (3.9%)	140 (5.5%)	150 (5.9%)	28 (1.1%)	31 (1.2%)	28 (1.1%)
2012	120 (4.1%)	180 (6.1%)	170 (5.8%)	23 (.8%)	37 (1.3%)	30 (1.0%)
2013	94 (2.9%)	178 (5.6%)	166 (5.2%)	16 (.5%)	20 (.6%)	35 (1.1%)
2014	95 (2.7%)	229 (6.6%)	165 (4.7%)	17 (.5%)	24 (.7%)	39 (1.1%)
2015	123 (2.8%)	309 (7.1%)	205 (4.7%)	24 (.5%)	28 (.6%)	43 (1.0%)
2016	121 (2.5%)	340 (6.9%)	247 (5.0%)	24 (.5%)	34 (.7%)	46 (.9%)
2017	152 (2.8%)	371 (6.7%)	283 (5.1%)	30 (.5%)	47 (.9%)	50 (.9%)
CAGR	13%	16%	11%	14%	26%	18%

Figure 3.1 shows that share and impact of corporate collaborations of UAE per year, which have both been fluctuating. For 2008-2012, the share was 3.53%, which went down to 2.61% for the 2013-2017. The main reason for this decline is arguably the faster growth of academic publications overall. The impact has remained above the global average throughout the period of analysis, apart from 2017 and actually increased from 1.81 on average for 2008-2012 to 1.90 on average for 2013-2017.

Figure 3.1— Share and FWCI of corporate collaborations for the UAE, 2008-2017. Dashed line shows the global average for FWCI. Source: Scopus
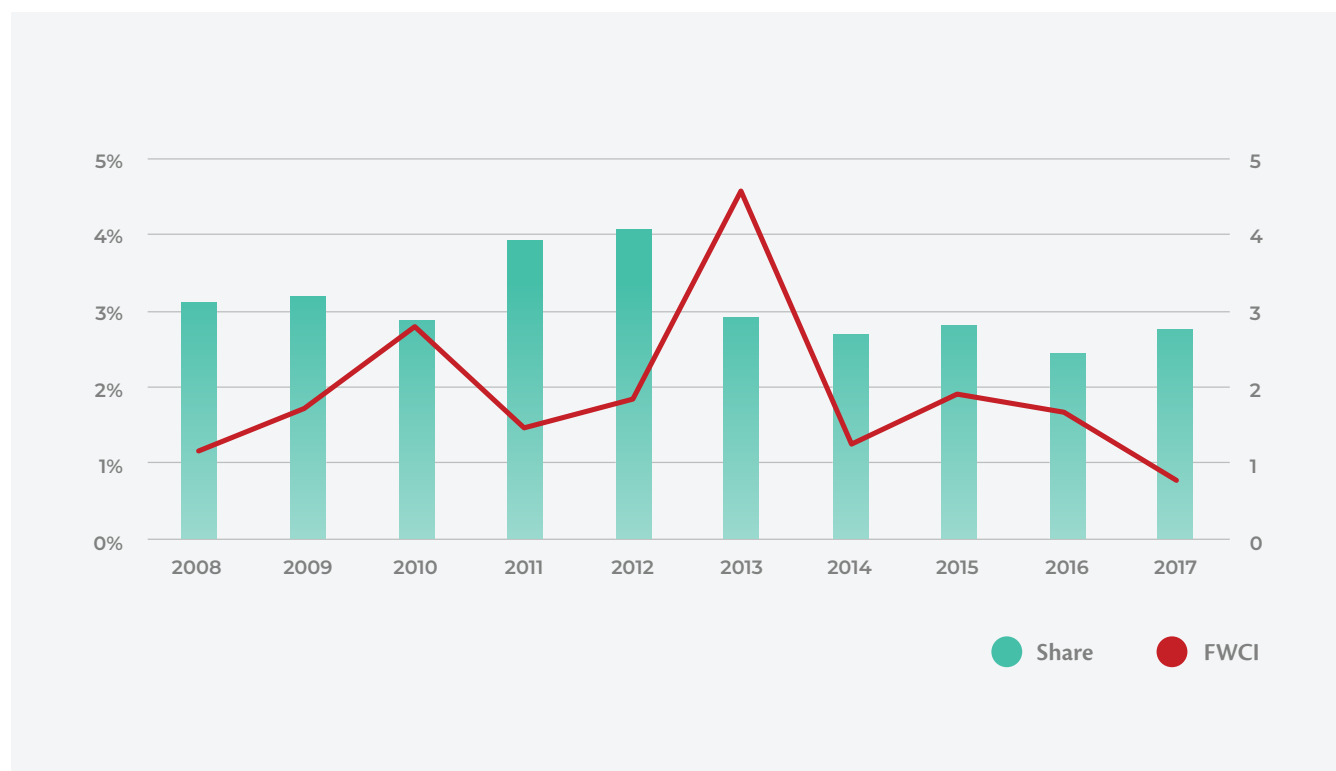
Among the comparator countries, Switzerland has the highest share of academic-corporate collaborations with over 8% for both periods (table 3.2). Considering that large multinational corporations such as Novartis, Hoffmann-La Roche and Nestle among others are headquartered in Switzerland, this result is not surprising. The presence of strong research institutions and corporates with research divisions in the same geography undoubtedly creates synergies. On the other hand, Saudi Arabia had the largest growth in the number of academic-corporate publications but since the overall output has increased with a similar speed, the share of academic-corporate publications declined. Saudi Aramco is probably one of the largest corporates driving the growth. A similar view can be observed for UAE where the overall output grew by over 14% but the share of corporate publications has fluctuated between 2.5% and 4.1%

Table 3.2— Number and share of corporate collaborations for UAE and comparators, 2008-2017. Source: Scopus

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	CAGR
UAE	51 (3.1%)	61 (3.2%)	65 (2.9%)	101 (3.9%)	120 (4.1%)	94 (2.9%)	95 (2.7%)	123 (2.8%)	121 (2.5%)	152 (2.8%)	14.4%
CHE	2620 (9.0%)	2706 (8.9%)	2680 (8.3%)	2847 (8.3%)	2970 (8.1%)	3071 (8.0%)	3172 (7.9%)	3258 (8.0%)	3357 (8.2%)	3417 (8.3%)	4.0%
IRL	445 (5.1%)	434 (4.5%)	423 (4.0%)	462 (4.2%)	532 (4.9%)	585 (5.2%)	552 (4.8%)	536 (4.8%)	564 (4.8%)	575 (4.9%)	3.5%
NZL	347 (3.6%)	346 (3.4%)	285 (2.7%)	357 (3.0%)	339 (2.8%)	414 (3.3%)	369 (2.8%)	356 (2.8%)	386 (2.9%)	441 (3.4%)	3.5%
SAU	89 (2.8%)	90 (2.1%)	152 (2.5%)	189 (2.1%)	252 (2.2%)	329 (2.3%)	346 (2.0%)	463 (2.5%)	497 (2.5%)	464 (2.4%)	22.4%
SGP	550 (4.5%)	506 (3.9%)	455 (3.2%)	515 (3.4%)	536 (3.2%)	547 (3.2%)	572 (3.2%)	585 (3.2%)	683 (3.6%)	664 (3.5%)	5.1%

3.2 TOP CORPORATE PARTNERS

Tables 3.3 and 3.4 list the top 10 corporate partners for the UAE during 2008-2012 and 2013-2017. In order to understand whether the collaboration benefits both partners, it is useful to remind the average FWCI for UAE was 0.97 during P1 and 1.13 for P2. A detailed list of top corporate partners across different subject areas is presented in Appendix H.

It can be seen that the top partner for both periods is ADCO, where joint publications resulted in an average citation impact that is below the global average but benefited ADCO. Hamad Medical Corporation is the second most collaborated partner for both periods, resulting in joint collaborations that s above the global average and of benefit to both parties on average. Most of the remaining top partners are the same across both periods although the positions change. While the first period

has a mix of corporate collaborations with oil and gas sector, medical and pharmaceuticals, in the second period there's a clear shift towards oil and gas sector collaborations. Across both periods collaboration with Bayer seem to be some of the most impactful even if the volume of publications have decline from the first period to the second.

In terms of different subject areas, it can be seen that corporate collaboration publications with the highest citation impact are in the fields of medical sciences, followed by agricultural sciences (appendix G). While there are some corporate partners in social sciences and humanities fields with which joint publications result in very high impact, it should be reminded that the publication numbers are also very limited and as such cannot provide a generalized insight.

Table 3.3— Top 10 corporate partners for UAE, 2008-2012. Source Scopus

Corporate entity	Joint publications	Joint publication FWCI	Partner FWCI
ADCO	69	0.86	0.85
Hamad Medical Corporation	64	1.07	0.67
ExxonMobil	24	1.11	1.49
Bayer	22	3.81	2.06
IBM	18	2.68	2.36
Etisalat British Telecom Innovation	18	1.41	1.34
ADNOC	17	0.42	0.35
Schlumberger-Doll Research	12	0.98	1.56
GlaxoSmithKline	8	2.20	2.07
International Union for Conservation of Nature and Natural Resources	7	12.92	4.06

3.3 PATENT CITATIONS

Knowledge transfer from the academic to the corporate sector can be counted as well by citations from patents to research publications. Commercial patents, in the same way as scientific publications, also contain references to previous work done within the same field. Patents usually cite other related patents or scholarly output (scientific publications). In this section we analyse citations from global patents to research output across different countries. As with academic citations, publications in the last years had less time to acquire citations,

which is why a decline is seen in patent citations from P1 to P2. Similar to the level of academic-corporate collaborations, Switzerland has the largest and Singapore has the second largest number of patent citations in both periods. This is actually not surprising as these countries also led in academic citation impact. The third place was occupied by Ireland in P1 whereas this place was taken by Saudi Arabia in P2, once more reflecting the trends in citation impact.

Figure 3.2— Patent citations per country, per period. Source: Scopus and LexisNexis TotalPatent database
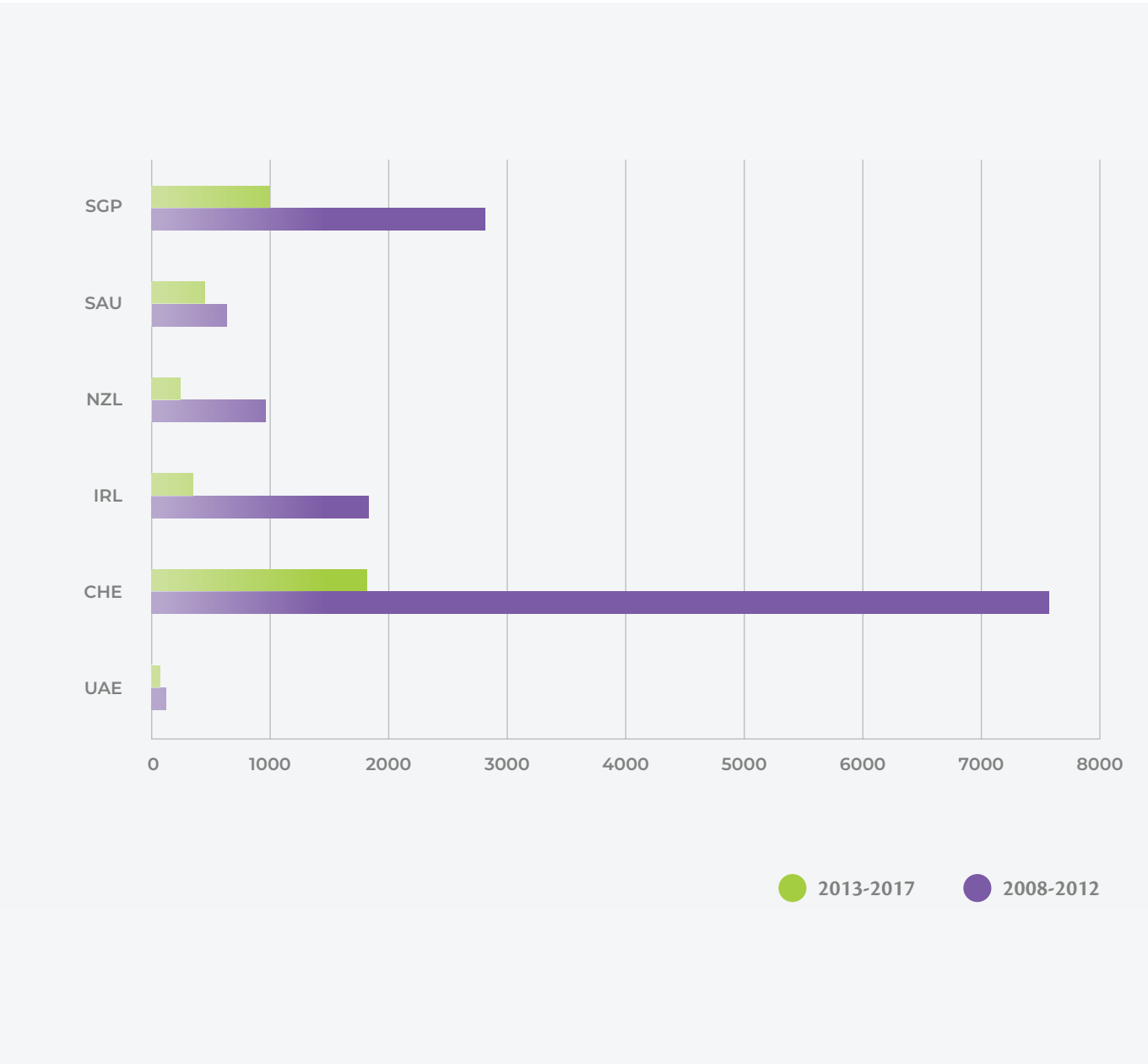
4. RESEARCH LEVELS

In this chapter, we analyse the publication output of UAE with regards to research levels from Basic Research through Applied Research towards Applied Technology.

KEY HIGHLIGHTS

UAE'S SHARE OF ARTICLES IN
BASIC SCIENCE 2008-2012

10.2%

UAE'S SHARE OF ARTICLES IN
BASIC SCIENCE 2008-2012

23.1%

UAE'S IMPACT OF ARTICLES IN
BASIC SCIENCE 2008-2012

1.02

UAE'S IMPACT OF ARTICLES IN
BASIC SCIENCE 2013-2017

1.19

UAE'S SHARE OF ARTICLES IN APPLIED
TECHNOLOGY 2008-2012

15.4%

UAE'S SHARE OF ARTICLES IN APPLIED
TECHNOLOGY 2013-2017

11.9%

UAE'S IMPACT OF ARTICLES IN APPLIED
TECHNOLOGY 2008-2012

1.00

UAE'S IMPACT E OF ARTICLES IN
APPLIED TECHNOLOGY 2013-2017

1.09

4.1 RESEARCH LEVELS FOR UAE

Research can be categorized in different stages in science, ranging from basic to applied/clinical. Previously we have analysed UAE's research using output (publication counts), impact (FWCI) and productivity (output per researcher or expenditure) as well as collaboration patterns and knowledge transfer indicators. An additional way of characterizing scientific literature is a classification of journals or articles as basic or applied . For an introduction to these classifications see box: "Research Levels"

RESEARCH LEVELS

Narin, Pinski, and Gee introduced a system of four research levels, ranging from most applied to most basic, classified journals by research level, and used those classifications to characterize institutional research. This initial research was based on journal classifications and had some deficiencies as it assumes that all publications in a particular journal share the same, static research level – which is unlikely – and it does not account for the fast-growing universe of research journal with nowadays more than 22,000 journals indexed by Scopus. For these deficiencies, Klavans and Boyack7 introduced a new model – trained from the title and abstract words and cited references – that classifies individual articles by research level. Generally speaking, the fields of physics, chemistry, biology, and parts of medicine are associated with basic research, while the fields of engineering, computer science, social sciences, and the more clinical

areas of medicine are more associated with applied research. For these areas there is a positive correlation between citation counts (impact) and research level: citation counts increase as one moves from the applied to the basic end of the distribution.

Initial findings show that researchers who publish in multiple research levels are more capable of moving their work along translational pathways than are researchers who only publish in a single level, thus contributing to a larger extent to knowledge transfer.

The research levels used in this analysis, ranging from basic to applied level, are: Basic Research, Applied Research, Engineering-Technological Mix, and Applied Technology It needs to be noted that – as mentioned above – the model works best in the Physical and Life Sciences, as the algorithm is less trained

If we look at the distribution of articles across the different spectrums, we see that most of the publications from UAE are in the applied technology end of the spectrum for both periods (figure 4.1 and 4.2). Where there has been a change across periods is the growth rate of publications and the citation impact. The first period saw mostly a growth of output in engineering-technology mix and applied technology whereas in the second period there has been a significant growth in the output of publications in basic research even if the number of publications in the more applied end was higher. This could be

an indication that in the most recent period, UAE institutions and researchers acquired more capability to conduct more basic research. In terms of citation impact, publications in all parts of the spectrum were around the global average, with applied technology and basic research publications having a smaller advantage. In the second period, all segments displayed an average citation impact above the World average, with basic research and engineering-technology mix having nearly 20% more impact than the global average.

Figure 4.1— UAE number of publications and FWCI per research level,2012-2008. Numbers at the bars indicate CAGR. Source: Scopus.
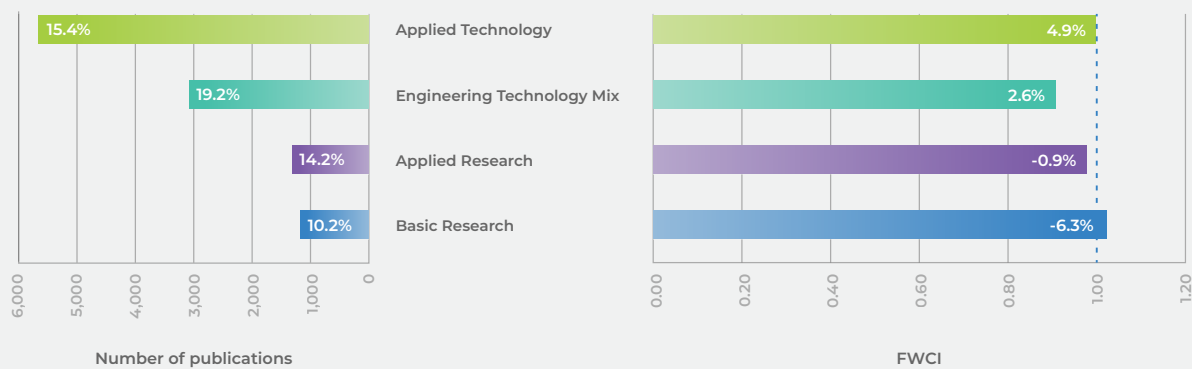
Figure 4.2— UAE number of publications and FWCI per research level,2017-2013. Numbers at the bars indicate CAGR. Source: Scopus
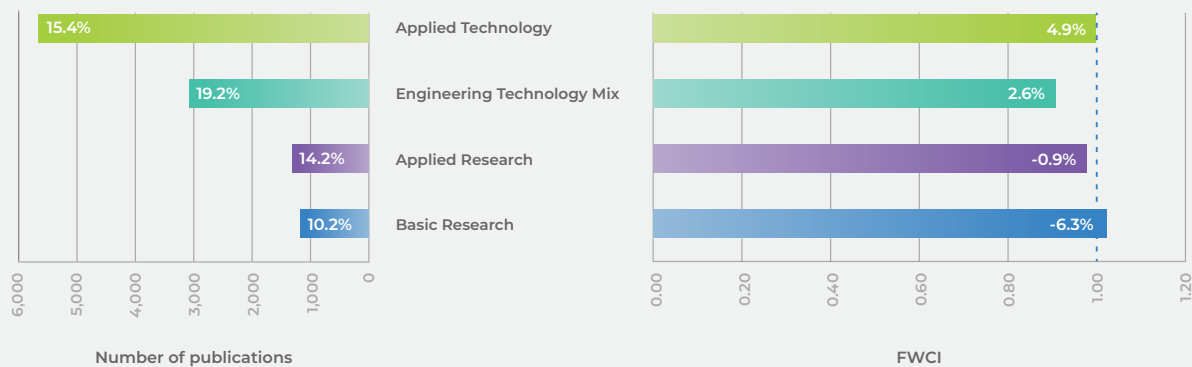
In terms of different subject areas it can be seen that for the UAE, agricultural sciences have the largest share of publications in basic research and applied research (table 4.1). Engineering and technologies, medical sciences and agricultural sciences all have equivalent levels of engineering-technological mix of publications. The table also shows that social sciences and humanities have the largest share of applied technology, which is counter-intuitive. As indicated at the start of this chapter, the algorithm used in the calculation of research levels is not very well trained for social sciences and humanities and this they should not be the focus of research level analyses. If these two subject are set aside, it is not surprising to see that publications in engineering and technologies have the highest share of applied technology, followed by publications in natural sciences.

Table 4.1— UAE publication distribution across different research levels and subjects, 2017-2008. Source: Scopus.

Research level	Natural Sciences	Engineering & Technologies	Medical Sciences	Agricultural Sciences	Social Sciences	Humanities
Basic scientific research	13.9%	5.9%	11.3%	29.1%	5.6%	16.6%
Applied research	15.2%	11.7%	19.0%	25.7%	3.4%	6.9%
Engineering-Technological mix	28.5%	32.9%	32.4%	32.5%	12.3%	15.3%
Applied technology	42.3%	49.5%	37.3%	12.7%	78.7%	61.1%

4.2 RESEARCH LEVELS ACROSS COMPARATORS

In this section, we have a comparative look at the research levels across different comparators. Figure 4.3 shows the share of publications across different research levels for 2008-2012. During this period UAE has the highest share of publications in applied technology and lowest for basic research. Switzerland on the other hand has the highest share of basic research and lowest share of applied technology. During P2 The UAE keeps its position of highest applied technology and lowest basic research among comparators although the share of former decreases and the latter increases. Switzerland remains as the country with the highest share of basic research, although its share decreases. Saudi Arabia is the country with the lowest share of applied technology in P2, with an increased share of basic research (Figure 4.4).

Figure 4.3— Share of publications across research levels for UAE and comparators, 2012-2008. Source: Scopus

Figure 4.4— Share of publications across research levels for UAE and comparators, 2017-2013. Source: Scopus

5. TOPICS OF PROMINENCE

In this chapter we present the top topic in which UAE published in in the last 5 years and analysing the prominence of this topic along with top players.

KEY HIGHLIGHTS

MOST PUBLISHED TOPIC FOR UAE
JURASSIC; RESERVOIR; SEQUENCE STRATIGRAPHIC

78

PUBLICATIONS IN 2013-2017,
WITH AVERAGE FWCI OF 0.64. TOPIC PROMINENCE
PERCENTILE: 84.7

TOPIC WITH HIGHEST WORLD PUBLICATION SHARE
55.9% OF ALL WORLD PUBLICATIONS IN ATOMIC LAYER DEPOSITION; ZINC OXIDE; CHARGE TRAPPING,

52

PUBLICATIONS IN 2013-2017, WITH AVERAGE FWCI OF 1.16.
TOPIC PROMINENCE PERCENTILE: 77.2
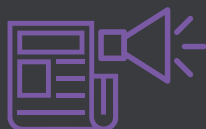
TOPIC WITH HIGHEST PROMINENCE PERCENTILE AMONG TOP 20 MOST PUBLISHED
ELECTRICITY; ELECTRIC LOAD MANAGEMENT; LOAD CONTROL

48

PUBLICATIONS IN 2013-2017, WITH AVERAGE FWCI OF 2.22.
TOPIC PROMINENCE PERCENTILE: 99.92

5.1 TOPICS OVERVIEW

Topics of Prominence (ToP) is a new analysis from Elsevier indicating the momentum in a particular field through ranking of topics according to prominence. Prominence is an indicator of the momentum of a particular field and does not make a judgement call whether a topic is important or not. 95% of all articles in Scopus are clustered into roughly 96,000 global and unique research topics based on recent citations, views and CiteScore values. By looking at citation patterns rather than journal categories, topics have the advantage of spanning across disciplines and being dynamic. Through topics of prominence (ToP) analyses, it is possible to identify emerging topics with high momentum and how these topics are related to a selected entity or group's research portfolio. Topics can be large or small, new or old, growing or declining. The granularity of topics allows for defining the problem-level structure of science. Due to the way it is structured, topics do not need field weighting to be coherent collections and also topics in social science and humanities are just as valid as in STEM areas, although they may be smaller and less prominent.

PROMINENCE COMBINES 3 METRICS TO INDICATE THE MOMENTUM OF THE TOPIC:

- CITATION COUNT IN YEAR N TO PAPERS PUBLISHED IN N AND N-1
- SCOPUS VIEWS COUNT IN YEAR N TO PAPERS PUBLISHED IN N AND N-1
- AVERAGE CITESCORE FOR YEAR N

Topics of prominence methodology allows entities to identify research fields that they are active in and if they are leading in these fields. In this report, it will also identify shows where UAE publishes most and if these are becoming important. If these most published fields are also highly prominent, then it will indicate that UAE is aligned with the global topics gaining momentum. If UAE's most published topics are not very prominent, it does not necessarily mean that these are 'wrong' topics, but perhaps topics that are more of local relevance.

Since the topics are pre-calculated using 95% of the publications in the Scopus database, hypercollaborated papers are included in the analyses presented in this section, which is different than the rest of the report.

5.2 GENERAL OVERVIEW OF UAE FROM A TOPICS PERSPECTIVE

Table 5.1 lists the top 20 topics for UAE for 2013-2017 ranked by output to understand whether these topics are also fields that have high momentum. It can be seen that over half of the topics in the list are in World's top 10% most prominent topics (those topics with a percentile score over 90.0), showing that UAE is broadly tuned to the pace and direction of research in the world. Furthermore, almost in these mentioned topics the average citation impact of UAE is beyond the global average. In the following subsections, we will focus on those topics where the prominence percentiles is above 90, to have a better understanding of those topics with high momentum. A detailed list of top 10 countries and institutions across the remaining topics is presented in Appendix J.

Table 5.1— Top 20 topics of UAE by output, 2013-2017.

Topic	UAE output in topic	World publication share	UAE FWCI	Topic prominence percentile
Jurassic; reservoir; sequence stratigraphic	78	17.5	0.64	84.7
Distillation; Desalination; distillation DCMD	58	5.5	2.48	99.8
Industry; Petroleum engineering; digital oilfield	54	4.4	0.28	76.5
Liquefied natural gas; Contracts; million ton/yr	54	14	0.02	53
Atomic layer deposition; Zinc oxide; Charge trapping	52	55.9	1.16	77.2
Anodes; Aluminum; metal pad	51	6.7	1.32	83.3
Networks (circuits); Design; fractional calculus	50	11.7	4.16	95
Electricity; Electric load management; load control	48	1.4	2.22	99.9
Middle East; United Arab Emirates; Saudi Arabia	47	25	0.62	66.1
Underwater acoustics; Sensor networks; acoustic networks	46	2.2	1.98	98.4
Hydrogen sulfide; Sulfur; sulfur recovery	45	16.4	0.91	93.2
water; coral reef; Arab Emirates	43	23.5	1.39	84.5
Smart power grids; Electric power transmission networks; grid communication	37	2	1.96	99.2
Amines; Absorption; solvent regeneration	37	1.9	1.73	99.7
Graph in graph theory; Index; atom-bond connectivity	37	3.1	0.64	96.1
Concrete beams and girders; Fiber reinforced plastics; strengthened beams	36	2.3	1.46	98.6
Unmanned aerial vehicles (UAV); Control; quadrotor helicopter	36	1.3	2.3	99.4
Hardware; Integrated circuits; hardware trojan	36	4.2	5.9	97.5
Coronavirus; Middle East; east respiratory	34	2.2	2.75	99.3
Web services; Social networking (online); Websites	33	30	1.05	74.3

5.2.1 DISTILLATION; DESALINATION; DISTILLATION DCMD

This topic is characterised by a very high prominence (99.8) with over 1,000 publications, growing trend and a FWCI nearly twice of the world average (1.91). The UAE is the 8th most published country in the World, with a citation impact 2.5 times above the global average and also above the topic average. China has the largest output in this field albeit with a lower citation impact (table 5.2).

Table 5.2— Top 10 countries in the topic by output

Country	Scholarly Output	FWCI
China	252	1.51
United States	154	2.78
Australia	115	2.73
Saudi Arabia	111	2.58
South Korea	106	2.03
Singapore	62	3.93
Italy	60	2.64
United Arab Emirates	58	2.48
Malaysia	44	1.12
Spain	42	3.32

KU is the third most published and impactful institution globally for this topic (table 5.3 and 5.4), accounting for most of UAE publications. While CAS is the most published institution, KAUST of Saudi Arabia has the highest citation impact, followed by Victoria University.

Table 5.3— Top 10 institutions in the topic by output

Institution	Scholarly Output	FWCI
Chinese Academy of Sciences	53	2.22
King Abdullah University of Science and Technology	45	3.35
Khalifa University of Science and Technology	44	2.89
University of Calabria	36	2.48
Nanyang Technological University	35	2.52
Victoria University	34	3.02
Hanyang University	31	2.14
King Abdulaziz University	30	2.3
Tianjin Polytechnic University	29	1.01
Kookmin University	27	2.03

Table 5.4— Top 10 institutions in the topic by impact

Institution	Scholarly Output	FWCI
King Abdullah University of Science and Technology	45	3.35
Victoria University	34	3.02
Khalifa University of Science and Technology	44	2.89
Nanyang Technological University	35	2.52
University of Calabria	36	2.48
King Abdulaziz University	30	2.3
Chinese Academy of Sciences	53	2.22
Hanyang University	31	2.14

5.2.2 NETWORKS (CIRCUITS); DESIGN; FRACTIONAL CALCULUS

This is a growing topic with over 400 publications and a FWCI of 1.75. While China accounts for a quarter of all publications, UAE ranks 4h but with the highest impact among the top 10 countries (table 5.5). University of Sharjah is the third most published institution globally (table 5.6) and practically is the only institution in the UAE that publishes in this topic and is the second most impactful institution (table 5.7), just behind university of Patras.

Table 5.5— Top 10 countries in the topic by output

Country	Scholarly Output	FWCI
China	115	0.93
India	67	1.9
Egypt	66	3.22
United Arab Emirates	50	4.16
Czech Republic	41	2.1
Greece	35	4.9
United States	35	2.63
Canada	30	3.27
Taiwan	18	0.93
Russian Federation	15	1.14

Table 5.6— Top 10 institutions in the topic by output

Institution	Scholarly Output	FWCI
Nile University	58	3.48
Cairo University	52	3.29
University of Sharjah	49	4.24
Brno University of Technology	40	2.16
University of Patras	35	4.9
University of Calgary	28	3.34
University of Alabama	19	3.29
Chang Jung Christian University	17	0.97
National Kaohsiung First University of Science and Technology	17	0.97
Sichuan University	17	1.37

Table 5.7— Top 10 institutions in the topic by impact

Institution	Scholarly Output	FWCI
University of Patras	35	4.9
University of Sharjah	49	4.24
Nile University	58	3.48
University of Calgary	28	3.34
Cairo University	52	3.29
Brno University of Technology	40	2.16

5.2.3 ELECTRICITY; ELECTRIC LOAD MANAGEMENT; LOAD CONTROL

The topic of electric load management is the largest topics globally with nearly 3,500 publications and a prominence percentile of 99.9. While UAE accounts only for 1.4% of global publications, its citation impact (2.22) is higher than the average citation impact of the topic (2.08) (table 5.8). The most published country is the United states, followed closely by

China. However, the United States has a much higher citation impact than both China and the global average whereas China lags the topic average.

Table 5.8 — Top 10 countries in the topic by output

Country	Scholarly Output	FWCI
United States	838	3.07
China	602	1.82
United Kingdom	229	2.04
Canada	179	2.69
India	178	1.24
Iran	173	2.67
Australia	158	2.66
Germany	120	1.69
Italy	119	2.61
Pakistan	106	2.18

Chinese institutions dominate the list of most published institutions (table 5.9) whereas more US institutions feature in the list of most impactful institutions (table 5.10). UAE institutions are not featured in either list due to size threshold but Higher Colleges of Technology has the largest output in this topic (29

publications) although its citation impact is below the topic average (1.62). With 5 publications, UAE University has the highest citation impact among UAE institutions (6.05), followed by Khalifa University (8 publications with an FWCI of 2.7).

Table 5.9 — Top 10 institutions in the topic by output

Institution	Scholarly Output	FWCI
Ministry of Education China	80	1.38
North China Electric Power University	64	1.46
Southeast University	64	1.83
COMSATS Institute of Information Technology	63	2.36
University of California at Berkeley	59	5.24
China Electric Power Research Institute	56	0.98
INESC-ID	56	3.58
Technical University of Denmark	56	2.26
University of Sydney	48	2.71
Zhejiang University	47	3.95

Table 5.10 — Top 10 institutions in the topic by impact

Institution	Scholarly Output	FWCI
University of California at Berkeley	59	5.24
University of Beira Interior	37	4.17
University of Lisbon	43	4.15
Singapore University of Technology and Design	34	4.09
University of Florida	31	4
Zhejiang University	47	3.95
INESC-ID	56	3.58
Pacific Northwest National Laboratory	33	3.58
ETH Zurich	42	3.54
Sharif University of Technology	34	3.24

5.2.4 UNDERWATER ACOUSTICS; SENSOR NETWORKS; ACOUSTIC NETWORKS

With over 2,000 publications, this is another highly prominent topic (98.4), with a FWCI of 1.4. The UAE accounts for slightly over 2% of the global publications with China having a clear lead in the output size, albeit with a citation impact below the topic and global average (table 5.11). Italy, Canada and Saudi Arabia have the highest citation impact among the most published institutions.

Table 5.11 — Top 10 countries in the topic by output

Country	Scholarly Output	FWCI
China	763	0.86
United States	385	1.92
India	183	0.89
South Korea	134	1.43
Pakistan	114	1.89
Canada	109	2.17
Italy	106	2.55
Saudi Arabia	54	2.03
Taiwan	49	1.25
Australia	48	0.75

Like some of the previous topics, Chinese institutions account for most of the output (table 5.12) whereas North American and European institutions have the largest impact (table 5.13). The Higher Colleges of Technology accounts for nearly all of UAE publications in this field and ranks 8th in the list of mot impactful institutions with over 30 publications.

Table 5.12 — Top 10 institutions in the topic by output

Institution	Scholarly Output	FWCI
Harbin Engineering University	133	0.7
University of Connecticut	100	2.05
COMSATS Institute of Information Technology	84	2.05
Xiamen University	69	0.8
Northwestern Polytechnical University Xian	67	0.69
Ministry of Education China	66	0.59
University of Alberta	51	2.16
Zhejiang University	50	1.36
Chinese Academy of Sciences	49	0.69
Dalhousie University	49	2.02

Table 5.13 — Top 10 institutions in the topic by impact

Institution	Scholarly Output	FWCI
Northeastern University	49	3.41
University of Rome La Sapienza	39	3.24
University of Padova	33	2.24
University of Alberta	51	2.16
University of Connecticut	100	2.05
COMSATS Institute of Information Technology	84	2.05
Dalhousie University	49	2.02
Higher Colleges of Technology	41	1.95
King Saud University	32	1.68
Zhejiang University	50	1.36

5.2.5 HYDROGEN SULFIDE; SULFUR; SULFUR RECOVERY

Despite having a relatively high prominence (93.2), this topic is limited in size to nearly 300 publications and an average citation impact below the global average (0.68). The US has the largest number of publications but the UAE, which ranks second by output, has a higher citation impact than both the US and the topic average. The only country with a citation impact over the global average is Italy.

Table 5.14 — Top 10 countries in the topic by output

Country	Scholarly Output	FWCI
United States	75	0.76
United Arab Emirates	45	0.91
China	34	0.72
Italy	24	1.64
Iran	20	0.44
Russian Federation	14	0.45
Denmark	13	0.69
Germany	12	0.77
India	10	0.44
Australia	9	0.67

On the other hand, at an institutional level, KU is the global leader in terms of output and has a citation impact over the topic average (table 5.15). While it has less than 30 publications, Politecnico di Milano has the highest citation impact.

Table 5.15 — Top 10 institutions in the topic by output and impact (marked by *)

Institution	Scholarly Output	FWCI
Khalifa University of Science and Technology *	43	0.89
University of Maryland *	29	1.11
Politecnico di Milano	15	1.92
Technical University of Denmark	12	0.75
Bulgarian Academy of Sciences	8	0.15
Boreskov Institute of Catalysis SB RAS	7	0.54
East China University of Science and Technology	7	0.6
University of North Texas	7	0.44
RAS - Siberian Branch	5	0.18
Research Institute of Petroleum Industry, Tehran	5	0.52

5.2.6 SMART POWER GRIDS; ELECTRIC POWER TRANSMISSION NETWORKS; GRID COMMUNICATION

The topic of smart power grids is a large (over 1,800 publications) topic that is highly prominent (99.2) with an average FWCI of 1.48. The UAE accounts for over 2% of global publications and has a higher citation impact (1.96) than the topic average. The United States and China lead the output with both countries having higher citation impacts than the topic average.

Table 5.16 — Top 10 countries in the topic by output

Country	Scholarly Output	FWCI
United States	396	2.16
China	345	1.7
Canada	143	2.79
India	135	1.32
Germany	94	1.44
United Kingdom	90	1.57
South Korea	76	1.05
Italy	63	2
Singapore	56	2.63
Brazil	55	1.01

Half of the top 10 institutions by output are from China followed by the US (table 17). Among the three institutions with more than 30 publications, University of Waterloo has the highest citation impact.

*Table 5.17 — Top 10 institutions in the topic by output and impact (marked by *)*

Institution	Scholarly Output	FWCI
Nanyang Technological University *	36	2.93
University of Waterloo *	33	3.42
Beijing University of Posts and Telecommunications *	31	0.81
University of Nebraska	26	2.67
Florida International University	24	2.36
University of Electronic Science and Technology of China	24	1.69
Tennessee Technological University	23	3.04
University of Ottawa	22	2.87
North China Electric Power University	21	0.73
China Electric Power Research Institute	19	0.4

5.2.7 AMINES; ABSORPTION; SOLVENT REGENERATION

Amines is another large (over 1,900 publications) and prominent (99.7) topic with an average FWCI of 1.16. While the UAE accounts for nearly 2% of all publications, it has a high citation impact (1.9). China has a clear lead in terms of output whereas Italy has the highest citation impact among the most published nations (table 5.18).

Table 5.18 — Top 10 countries in the topic by output

Country	Scholarly Output	FWCI
China	411	1.02
United States	208	1.2
Norway	159	1.67
Canada	142	1.6
United Kingdom	134	1.48
Australia	131	1.72
Iran	124	1.18
Malaysia	80	1.22
South Korea	79	0.97
Italy	72	2.01

The most published institution is University of Regina (table 5.19) whereas the Netherlands Organisation for Applied Scientific Research (TNO) has the largest impact, despite having a more limited set of publications (table 5.20). Similarly, KU is the third most impactful institution globally (with over 30 publications) and drives the UAE efforts in this topic.

Table 5.19 — Top 10 institutions in the topic by output

Institution	Scholarly Output	FWCI
University of Regina	95	1.51
Norwegian University of Science and Technology	84	1.59
Hunan University	75	1.62
University of Texas at Austin	67	1.56
Universiti Teknologi Petronas	57	1.42
Ministry of Education China	54	0.89
Tsinghua University	52	1.31
North China Electric Power University	46	0.75
SINTEF	45	1.44
CSIRO	39	1.96

Table 5.20 — Top 10 institutions in the topic by impact

Institution	Scholarly Output	FWCI
Netherlands Organisation for Applied Scientific Research - TNO	31	2.61
CSIRO	39	1.96
Khalifa University of Science and Technology	34	1.87
Technical University of Denmark	34	1.68
University of Melbourne	33	1.68
Hunan University	75	1.62
Imperial College London	30	1.62
Norwegian University of Science and Technology	84	1.59
University of Texas at Austin	67	1.56
University of Regina	95	1.51

5.2.8 GRAPH IN GRAPH THEORY; INDEX; ATOM-BOND CONNECTIVITY

This topic has a growing trend with over 1,200 publications in the last five years and a FWCI of 1.13. China accounts for more than one third of the publications and Serbia has the largest citation impact among the most published countries (table 5.21).

Table 5.21 — Top 10 institution in the topic by output

Institution	Scholarly Output	FWCI
China	466	1.31
Iran	286	0.89
Pakistan	144	1.11
India	129	0.75
Serbia	89	2.24
United States	72	1.46
South Korea	71	1.74
Slovenia	67	1.96
Romania	46	0.79
Malaysia	39	0.51

Iranian universities lead the list of most published institutions although the top ones have citation impacts less than the topic average (table 52). University of Kragujevac is the most impactful institution, but followed closely by three other institutions (table 5.23). In the UAE, UAE University has the largest output (30 publications) but a low citation impact (0.4) followed by University of Sharjah (9 publications with an average citation impact of 1.47).

Table 5.22 — Top 10 institutions in the topic by output

Institution	Scholarly Output	FWCI
Iran University of Science and Technology	78	0.74
Islamic Azad University	66	0.46
University of Kashan	65	1.03
University of Kragujevac	65	2.5
National University of Sciences and Technology Pakistan	64	1.01
Yunnan Normal University	59	2.35
Sungkyunkwan University	57	1.77
COMSATS Institute of Information Technology	46	0.89
University of Ljubljana	46	2.18
Tarbiat Modarres University	44	1.17

Table 5.23 — Top 10 institutions in the topic by impact

Institution	Scholarly Output	FWCI
University of Kragujevac	65	2.5
Yunnan Normal University	59	2.35
University of Primorska	31	2.19
University of Ljubljana	46	2.18
Nanjing University of Aeronautics and Astronautics	36	1.8
Sungkyunkwan University	57	1.77
Tarbiat Modarres University	44	1.17
University of Kashan	65	1.03
National University of Sciences and Technology Pakistan	64	1.01
COMSATS Institute of Information Technology	46	0.89

5.2.9 CONCRETE BEAMS AND GIRDERS; FIBER REINFORCED PLASTICS; STRENGTHENED BEAMS

With over 1,500 publications, this topic is prominent (98.6) with a rather low FWCI (0.73). The UAE accounts for just above 2% of all publications but has double the average citation impact (1.46). China has significantly more publications than any other country but also the lowest citation impact among the top publishers (table 5.24).

Table 5.24 — Top 10 countries in the topic by output

Country	Scholarly Output	FWCI
China	429	0.47
United States	186	1.1
Australia	116	1.01
Italy	108	1.27
Portugal	92	1.4
United Kingdom	92	0.83
India	77	0.53
Canada	64	0.86
Malaysia	62	0.69
Iran	57	0.63

The dominance of China is visible in the institutional list as well (table 5.25), although University of Minho has the largest output and citation impact (table 5.26). American University of Sharjah and UAE University account for most of the UAE output, with 18 and 12 publications respectively. The former also has much stronger FWCI (2.24) compared to the latter (0.41).

Table 5.24 — Top 10 institutions in the topic by output

Institution	Scholarly Output	FWCI
University of Minho	65	1.38
Southeast University	39	0.6
Ministry of Education China	37	0.63
Swinburne University of Technology	32	0.88
Tongji University	28	0.8
University of Malaya	28	0.89
Hong Kong Polytechnic University	27	1.43
Guangdong University of Technology	24	0.95
South China University of Technology	23	0.29
Universidade Nova de Lisboa	23	1.47

Institution	Scholarly Output	FWCI
University of Minho	65	1.38
Swinburne University of Technology	32	0.88
Ministry of Education China	37	0.63
Southeast University	39	0.6

5.2.10 UNMANNED AERIAL VEHICLES (UAV); CONTROL; QUADROTOR HELICOPTER

One of the largest topics analysed in this report, there are more than 2,700 publications under this topic with a growing trend. With a prominence percentile of 99.4, the average FWCI is 1.64. China has nearly double amount of publications compared to the nearest competitor (US), whereas Switzerland has the highest citation impact among the most published institutions. The UAE accounts for only 1.3% of the global output but has a high citation impact (2.3).

Table 5.27— Top 10 countries in the topic by output

Country	Scholarly Output	FWCI
China	616	1.22
United States	373	2.37
France	201	2.2
South Korea	144	1.69
Mexico	130	1.7
Canada	123	1.82
Japan	119	0.88
Italy	113	2.44
Germany	102	2.64
Switzerland	76	3.91

Table 5.28 — Top 10 institution in the topic by output

Institution	Scholarly Output	FWCI
CNRS	97	2.37
Beihang University	94	1.59
ETH Zurich	64	4.04
CINVESTAV-IPN	63	1.49
Universite de Technologie de Compiegne	56	2.25
Chinese Academy of Sciences	50	1.19
Nanjing University of Aeronautics and Astronautics	49	1.25
Seoul National University	37	2.88
Beijing Institute of Technology	32	1.33
Concordia University	31	2.43

Table 5.29 — Top 10 institution in the topic by impact

Institution	Scholarly Output	FWCI
ETH Zurich	64	4.04
Seoul National University	37	2.88
Concordia University	31	2.43
CNRS	97	2.37
Tsinghua University	30	2.37
Universite de Technologie de Compiegne	56	2.25
Beihang University	94	1.59
CINVESTAV-IPN	63	1.49
Beijing Institute of Technology	32	1.33
Nanjing University of Aeronautics and Astronautics	49	1.25

5.2.11 HARDWARE; INTEGRATED CIRCUITS; HARDWARE TROJAN

This is a fast-growing topic with over 850 publications and a citation impact of 2.73. The UAE accounts for over 4% of all publications and has a very high citation impact of 5.9 (table 5.30). The United States accounts for more than half of all publications and has a citation impact of 3.8, second to UAE among the most published nations.

Table 5.30— Top 10 countries in the topic by output

Country	Scholarly Output	FWCI
United States	474	3.82
China	116	1.23
India	69	1.6
France	48	2.64
United Arab Emirates	36	5.9
Germany	32	2.85
Japan	28	2.4
Singapore	22	1.61
Hong Kong	20	3.11
Iran	16	0.7

The list of most published institutions is almost entirely dominated by the US institutions (table 5.31). NYU Abu Dhabi which ranks 7th in terms of output has the highest citation impact of all institutions, with a significant difference to the other institutions.

Table 5.31— Top 10 institutions in the topic by output

Institution	Scholarly Output	FWCI
University of Florida	60	3.23
New York University	51	5.94
University of Central Florida	46	4.39
University of Connecticut	34	5.46
University of Texas at Dallas	34	4.06
University of Maryland	32	3.12
NYU Abu Dhabi	30	7.05
Intel	23	4.11
Nanyang Technological University	19	1.5
CNRS	17	4.23

Table 5.31 — Top 10 institutions in the topic by output

Institution	Scholarly Output	FWCI
NYU Abu Dhabi	30	7.05
New York University	51	5.94
University of Connecticut	34	5.46
University of Central Florida	46	4.39
University of Texas at Dallas	34	4.06
University of Florida	60	3.23
University of Maryland	32	3.12
Intel	23	4.11
Nanyang Technological University	19	1.5
CNRS	17	4.23

Table 5.32— Top 10 institutions in the topic by output

Institution	Scholarly Output	FWCI
NYU Abu Dhabi	30	7.05
New York University	51	5.94
University of Connecticut	34	5.46
University of Central Florida	46	4.39
University of Texas at Dallas	34	4.06
University of Florida	60	3.23
University of Maryland	32	3.12

6. MOBILITY

In this section, we study the mobility patterns of UAE's researchers, answering questions such as whether UAE's researchers are internationally mobile and whether UAE is attractive to international talent.

KEY HIGHLIGHTS

INFLOWING RESEARCHERS

20.5%

OF ALL ACTIVE RESEARCHERS
WITH AN AVERAGE FWCI OF 1.24

OUTGOING RESEARCHERS

10.9 %

OF ALL ACTIVE RESEARCHERS
WITH AN AVERAGE FWCI OF 1.43

TRANSITORY RESEARCHERS

54.9%

OF ALL ACTIVE RESEARCHERS
WITH AN AVERAGE FWCI OF 1.65

SEDENTARY RESEARCHERS

13.7%

OF ALL ACTIVE RESEARCHERS
WITH AN AVERAGE FWCI OF 1.18

6.1 MOBILITY

In this section we present an overview of research mobility using Scopus author profile data to derive a history of active UAE author affiliations recorded in their published articles and to assign them to mobility classes defined by the type and duration of observed moves. It should be noted that the tracking of affiliation history of researchers may be more limited for the fields of Social Sciences and Humanities as a reasonable part of research in these fields are in the form of books, monographs and non-textual data. These data sources are not captured in this report.

A total of 148,450 author profiles were identified in Scopus of which 52,466 were identified as active researchers. The 'active researcher' filter is used to excludes author profiles with relatively few articles over the 21-year period of analyses as these profiles are likely to represent those individuals who left the research system. The filter therefore restricts the analysis to those authors with at least 1 article in the latest 5-year period (2013-2018) and at least 10 articles in the entire 21 year period (1996-2018), or those with fewer than 10 articles in 1998-2018 but at least 4 articles in 2012-2016.

MOBILITY CLASSES

The measurement of international researcher mobility in the published literature is complicated due to the difficulties involved in teasing out long-term mobility from short-term mobility (such as doctoral research visits, sabbaticals, secondments, etc.), which might be deemed instead to reflect a form of collaboration. In this study, researchers who stayed overseas for 2 years or more were considered migratory, and were further subdivided into those where the researcher remained abroad or where they subsequently returned to their original country. Researchers who stayed overseas for less than 2 years were deemed transitory, and were also further subdivided into those who mostly published under a UAE and non-UAE affiliation. Since author nationality is not captured in article or author data, authors are assumed to be from the country where they first published (for migratory mobility) or from the country where they published the majority of their articles (for transitory mobility). In individual cases, these criteria may result in authors being assigned migratory patterns that may not accurately reflect the real situation, but such errors are assumed to be evenly distributed across the groups and so the overall pattern remains valid. Researchers without any apparent mobility based on their published affiliations were considered non-migratory.

This mobility analysis is based on each author's output for the period 1996-2018, which captures a mixed cohort of researchers. Some researchers may publish articles during the entire period, others have become active only relatively recently, and yet others may have (mostly)

stopped publishing. This means that researchers who have entered the cohort relatively recently will not have had as many opportunities to be included in the Migratory and Transitory groups. Moreover, the set of short publication history researchers also includes PhD students, who typically do not move between different institutions. Therefore, as a consequence of the methodology, and not necessarily any behavioural differences, the relative mobility of the short publication history researchers will be lower.

MOBILITY INDICATORS

To better understand the composition of each group defined above, three aggregate indicators were calculated for each to represent the productivity and seniority of the researchers they contain, and the field-weighted citation impact of their articles.

- **Relative Productivity** — represents a measure of the articles per year since the first appearance of each researcher as an author during the period 1996–2018, relative to all UAE researchers in the same period. This measure does not include research outputs that are not in the form of articles, proceedings and reviews.

- **Relative length of service (seniority)** — represents the average number of years since the first appearance of each researchers who have published during the period 1996–2018 and are in a given migratory category, relative to average number of years since the first appearance across all UAE researchers in the same period.

- **Field-weighted citation impact (FWCI)** — is calculated for all articles in each mobility class.

All three indicators are calculated for each author's entire output in the period (i.e., not just those articles listing a UAE address for that author).

Figure 6.1 gives a snapshot of researcher mobility patterns based on the available data at the author level for the 1996-2018 period. UAE active researchers were highly mobile internationally, with over 86% of active researchers having published at least one article under a non-UAE affiliation (total of Inflow, Transitory and Outflow categories). Although the researchers classified as non-migratory may have travelled and collaborated internationally in this period, their activities did not lead to a peer-reviewed article with an affiliation to a non-UAE institution, captured in the Scopus database.

The relative productivity rate (articles published per year since first appearance as an author) of all active researchers were higher than that of the non-migratory researchers.

Nearly 55% of all active researchers were transitory researchers and they have the highest productivity and citation impact among the active groups. There is a larger group of researcher that come to the UAE than those that leave, however these researchers have lower productivity and citation impact than those researchers that leave the UAE. Around 14% of the active researcher were non-migratory and are associated with the lowest productivity and citation impact. A detailed breakdown of the mobility classes and associated definitions are provided in Appendix K.

Figure 6.1— Mobility chart for UAE researchers, 2018-1996. Source: Scopus

UAE

Active research: **6,793**
FCWI: **1.53**

INFLOW

Researchers: **20.5%**
Relative productivity: **0.73**
Seniority: **1.20**
FWCI: **1.24**

NON-MIGRATORY

Researchers: **13.7%**
Relative productivity: **0.47**
Seniority: **1.20**
FWCI: **1.18**
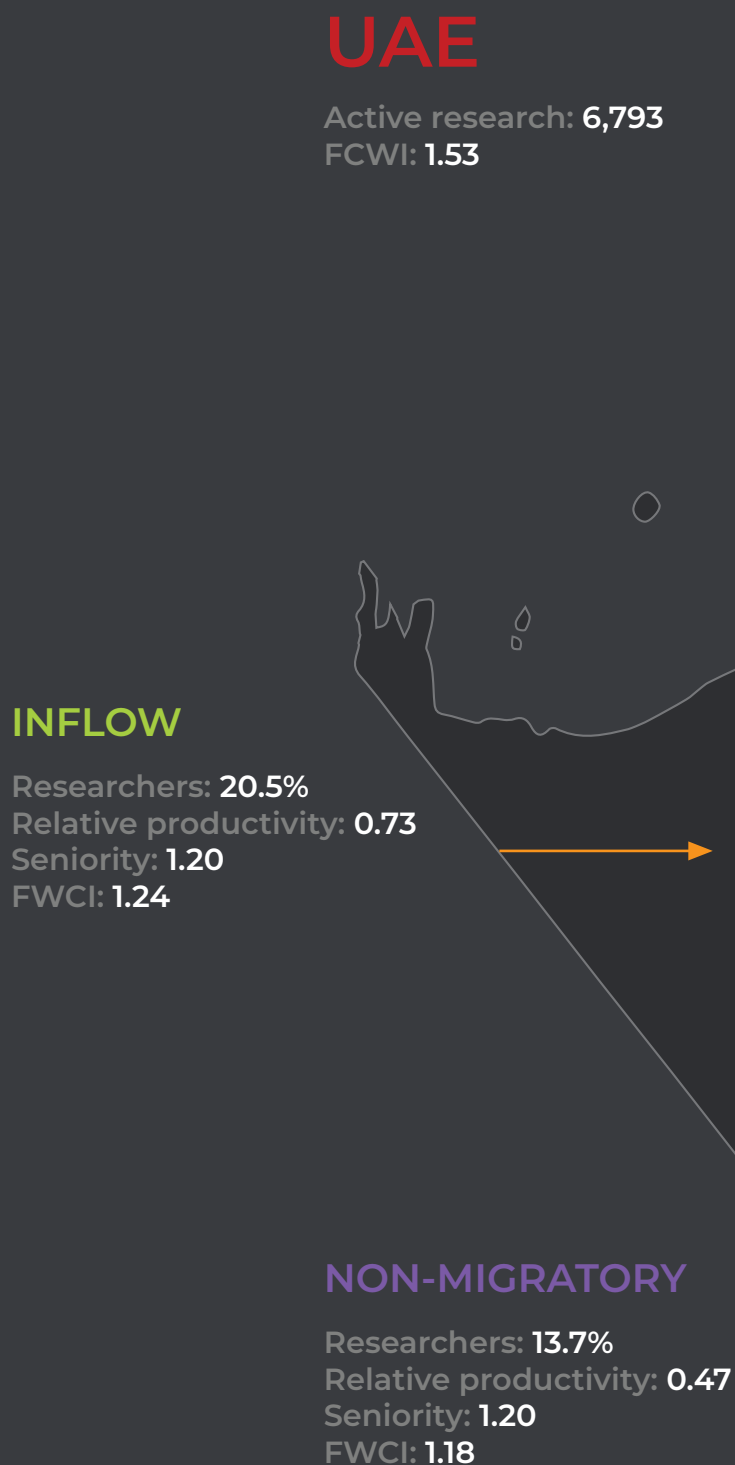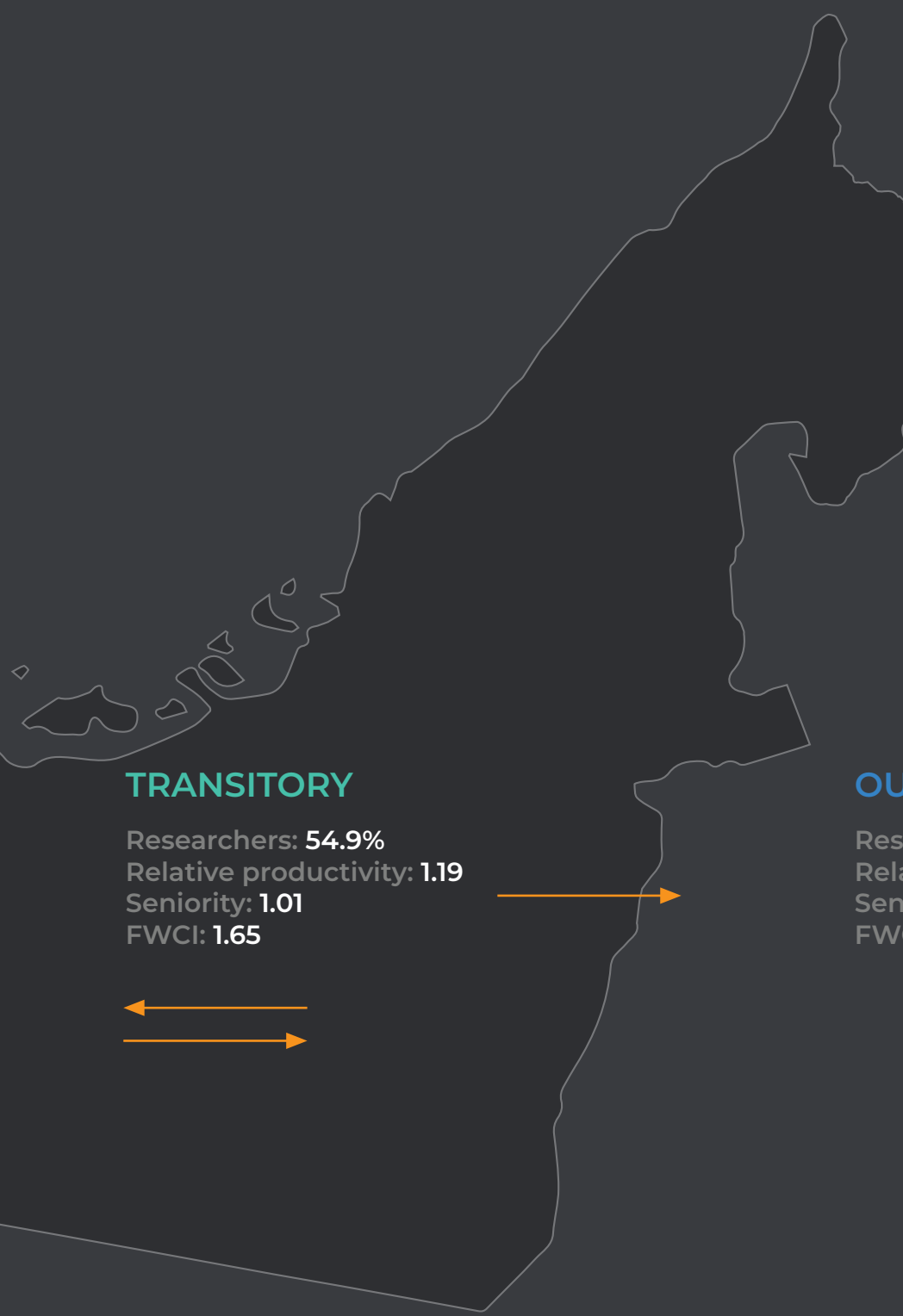
TRANSITORY

Researchers: 54.9%
Relative productivity: 1.19
Seniority: 1.01
FWCI: 1.65

OUTFLOW

Researchers: 10.9%
Relative productivity: 0.99
Seniority: 1.22
FWCI: 1.43

APPENDIX A
TOP 5 UAE INSTITUTIONS BY OUTPUT, PER SUBJECT AREA

Institution	Period	Subject area	Publications	Citations	FWCI
United Arab Emirates University	2008-2012	Natural Sciences	1,902	29,508	0.99
Khalifa University of Science and Technology	2008-2012	Natural Sciences	1,596	25,310	1.33
American University of Sharjah	2008-2012	Natural Sciences	792	8,854	0.89
University of Sharjah	2008-2012	Natural Sciences	490	4,890	0.79
Zayed University	2008-2012	Natural Sciences	171	1,753	1.44
Khalifa University of Science and Technology	2013-2017	Natural Sciences	4,500	30,000	1.45
United Arab Emirates University	2013-2017	Natural Sciences	2,205	12,489	1.02
NYU Abu Dhabi	2013-2017	Natural Sciences	1,063	8,104	1.55
American University of Sharjah	2013-2017	Natural Sciences	1,029	4,488	0.96
University of Sharjah	2013-2017	Natural Sciences	944	3,229	1.08

Institution	Period	Subject area	Publications	Citations	FWCI
Khalifa University of Science and Technology	2008-2012	Engineering & Technologies	1,289	20,854	1.40
United Arab Emirates University	2008-2012	Engineering & Technologies	783	11,294	1.21
American University of Sharjah	2008-2012	Engineering & Technologies	484	5,018	1.00
University of Sharjah	2008-2012	Engineering & Technologies	264	2,459	0.80
NYU Abu Dhabi	2008-2012	Engineering & Technologies	60	975	2.47
Khalifa University of Science and Technology	2013-2017	Engineering & Technologies	3,475	24,729	1.52
United Arab Emirates University	2013-2017	Engineering & Technologies	939	4,350	1.19
American University of Sharjah	2013-2017	Engineering & Technologies	743	3,566	1.07
University of Sharjah	2013-2017	Engineering & Technologies	614	2,153	1.19
NYU Abu Dhabi	2013-2017	Engineering & Technologies	365	2,578	2.05

Institution	Period	Subject area	Publications	Citations	FWCI
United Arab Emirates University	2008-2012	Medical Sciences	919	18,135	0.95
University of Sharjah	2008-2012	Medical Sciences	198	2,833	0.86
Dubai Hospital	2008-2012	Medical Sciences	189	4,042	0.95
Tawam Hospital	2008-2012	Medical Sciences	167	1,909	0.70
Gulf Medical University	2008-2012	Medical Sciences	93	1,786	0.99
United Arab Emirates University	2013-2017	Medical Sciences	1,199	9,264	1.14
University of Sharjah	2013-2017	Medical Sciences	366	1,319	0.83
Khalifa University of Science and Technology	2013-2017	Medical Sciences	304	1,839	1.25
NYU Abu Dhabi	2013-2017	Medical Sciences	224	2,112	1.57
Tawam Hospital	2013-2017	Medical Sciences	220	1,056	0.85

Institution	Period	Subject area	Publications	Citations	FWCI
United Arab Emirates University	2008-2012	Agricultural Sciences	173	2,824	0.79
American University of Sharjah	2008-2012	Agricultural Sciences	25	385	0.88
EAD - Environment Agency Abu Dhabi	2008-2012	Agricultural Sciences	22	363	0.96
Khalifa University of Science and Technology	2008-2012	Agricultural Sciences	18	173	0.72
Zayed University	2008-2012	Agricultural Sciences	12	209	0.88
United Arab Emirates University	2013-2017	Agricultural Sciences	240	1,500	0.97
Khalifa University of Science and Technology	2013-2017	Agricultural Sciences	75	640	1.56
NYU Abu Dhabi	2013-2017	Agricultural Sciences	68	569	1.70
University of Sharjah	2013-2017	Agricultural Sciences	52	189	0.93
American University of Sharjah	2013-2017	Agricultural Sciences	28	108	0.79

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Institution	Period	Subject area	Publications	Citations	FWCI
United Arab Emirates University	2008-2012	Social Sciences	404	4,315	0.96
American University of Sharjah	2008-2012	Social Sciences	350	4,136	0.95
University of Sharjah	2008-2012	Social Sciences	197	1,519	0.70
Khalifa University of Science and Technology	2008-2012	Social Sciences	157	1,476	1.30
Zayed University	2008-2012	Social Sciences	131	1,436	1.19
United Arab Emirates University	2013-2017	Social Sciences	514	1,611	0.91
American University of Sharjah	2013-2017	Social Sciences	439	1,760	1.18
Zayed University	2013-2017	Social Sciences	309	1,067	1.11
Khalifa University of Science and Technology	2013-2017	Social Sciences	302	2,090	1.76
NYU Abu Dhabi	2013-2017	Social Sciences	251	883	1.25

Institution	Period	Subject area	Publications	Citations	FWCI
United Arab Emirates University	2008-2012	Humanities	81	948	0.76
American University of Sharjah	2008-2012	Humanities	48	316	1.12
University of Sharjah	2008-2012	Humanities	19	95	0.51
NYU Abu Dhabi	2008-2012	Humanities	17	99	0.82
Zayed University	2008-2012	Humanities	16	135	0.89
NYU Abu Dhabi	2013-2017	Humanities	106	417	1.51
American University of Sharjah	2013-2017	Humanities	75	147	0.88
United Arab Emirates University	2013-2017	Humanities	71	95	0.61
Zayed University	2013-2017	Humanities	49	108	1.05
Khalifa University of Science and Technology	2013-2017	Humanities	37	99	1.15

APPENDIX B
TOP 5 UAE INSTITUTIONS BY CITATIONS, PER SUBJECT AREA

Institution	Period	Subject area	Publications	Citations	FWCI
United Arab Emirates University	2008-2012	Natural Sciences	1,902	29,508	0.99
Khalifa University of Science and Technology	2008-2012	Natural Sciences	1,596	25,310	1.33
American University of Sharjah	2008-2012	Natural Sciences	792	8,854	0.89
University of Sharjah	2008-2012	Natural Sciences	490	4,890	0.79
NYU Abu Dhabi	2008-2012	Natural Sciences	93	2,558	1.94
Khalifa University of Science and Technology	2013-2017	Natural Sciences	4,500	30,000	1.45
United Arab Emirates University	2013-2017	Natural Sciences	2,205	12,489	1.02
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University of Sharjah	2013-2017	Natural Sciences	944	3,229	1.08

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University of Sharjah	2008-2012	Engineering & Technologies	264	2,459	0.80
NYU Abu Dhabi	2008-2012	Engineering & Technologies	60	975	2.47
Khalifa University of Science and Technology	2013-2017	Engineering & Technologies	3,475	24,729	1.52
United Arab Emirates University	2013-2017	Engineering & Technologies	939	4,350	1.19
American University of Sharjah	2013-2017	Engineering & Technologies	743	3,566	1.07
NYU Abu Dhabi	2013-2017	Engineering & Technologies	365	2,578	2.05
University of Sharjah	2013-2017	Engineering & Technologies	614	2,153	1.19

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Institution	Period	Subject area	Publications	Citations	FWCI
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Dubai Hospital	2008-2012	Medical Sciences	189	4,042	0.95
Khalifa University of Science and Technology	2008-2012	Medical Sciences	70	3,095	2.43
University of Sharjah	2008-2012	Medical Sciences	198	2,833	0.86
Tawam Hospital	2008-2012	Medical Sciences	167	1,909	0.70
United Arab Emirates University	2013-2017	Medical Sciences	1,199	9,264	1.14
NYU Abu Dhabi	2013-2017	Medical Sciences	224	2,112	1.57
Khalifa University of Science and Technology	2013-2017	Medical Sciences	304	1,839	1.25
University of Sharjah	2013-2017	Medical Sciences	366	1,319	0.83
Dubai Hospital	2013-2017	Medical Sciences	216	1,229	0.96

Institution	Period	Subject area	Publications	Citations	FWCI
Khalifa University of Science and Technology	2008-2012	Engineering & Technologies	1,289	20,854	1.40
United Arab Emirates University	2008-2012	Engineering & Technologies	783	11,294	1.21
American University of Sharjah	2008-2012	Engineering & Technologies	484	5,018	1.00
University of Sharjah	2008-2012	Engineering & Technologies	264	2,459	0.80
NYU Abu Dhabi	2008-2012	Engineering & Technologies	60	975	2.47
Khalifa University of Science and Technology	2013-2017	Engineering & Technologies	3,475	24,729	1.52
United Arab Emirates University	2013-2017	Engineering & Technologies	939	4,350	1.19
American University of Sharjah	2013-2017	Engineering & Technologies	743	3,566	1.07
NYU Abu Dhabi	2013-2017	Engineering & Technologies	365	2,578	2.05
University of Sharjah	2013-2017	Engineering & Technologies	614	2,153	1.19

Institution	Period	Subject area	Publications	Citations	FWCI
United Arab Emirates University	2008-2012	Medical Sciences	919	18,135	0.95
Dubai Hospital	2008-2012	Medical Sciences	189	4,042	0.95
Khalifa University of Science and Technology	2008-2012	Medical Sciences	70	3,095	2.43
University of Sharjah	2008-2012	Medical Sciences	198	2,833	0.86
Tawam Hospital	2008-2012	Medical Sciences	167	1,909	0.70
United Arab Emirates University	2013-2017	Medical Sciences	1,199	9,264	1.14
NYU Abu Dhabi	2013-2017	Medical Sciences	224	2,112	1.57
Khalifa University of Science and Technology	2013-2017	Medical Sciences	304	1,839	1.25
University of Sharjah	2013-2017	Medical Sciences	366	1,319	0.83
Dubai Hospital	2013-2017	Medical Sciences	216	1,229	0.96

Institution	Period	Subject area	Publications	Citations	FWCI
United Arab Emirates University	2008-2012	Agricultural Sciences	173	2,824	0.79
NYU Abu Dhabi	2008-2012	Agricultural Sciences	12	464	2.28
American University of Sharjah	2008-2012	Agricultural Sciences	25	385	0.88
EAD - Environment Agency Abu Dhabi	2008-2012	Agricultural Sciences	22	363	0.96
Sheikh Khalifa Medical City	2008-2012	Agricultural Sciences	1	349	15.81
United Arab Emirates University	2013-2017	Agricultural Sciences	240	1,500	0.97
Khalifa University of Science and Technology	2013-2017	Agricultural Sciences	75	640	1.56
NYU Abu Dhabi	2013-2017	Agricultural Sciences	68	569	1.70
University of Sharjah	2013-2017	Agricultural Sciences	52	189	0.93
Zayed University	2013-2017	Agricultural Sciences	28	123	0.65

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TOP 5 UAE INSTITUTIONS BY CITATIONS, PER SUBJECT AREA

Institution	Period	Subject area	Publications	Citations	FWCI
United Arab Emirates University	2008-2012	Social Sciences	404	4,315	0.96
American University of Sharjah	2008-2012	Social Sciences	350	4,136	0.95
University of Sharjah	2008-2012	Social Sciences	197	1,519	0.70
Khalifa University of Science and Technology	2008-2012	Social Sciences	157	1,476	1.30
Zayed University	2008-2012	Social Sciences	131	1,436	1.19
Khalifa University of Science and Technology	2013-2017	Social Sciences	302	2,090	1.76
American University of Sharjah	2013-2017	Social Sciences	439	1,760	1.18
United Arab Emirates University	2013-2017	Social Sciences	514	1,611	0.91
Zayed University	2013-2017	Social Sciences	309	1,067	1.11
NYU Abu Dhabi	2013-2017	Social Sciences	251	883	1.25

Institution	Period	Subject area	Publications	Citations	FWCI
United Arab Emirates University	2008-2012	Humanities	81	948	0.76
American University of Sharjah	2008-2012	Humanities	48	316	1.12
Zayed University	2008-2012	Humanities	16	135	0.89
NYU Abu Dhabi	2008-2012	Humanities	17	99	0.82
University of Sharjah	2008-2012	Humanities	19	95	0.51
NYU Abu Dhabi	2013-2017	Humanities	106	417	1.51
American University of Sharjah	2013-2017	Humanities	75	147	0.88
Zayed University	2013-2017	Humanities	49	108	1.05
Khalifa University of Science and Technology	2013-2017	Humanities	37	99	1.15
United Arab Emirates University	2013-2017	Humanities	71	95	0.61

APPENDIX C
TOP 5 UAE INSTITUTIONS BY FWCI, PER SUBJECT AREA

Institution	Period	Subject area	Publications	Citations	FWCI
United Arab Emirates University	2008-2012	Natural Sciences	1,902	29,508	0.99
Khalifa University of Science and Technology	2008-2012	Natural Sciences	1,596	25,310	1.33
American University of Sharjah	2008-2012	Natural Sciences	792	8,854	0.89
University of Sharjah	2008-2012	Natural Sciences	490	4,890	0.79
NYU Abu Dhabi	2008-2012	Natural Sciences	93	2,558	1.94
NYU Abu Dhabi	2013-2017	Natural Sciences	1,063	8,104	1.55
Khalifa University of Science and Technology	2013-2017	Natural Sciences	4,500	30,000	1.45
Tawam Hospital	2013-2017	Natural Sciences	81	673	1.14
University of Sharjah	2013-2017	Natural Sciences	944	3,229	1.08
United Arab Emirates University	2013-2017	Natural Sciences	2,205	12,489	1.02

Institution	Period	Subject area	Publications	Citations	FWCI
Khalifa University of Science and Technology	2008-2012	Engineering & Technologies	1,289	20,854	1.40
United Arab Emirates University	2008-2012	Engineering & Technologies	783	11,294	1.21
American University of Sharjah	2008-2012	Engineering & Technologies	484	5,018	1.00
University of Sharjah	2008-2012	Engineering & Technologies	264	2,459	0.80
NYU Abu Dhabi	2008-2012	Engineering & Technologies	60	975	2.47
NYU Abu Dhabi	2013-2017	Engineering & Technologies	365	2,578	2.05
Khalifa University of Science and Technology	2013-2017	Engineering & Technologies	3,475	24,729	1.52
Higher Colleges of Technology	2013-2017	Engineering & Technologies	143	500	1.39
Zayed University	2013-2017	Engineering & Technologies	114	407	1.35
University of Sharjah	2013-2017	Engineering & Technologies	614	2,153	1.19

APPENDIX D
SHARE AND IMPACT OF INTERNATIONAL COLLABORATION PER SUBJECT AND COMPARATOR

SHARE AND FWCI OF INTERNATIONAL COLLABORATION IN THE FIELD OF NATURAL SCIENCES

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	CAGR
UAE	58.2%	61.4%	58.3%	58.6%	58.4%	62.1%	64.2%	65.0%	66.2%	66.4%	1.5%
CHE	63.4%	64.4%	65.2%	65.8%	66.6%	67.6%	68.7%	70.5%	71.6%	72.6%	1.5%
IRL	53.1%	53.6%	54.1%	54.4%	58.5%	59.8%	61.4%	64.3%	65.8%	66.9%	2.6%
NZL	50.9%	51.7%	55.0%	55.3%	56.0%	58.1%	59.7%	62.0%	61.4%	64.5%	2.7%
SAU	44.5%	48.1%	58.9%	66.6%	69.7%	69.1%	72.9%	76.1%	77.0%	77.7%	6.4%
SGP	47.4%	49.6%	50.6%	53.1%	55.5%	59.0%	62.1%	64.2%	64.9%	66.3%	3.8%

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	CAGR
UAE	1.15	1.07	1.26	1.34	1.19	1.24	1.32	1.33	1.22	1.23	0.8%
CHE	1.96	2.01	1.98	1.91	1.92	1.93	1.89	2.01	1.91	1.92	-0.2%
IRL	1.68	1.64	1.62	1.67	1.70	1.71	1.56	1.69	1.74	1.73	0.4%
NZL	1.51	1.60	1.66	1.52	1.51	1.65	1.51	1.50	1.58	1.64	1.0%
SAU	0.93	1.18	1.30	1.31	1.27	1.50	1.49	1.63	1.74	2.05	9.2%
SGP	1.66	1.79	2.01	2.00	2.11	2.04	1.91	1.97	2.06	1.95	1.8%

SHARE AND FWCI OF INTERNATIONAL COLLABORATION IN THE FIELD OF ENGINEERING AND TECHNOLOGY

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	CAGR
UAE	61.1%	58.3%	61.6%	55.4%	64.1%	58.7%	63.2%	64.6%	63.3%	65.1%	0.7%
CHE	56.2%	59.0%	57.8%	57.5%	58.7%	59.3%	61.2%	62.7%	64.4%	65.5%	1.7%
IRL	48.2%	47.5%	48.2%	49.4%	53.9%	56.5%	56.5%	61.2%	62.2%	65.4%	3.5%
NZL	43.8%	43.5%	47.2%	50.6%	50.6%	50.7%	54.0%	55.4%	55.9%	60.0%	3.6%
SAU	41.1%	47.5%	59.3%	65.7%	70.6%	70.2%	72.5%	75.0%	75.4%	76.2%	7.1%
SGP	42.5%	43.8%	44.1%	46.7%	49.6%	53.5%	55.8%	59.1%	60.3%	62.3%	4.4%

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	CAGR
UAE	1.35	1.14	1.17	1.45	1.36	1.57	1.54	1.46	1.28	1.32	-0.3%
CHE	2.10	2.06	1.99	1.90	1.94	1.92	1.90	1.86	1.83	1.86	-1.4%
IRL	1.61	1.60	1.63	1.77	1.97	1.71	1.56	1.60	1.61	1.54	-0.5%
NZL	1.53	1.49	1.72	1.55	1.39	1.32	1.33	1.30	1.46	1.78	1.7%
SAU	0.97	1.15	1.37	1.32	1.36	1.51	1.79	1.79	1.89	2.47	11.0%
SGP	1.74	1.83	2.08	2.12	2.29	2.37	2.11	2.02	2.17	2.11	2.2%

APPENDIX D
SHARE AND IMPACT OF INTERNATIONAL COLLABORATION PER SUBJECT AND COMPARATOR

SHARE AND FWCI OF INTERNATIONAL COLLABORATION IN THE FIELD OF MEDICAL SCIENCES

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	CAGR
UAE	59.6%	61.7%	61.1%	62.8%	65.6%	69.2%	71.3%	71.0%	79.1%	80.8%	3.4%
CHE	58.6%	60.3%	61.5%	62.5%	64.0%	64.4%	66.5%	68.2%	69.9%	71.3%	2.2%
IRL	48.1%	47.9%	46.4%	45.6%	48.7%	50.4%	52.7%	55.7%	58.8%	60.0%	2.5%
NZL	48.4%	49.9%	47.8%	48.1%	49.0%	54.7%	56.0%	56.9%	58.1%	59.8%	2.4%
SAU	35.5%	37.3%	43.6%	55.3%	61.2%	63.3%	66.7%	70.8%	72.2%	70.4%	7.9%
SGP	47.5%	50.0%	54.8%	54.3%	56.7%	58.2%	59.1%	61.6%	62.2%	65.3%	3.6%

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	CAGR
UAE	1.47	1.28	1.19	1.37	1.14	1.85	1.43	1.49	1.29	1.05	-3.7%
CHE	2.25	2.27	2.35	2.44	2.32	2.19	2.14	2.30	2.22	2.26	0.0%
IRL	2.14	2.12	2.10	2.33	2.09	2.24	2.09	2.20	2.34	2.11	-0.1%
NZL	2.14	2.16	1.86	2.09	1.97	1.93	1.85	2.05	2.00	2.02	-0.6%
SAU	1.13	1.23	1.19	1.33	1.32	1.76	1.40	1.28	1.58	1.37	2.1%
SGP	2.03	2.09	2.10	2.08	2.22	2.04	2.09	1.84	2.02	1.98	-0.3%

SHARE AND FWCI OF INTERNATIONAL COLLABORATION IN THE FIELD OF AGRICULTURAL SCIENCES

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	CAGR
UAE	59.5%	67.7%	51.5%	62.8%	64.6%	70.4%	70.1%	80.6%	77.4%	75.8%	2.7%
CHE	63.1%	64.7%	65.0%	68.1%	67.6%	70.4%	72.1%	70.6%	73.2%	73.6%	1.7%
IRL	49.1%	50.7%	47.7%	51.3%	57.5%	56.8%	62.7%	62.7%	65.6%	64.2%	3.0%
NZL	48.1%	48.0%	49.0%	54.0%	52.8%	55.2%	57.8%	58.2%	58.6%	60.8%	2.6%
SAU	42.4%	43.6%	49.9%	60.7%	66.8%	73.1%	78.3%	80.2%	82.1%	79.5%	7.2%
SGP	64.2%	64.6%	67.2%	67.5%	69.1%	71.8%	73.2%	75.3%	74.6%	75.2%	1.8%

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	CAGR
UAE	1.23	1.04	1.16	1.52	0.81	1.39	1.23	1.24	1.04	1.12	-1.0%
CHE	2.09	1.85	1.98	1.83	1.71	1.69	1.68	1.74	1.64	1.75	-2.0%
IRL	1.72	1.54	1.81	1.99	1.61	1.59	1.81	1.74	1.73	1.91	1.1%
NZL	1.53	1.59	1.69	1.45	1.47	1.45	1.63	1.48	1.55	1.49	-0.3%
SAU	0.53	0.89	0.98	0.99	1.27	1.10	1.14	1.42	1.44	1.37	11.1%
SGP	1.65	1.54	1.45	2.05	1.47	1.23	1.39	1.20	1.38	1.59	-0.5%

APPENDIX D
SHARE AND IMPACT OF INTERNATIONAL COLLABORATION PER SUBJECT AND COMPARATOR

SHARE AND FWCI OF INTERNATIONAL COLLABORATION IN THE FIELD OF SOCIAL SCIENCES

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	CAGR
UAE	31.5%	50.6%	42.4%	42.5%	47.5%	54.2%	51.1%	53.5%	53.8%	57.8%	7.0%
CHE	46.7%	46.8%	48.4%	50.3%	52.2%	55.0%	54.4%	56.3%	57.1%	58.8%	2.6%
IRL	36.7%	36.5%	35.6%	34.6%	37.6%	40.5%	40.6%	40.5%	44.0%	44.6%	2.2%
NZL	36.3%	39.9%	37.9%	38.3%	39.5%	43.5%	43.8%	42.3%	43.3%	46.4%	2.8%
SAU	33.3%	41.3%	56.8%	51.8%	54.8%	57.1%	59.4%	63.6%	64.1%	65.0%	7.7%
SGP	47.3%	48.8%	46.6%	50.0%	50.1%	52.0%	53.5%	56.5%	56.5%	58.3%	2.4%

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	CAGR
UAE	0.93	1.20	1.53	1.35	0.99	1.42	1.22	1.34	1.25	0.97	0.4%
CHE	1.98	1.94	1.88	1.96	2.10	1.76	1.77	2.35	1.83	1.93	-0.3%
IRL	1.93	1.87	1.70	1.70	1.63	1.72	1.74	1.71	1.53	1.67	-1.6%
NZL	1.44	1.39	1.52	1.59	1.54	1.58	1.47	1.71	1.64	1.71	1.9%
SAU	1.07	0.85	1.07	1.22	1.17	1.43	1.56	1.50	1.41	1.54	4.2%
SGP	1.42	1.65	1.80	1.86	1.78	1.77	1.67	1.76	1.73	1.53	0.8%

SHARE AND FWCI OF INTERNATIONAL COLLABORATION IN THE FIELD OF SOCIAL SCIENCES

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	CAGR
UAE	32.8%	58.3%	23.7%	23.9%	29.7%	35.1%	41.2%	34.9%	44.3%	43.5%	3.2%
CHE	35.4%	34.2%	34.7%	35.8%	33.7%	36.4%	35.0%	34.2%	34.1%	36.8%	0.5%
IRL	17.4%	20.7%	17.1%	22.6%	28.2%	21.4%	24.4%	29.8%	25.3%	28.5%	5.7%
NZL	26.8%	27.2%	29.3%	29.6%	32.8%	33.8%	32.1%	33.0%	32.2%	33.4%	2.5%
SAU	50.0%	35.0%	34.6%	41.4%	29.6%	39.1%	48.9%	49.2%	47.0%	56.6%	1.4%
SGP	25.9%	29.6%	28.6%	33.2%	40.5%	32.0%	37.5%	38.2%	39.6%	41.6%	5.4%

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	CAGR
UAE	1.29	1.08	1.55	1.36	1.00	2.00	1.65	1.43	1.63	1.08	-2.0%
CHE	2.53	3.36	2.42	2.30	2.48	3.57	2.18	1.81	2.02	2.43	-0.5%
IRL	2.11	1.72	1.64	2.16	1.67	1.74	1.81	2.12	1.68	2.10	0.0%
NZL	2.09	4.46	1.88	2.43	2.01	4.66	2.01	2.47	1.99	2.31	1.1%
SAU	1.52	0.67	0.87	1.12	1.58	2.58	1.72	1.61	1.93	1.88	2.4%
SGP	3.61	2.18	2.20	2.21	2.26	2.19	2.21	2.61	1.86	2.41	-4.4%

APPENDIX E
TOP 20 INTERNATIONAL COLLABORATION PARTNERS FOR UAE, PER SUBJECT AND PERIOD

TOP 20 PARTNERS IN NATURAL SCIENCES

Country	Period	Joint publications	Joint publication FWCI	Partner FWCI	Country	Period	Joint publications	Joint publication FWCI	Partner FWCI
USA	2008-2012	1,153	1.70	1.52	USA	2013-2017	2,598	1.58	1.49
CAN	2008-2012	578	1.37	1.39	GBR	2013-2017	1,175	1.44	1.54
GBR	2008-2012	503	1.37	1.51	CAN	2013-2017	1,160	1.38	1.39
FRA	2008-2012	260	1.82	1.33	IND	2013-2017	576	1.22	0.83
DEU	2008-2012	246	1.53	1.40	SAU	2013-2017	575	1.49	1.50
AUS	2008-2012	240	1.73	1.43	FRA	2013-2017	568	1.53	1.30
IND	2008-2012	238	1.33	0.80	CHN	2013-2017	545	1.74	1.00
EGY	2008-2012	235	0.87	0.79	EGY	2013-2017	511	1.33	0.92
JOR	2008-2012	160	0.66	0.75	AUS	2013-2017	499	1.59	1.53
SAU	2008-2012	144	0.98	1.06	DEU	2013-2017	474	1.74	1.40
NLD	2008-2012	139	1.97	1.67	ITA	2013-2017	442	1.51	1.43
CHN	2008-2012	118	1.89	0.80	MYS	2013-2017	351	1.19	0.89
MYS	2008-2012	115	0.81	0.83	PAK	2013-2017	313	1.22	1.06
JPN	2008-2012	108	1.03	0.98	JOR	2013-2017	289	1.09	0.90
ITA	2008-2012	97	2.67	1.31	GRC	2013-2017	255	1.94	1.23
OMN	2008-2012	95	0.81	0.87	QAT	2013-2017	247	1.57	1.57
SGP	2008-2012	92	1.74	1.73	ESP	2013-2017	237	1.63	1.32
TUR	2008-2012	89	1.47	0.94	JPN	2013-2017	233	1.64	0.98
SWE	2008-2012	84	1.33	1.47	KOR	2013-2017	232	1.22	1.03
DZA	2008-2012	81	0.89	0.69	NLD	2013-2017	229	2.05	1.66
KOR	2008-2012	77	1.52	1.04	TUN	2013-2017	222	0.92	0.79
IRN	2008-2012	77	0.92	0.86	OMN	2013-2017	186	1.29	0.98
ESP	2008-2012	74	1.41	1.29	DZA	2013-2017	180	1.36	0.75
KWT	2008-2012	58	1.13	0.80	TUR	2013-2017	168	1.43	0.90
BEL	2008-2012	57	2.13	1.53	IRN	2013-2017	166	1.23	1.02
LBN	2008-2012	57	0.85	0.89	SWE	2013-2017	159	1.97	1.53
ZAF	2008-2012	53	2.38	1.02	SGP	2013-2017	154	1.83	1.83
BRA	2008-2012	49	1.70	0.83	PRT	2013-2017	146	1.61	1.23
FIN	2008-2012	49	1.59	1.43	DNK	2013-2017	118	2.07	1.66
TUN	2008-2012	49	0.79	0.77	CHE	2013-2017	115	2.48	1.77

TOP 20 PARTNERS IN ENGINEERING AND TECHNOLOGY

Country	Period	Joint publications	Joint publication FWCI	Partner FWCI	Country	Period	Joint publications	Joint publication FWCI	Partner FWCI
USA	2008-2012	632	1.70	1.52	USA	2013-2017	1,318	1.72	1.46
CAN	2008-2012	295	1.39	1.39	CAN	2013-2017	687	1.37	1.36
GBR	2008-2012	248	1.13	1.45	GBR	2013-2017	590	1.55	1.49
IND	2008-2012	124	0.93	0.93	CHN	2013-2017	320	1.79	0.90
EGY	2008-2012	97	1.00	0.89	EGY	2013-2017	285	1.43	1.08
AUS	2008-2012	90	1.81	1.52	IND	2013-2017	273	1.35	0.93
FRA	2008-2012	89	1.41	1.35	SAU	2013-2017	260	1.36	1.72
SGP	2008-2012	87	1.84	1.80	MYS	2013-2017	253	1.23	0.99
CHN	2008-2012	78	1.63	0.71	AUS	2013-2017	224	1.35	1.58
JOR	2008-2012	72	0.46	0.71	FRA	2013-2017	219	1.57	1.21
KOR	2008-2012	67	1.48	1.13	KOR	2013-2017	188	1.06	1.07
SAU	2008-2012	63	1.17	1.13	JOR	2013-2017	179	1.03	0.88
DEU	2008-2012	61	0.96	1.39	GRC	2013-2017	169	2.44	1.34
JPN	2008-2012	59	1.60	0.99	PAK	2013-2017	168	1.46	1.34
NLD	2008-2012	56	1.15	1.64	DEU	2013-2017	156	1.26	1.35
MYS	2008-2012	55	0.78	0.94	ITA	2013-2017	155	1.55	1.56
DZA	2008-2012	52	1.04	0.78	QAT	2013-2017	133	1.89	1.76
KWT	2008-2012	49	1.49	0.87	DZA	2013-2017	116	1.56	0.86
IRN	2008-2012	45	0.87	0.99	ESP	2013-2017	106	1.63	1.34
TUR	2008-2012	33	0.98	1.13	IRN	2013-2017	105	1.25	1.24
ITA	2008-2012	32	2.42	1.50	TUR	2013-2017	102	1.25	1.01
QAT	2008-2012	31	1.34	1.36	SGP	2013-2017	101	1.70	1.97
OMN	2008-2012	31	0.45	0.86	TUN	2013-2017	94	0.76	0.87
LBN	2008-2012	25	0.79	1.00	JPN	2013-2017	91	1.27	0.97
ZAF	2008-2012	24	0.83	0.93	NLD	2013-2017	86	1.41	1.56
TUN	2008-2012	23	0.96	0.82	SWE	2013-2017	83	1.92	1.51
BRA	2008-2012	22	0.68	0.94	PRT	2013-2017	78	1.62	1.30
FIN	2008-2012	20	0.89	1.50	OMN	2013-2017	76	1.10	0.99
NZL	2008-2012	19	1.84	1.34	LBN	2013-2017	49	1.08	1.10
ESP	2008-2012	19	1.04	1.37	BRA	2013-2017	48	1.67	0.88

APPENDIX E
TOP 20 INTERNATIONAL COLLABORATION PARTNERS FOR UAE, PER SUBJECT AND PERIOD

TOP 20 PARTNERS IN MEDICAL SCIENCES

Country	Period	Joint publications	Joint publication FWCI	Partner FWCI	Country	Period	Joint publications	Joint publication FWCI	Partner FWCI
USA	2008-2012	424	1.87	1.54	USA	2013-2017	1,052	2.03	1.49
GBR	2008-2012	258	1.42	1.60	GBR	2013-2017	543	2.50	1.68
DEU	2008-2012	159	1.95	1.41	SAU	2013-2017	364	1.36	1.19
CAN	2008-2012	142	1.95	1.65	IND	2013-2017	342	2.72	0.65
SAU	2008-2012	132	1.13	0.91	EGY	2013-2017	312	1.27	0.82
EGY	2008-2012	117	0.98	0.81	DEU	2013-2017	301	3.77	1.48
IND	2008-2012	109	1.23	0.68	CAN	2013-2017	298	4.07	1.67
FRA	2008-2012	94	1.53	1.37	AUS	2013-2017	273	3.55	1.64
NLD	2008-2012	90	2.36	1.86	ITA	2013-2017	204	3.11	1.52
OMN	2008-2012	89	1.26	0.69	QAT	2013-2017	168	1.46	1.44
AUS	2008-2012	84	1.29	1.61	FRA	2013-2017	166	4.29	1.51
KWT	2008-2012	83	1.02	0.74	OMN	2013-2017	150	1.30	0.89
QAT	2008-2012	74	1.19	1.07	SWE	2013-2017	139	4.64	1.81
JOR	2008-2012	69	0.90	0.73	CHN	2013-2017	138	7.04	0.90
ITA	2008-2012	66	2.90	1.37	JOR	2013-2017	129	1.10	0.74
BHR	2008-2012	63	1.02	0.55	MYS	2013-2017	125	4.18	0.81
AUT	2008-2012	53	2.44	1.60	GRC	2013-2017	125	1.96	1.38
ESP	2008-2012	53	2.25	1.18	CHE	2013-2017	123	3.70	1.85
LBN	2008-2012	50	1.09	1.06	LBN	2013-2017	122	1.09	1.16
CHE	2008-2012	49	1.81	1.85	TUR	2013-2017	120	4.83	0.65
JPN	2008-2012	48	2.31	0.85	ESP	2013-2017	119	2.43	1.37
SWE	2008-2012	44	3.34	1.72	BRA	2013-2017	118	7.73	0.96
PAK	2008-2012	38	2.00	0.64	JPN	2013-2017	118	5.39	0.92
CHN	2008-2012	36	2.50	0.68	PAK	2013-2017	116	3.84	0.73
IRN	2008-2012	36	2.29	0.63	NLD	2013-2017	110	3.09	1.86
YEM	2008-2012	34	1.36	0.76	KOR	2013-2017	103	3.63	0.99
BEL	2008-2012	33	2.66	1.78	ETH	2013-2017	99	0.94	0.98
NZL	2008-2012	33	1.60	1.50	ZAF	2013-2017	96	6.07	1.39
TUR	2008-2012	32	3.12	0.58	KWT	2013-2017	93	1.40	0.90
HUN	2008-2012	32	1.55	1.12	IRN	2013-2017	83	4.60	0.74

TOP 20 PARTNERS IN AGRICULTURAL SCIENCES

Country	Period	Joint publications	Joint publication FWCI	Partner FWCI	Country	Period	Joint publications	Joint publication FWCI	Partner FWCI
USA	2008-2012	73	1.70	1.37	USA	2013-2017	152	1.48	1.25
GBR	2008-2012	44	1.86	1.60	GBR	2013-2017	89	1.69	1.48
EGY	2008-2012	39	0.83	0.77	AUS	2013-2017	57	2.07	1.41
CAN	2008-2012	33	1.45	1.39	DEU	2013-2017	49	1.49	1.32
AUS	2008-2012	30	2.10	1.39	CAN	2013-2017	40	1.93	1.31
DEU	2008-2012	22	2.35	1.31	FRA	2013-2017	40	1.91	1.34
FRA	2008-2012	22	2.09	1.35	SAU	2013-2017	38	1.59	1.17
IND	2008-2012	20	1.24	0.59	IND	2013-2017	35	1.38	0.66
OMN	2008-2012	16	1.05	0.93	JOR	2013-2017	35	0.81	0.71
CHN	2008-2012	14	2.85	0.91	QAT	2013-2017	31	1.11	1.13
NLD	2008-2012	14	1.49	1.74	OMN	2013-2017	28	1.38	1.06
ITA	2008-2012	12	1.72	1.29	ESP	2013-2017	27	1.51	1.32
ZAF	2008-2012	12	1.34	0.99	EGY	2013-2017	27	1.13	0.86
CHE	2008-2012	10	2.31	1.65	ITA	2013-2017	24	2.22	1.43
PAK	2008-2012	10	0.84	0.71	PAK	2013-2017	21	1.46	0.81
MYS	2008-2012	10	0.49	0.78	MYS	2013-2017	21	0.73	0.83
SWE	2008-2012	9	1.31	1.53	GRC	2013-2017	18	1.21	1.28
SAU	2008-2012	8	1.83	0.80	THA	2013-2017	18	0.94	0.83
TUR	2008-2012	7	1.05	0.67	CHN	2013-2017	16	2.90	0.91
JOR	2008-2012	7	0.69	0.65	TUN	2013-2017	16	1.15	1.01
JPN	2008-2012	6	2.17	0.86	ETH	2013-2017	15	0.76	0.94
KEN	2008-2012	5	2.31	1.27	HUN	2013-2017	14	0.52	0.97
QAT	2008-2012	5	1.64	1.36	JPN	2013-2017	13	2.05	0.87
THA	2008-2012	5	0.88	0.86	NZL	2013-2017	13	2.04	1.31
NZL	2008-2012	5	0.50	1.29	NLD	2013-2017	13	1.80	1.59
IRN	2008-2012	5	0.50	0.60	MAR	2013-2017	13	1.77	0.96
IRQ	2008-2012	4	0.98	0.40	ZAF	2013-2017	12	2.81	1.09
ESP	2008-2012	4	0.93	1.37	SWE	2013-2017	12	1.61	1.47
AUT	2008-2012	4	0.86	1.34	BRA	2013-2017	11	2.36	0.72
SDN	2008-2012	4	0.60	0.46	KWT	2013-2017	11	1.40	1.19

APPENDIX E
TOP 20 INTERNATIONAL COLLABORATION PARTNERS FOR UAE, PER SUBJECT AND PERIOD

TOP 20 PARTNERS IN SOCIAL SCIENCES

Country	Period	Joint publications	Joint publication FWCI	Partner FWCI	Country	Period	Joint publications	Joint publication FWCI	Partner FWCI
USA	2008-2012	246	1.38	1.35	USA	2013-2017	552	1.55	1.31
GBR	2008-2012	142	1.11	1.41	GBR	2013-2017	318	1.32	1.46
CAN	2008-2012	107	1.46	1.36	CAN	2013-2017	170	1.55	1.31
AUS	2008-2012	85	1.83	1.24	AUS	2013-2017	151	1.42	1.34
IND	2008-2012	53	1.18	0.67	MYS	2013-2017	104	0.93	0.73
NZL	2008-2012	40	0.97	1.18	IND	2013-2017	97	1.29	0.70
MYS	2008-2012	31	0.69	0.73	FRA	2013-2017	96	1.19	0.93
FRA	2008-2012	24	0.99	0.88	CHN	2013-2017	89	1.98	1.02
CHN	2008-2012	22	2.79	0.72	SAU	2013-2017	80	1.45	1.19
JOR	2008-2012	20	0.69	0.46	DEU	2013-2017	71	1.37	1.28
SAU	2008-2012	19	1.38	0.88	JOR	2013-2017	58	0.77	0.64
NLD	2008-2012	19	1.30	1.70	EGY	2013-2017	56	0.92	0.94
EGY	2008-2012	19	0.55	0.85	PAK	2013-2017	56	0.62	0.82
DEU	2008-2012	18	0.71	1.22	QAT	2013-2017	53	1.08	1.06
SGP	2008-2012	17	3.90	1.44	ITA	2013-2017	49	1.54	1.31
FIN	2008-2012	14	1.38	1.38	ZAF	2013-2017	46	1.05	0.85
KOR	2008-2012	14	1.10	1.06	NLD	2013-2017	40	1.06	1.73
GRC	2008-2012	12	0.64	1.02	NZL	2013-2017	36	1.53	1.25
TUR	2008-2012	12	0.40	0.83	GRC	2013-2017	36	1.41	1.12
HKG	2008-2012	11	1.05	1.33	TUN	2013-2017	34	1.00	0.85
BHR	2008-2012	11	0.78	0.54	LBN	2013-2017	31	1.01	1.18
SWE	2008-2012	10	1.39	1.51	DNK	2013-2017	29	3.10	1.67
MAR	2008-2012	9	1.44	0.63	KOR	2013-2017	29	1.72	0.96
BEL	2008-2012	9	1.06	1.45	TUR	2013-2017	26	1.66	0.77
JPN	2008-2012	9	0.84	0.76	FIN	2013-2017	25	1.47	1.49
PAK	2008-2012	9	0.21	0.64	IRN	2013-2017	23	2.48	0.87
LBN	2008-2012	8	1.70	1.11	SWE	2013-2017	23	1.56	1.49
QAT	2008-2012	8	1.35	0.99	ESP	2013-2017	23	1.42	1.00
OMN	2008-2012	8	1.24	0.75	KWT	2013-2017	22	0.61	0.81
KWT	2008-2012	8	1.13	0.75	SGP	2013-2017	21	1.30	1.42

TOP 20 PARTNERS IN HUMANITIES

Country	Period	Joint publications	Joint publication FWCI	Partner FWCI	Country	Period	Joint publications	Joint publication FWCI	Partner FWCI
USA	2008-2012	27	1.13	1.45	USA	2013-2017	81	2.37	1.36
GBR	2008-2012	16	1.74	1.53	GBR	2013-2017	51	2.77	1.53
AUS	2008-2012	9	1.08	1.46	AUS	2013-2017	19	2.65	1.51
CAN	2008-2012	8	1.60	1.43	FRA	2013-2017	15	2.07	0.80
FRA	2008-2012	8	1.32	0.77	DEU	2013-2017	12	2.15	1.20
DEU	2008-2012	8	0.84	1.16	CAN	2013-2017	9	2.65	1.35
KWT	2008-2012	4	1.29	0.73	ITA	2013-2017	8	3.15	0.94
BEL	2008-2012	4	0.55	1.27	SAU	2013-2017	8	1.28	1.33
QAT	2008-2012	3	2.41	1.39	MYS	2013-2017	8	1.05	0.82
KOR	2008-2012	3	1.84	1.05	NLD	2013-2017	7	1.61	1.62
IND	2008-2012	3	1.01	0.75	EGY	2013-2017	7	0.63	0.86
IRL	2008-2012	3	0.95	1.06	IND	2013-2017	7	0.52	0.79
JOR	2008-2012	3	0.00	0.76	CHN	2013-2017	6	3.58	1.03
CHE	2008-2012	2	2.69	1.47	SWE	2013-2017	6	0.85	1.47
FIN	2008-2012	2	2.26	1.45	ESP	2013-2017	6	0.68	0.73
HKG	2008-2012	2	2.20	1.44	JPN	2013-2017	6	0.57	0.99
BHR	2008-2012	2	1.88	0.93	JOR	2013-2017	6	0.00	0.64
JPN	2008-2012	2	1.81	0.99	FIN	2013-2017	5	2.28	1.59
AUT	2008-2012	2	1.47	1.22	NZL	2013-2017	5	1.43	1.55
CHN	2008-2012	2	1.10	0.93	AUT	2013-2017	5	0.56	1.20
NLD	2008-2012	2	1.03	1.59	GRC	2013-2017	4	1.23	1.23
SDN	2008-2012	2	0.91	0.69	PAK	2013-2017	4	0.91	0.77
NZL	2008-2012	2	0.85	1.56	QAT	2013-2017	4	0.56	1.43
OMN	2008-2012	1	3.76	0.58	CHE	2013-2017	3	10.17	1.44
SAU	2008-2012	1	3.76	0.90	OMN	2013-2017	3	4.40	0.68
YEM	2008-2012	1	3.76	1.71	PRT	2013-2017	3	2.58	1.12
CZE	2008-2012	1	2.35	0.67	ZAF	2013-2017	3	1.35	1.00
IRN	2008-2012	1	1.37	0.57	THA	2013-2017	3	0.81	0.83
BRN	2008-2012	1	1.19	0.82	CZE	2013-2017	2	7.43	0.75
ITA	2008-2012	1	1.03	1.00	LBN	2013-2017	2	3.64	1.21

APPENDIX F
TOP 5 UAE INSTITUTIONS BY INTERNATIONAL COLLABORATION, PER SUBJECT AREA

TOP 5 INSTITUTIONS IN NATURAL SCIENCES BY NUMBER OF INTERNATIONALLY COLLABORATED PUBLICATIONS

Institution	Period	Output	FWCI	Publication share
Khalifa University of Science and Technology	2008-2012	1,119	1.53	70.1%
United Arab Emirates University	2008-2012	1,055	1.14	55.5%
American University of Sharjah	2008-2012	413	1.02	52.1%
University of Sharjah	2008-2012	261	0.96	53.3%
Zayed University	2008-2012	126	1.48	73.7%
Institution	**Period**	**Output**	**FWCI**	**Publication share**
Khalifa University of Science and Technology	2013-2017	2,939	1.58	65.3%
United Arab Emirates University	2013-2017	1,448	1.15	65.7%
NYU Abu Dhabi	2013-2017	924	1.64	86.9%
University of Sharjah	2013-2017	592	1.24	62.7%
American University of Sharjah	2013-2017	569	0.91	55.3%

TOP 5 INSTITUTIONS IN NATURAL SCIENCES BY SHARE OF INTERNATIONALLY COLLABORATED PUBLICATIONS

Institution	Period	Output	FWCI	Publication share
INSEAD Abu Dhabi	2008-2012	2	0.85	100.0%
NYU Abu Dhabi	2008-2012	83	1.93	89.2%
Heriot-Watt University Dubai Campus	2008-2012	26	0.80	83.9%
Al Marfaq Hospital	2008-2012	3	1.32	75.0%
Sheikh Khalifa Medical City	2008-2012	6	4.36	75.0%
Institution	**Period**	**Output**	**FWCI**	**Publication share**
Institute of Management Technology, Dubai	2013-2017	5	0.60	100.0%
Abu Dhabi Education Council	2013-2017	2	1.44	100.0%
Dubai Hospital	2013-2017	28	1.77	96.6%
Sheikh Khalifa Medical City	2013-2017	24	0.77	96.0%
Mohammed Bin Rashid University of Medicine and Health Sciences	2013-2017	22	3.33	95.7%

TOP 5 INSTITUTIONS IN ENGINEERING AND TECHNOLOGY BY NUMBER OF INTERNATIONALLY COLLABORATED PUBLICATIONS

Institution	Period	Output	FWCI	Publication share
Khalifa University of Science and Technology	2008-2012	916	1.61	71.1%
United Arab Emirates University	2008-2012	405	1.30	51.7%
American University of Sharjah	2008-2012	217	1.05	44.8%
University of Sharjah	2008-2012	145	0.94	54.9%
NYU Abu Dhabi	2008-2012	52	2.48	86.7%

Institution	Period	Output	FWCI	Publication share
Khalifa University of Science and Technology	2013-2017	2,226	1.67	64.1%
United Arab Emirates University	2013-2017	565	1.37	60.2%
University of Sharjah	2013-2017	411	1.33	66.9%
American University of Sharjah	2013-2017	407	1.03	54.8%
NYU Abu Dhabi	2013-2017	291	2.32	79.7%

TOP 5 INSTITUTIONS IN AGRICULTURAL SCIENCES BY SHARE OF INTERNATIONALLY COLLABORATED PUBLICATIONS

Institution	Period	Output	FWCI	Publication share
Ministry of Health United Arab Emirates	2008-2012	2	0.00	100.0%
Sheikh Khalifa Medical City	2008-2012	1	0.33	100.0%
Heriot-Watt University Dubai Campus	2008-2012	17	0.93	89.5%
Alhosn University	2008-2012	20	0.45	87.0%
NYU Abu Dhabi	2008-2012	52	2.48	86.7%

Institution	Period	Output	FWCI	Publication share
Khalifa University of Science and Technology	2013-2017	2226	1.67	64.1%
United Arab Emirates University	2013-2017	565	1.37	60.2%
American University of Sharjah	2013-2017	407	1.03	54.8%
University of Sharjah	2013-2017	411	1.33	66.9%
NYU Abu Dhabi	2013-2017	291	2.32	79.7%

APPENDIX F
TOP 5 UAE INSTITUTIONS BY INTERNATIONAL COLLABORATION, PER SUBJECT AREA

TOP 5 INSTITUTIONS IN MEDICAL SCIENCES BY NUMBER OF INTERNATIONALLY COLLABORATED PUBLICATIONS

Institution	Period	Output	FWCI	Publication share
United Arab Emirates University	2008-2012	557	1.15	60.6%
University of Sharjah	2008-2012	129	0.98	65.2%
Dubai Hospital	2008-2012	98	1.39	51.9%
Tawam Hospital	2008-2012	61	1.26	36.5%
Gulf Medical University	2008-2012	52	1.48	55.9%
Institution	Period	Output	FWCI	Publication share
United Arab Emirates University	2013-2017	875	1.26	73.0%
University of Sharjah	2013-2017	286	0.91	78.1%
Khalifa University of Science and Technology	2013-2017	230	1.33	75.7%
NYU Abu Dhabi	2013-2017	206	1.63	92.0%
Dubai Hospital	2013-2017	129	1.43	59.7%

TOP 5 INSTITUTIONS IN MEDICAL SCIENCES BY SHARE OF INTERNATIONALLY COLLABORATED PUBLICATIONS

Institution	Period	Output	FWCI	Publication share
Abu Dhabi University	2008-2012	6	0.81	100.0%
Sheikh Khalifa Medical City	2008-2012	57	1.46	86.4%
NYU Abu Dhabi	2008-2012	5	2.79	83.3%
Khalifa University of Science and Technology	2008-2012	56	2.97	80.0%
Zayed University	2008-2012	26	0.93	78.8%
Institution	Period	Output	FWCI	Publication share
Alhosn University	2013-2017	1	0.00	100.0%
Emirates College of Technology	2013-2017	1	0.00	100.0%
NYU Abu Dhabi	2013-2017	206	1.63	92.0%
Mohammed Bin Rashid University of Medicine and Health Sciences	2013-2017	59	1.72	90.8%
American University in Dubai	2013-2017	11	1.11	84.6%

TOP 5 INSTITUTIONS IN AGRICULTURAL SCIENCES BY NUMBER OF INTERNATIONALLY COLLABORATED PUBLICATIONS

Institution	Period	Output	FWCI	Publication share
Khalifa University of Science and Technology	2008-2012	916	1.61	71.1%
United Arab Emirates University	2008-2012	405	1.30	51.7%
American University of Sharjah	2008-2012	217	1.05	44.8%
University of Sharjah	2008-2012	145	0.94	54.9%
NYU Abu Dhabi	2008-2012	52	2.48	86.7%

Institution	Period	Output	FWCI	Publication share
Khalifa University of Science and Technology	2013-2017	2,226	1.67	64.1%
United Arab Emirates University	2013-2017	565	1.37	60.2%
University of Sharjah	2013-2017	411	1.33	66.9%
American University of Sharjah	2013-2017	407	1.03	54.8%
NYU Abu Dhabi	2013-2017	291	2.32	79.7%

APPENDIX F
TOP 5 UAE INSTITUTIONS BY INTERNATIONAL COLLABORATION, PER SUBJECT AREA

TOP 5 INSTITUTIONS IN AGRICULTURAL SCIENCES BY NUMBER OF INTERNATIONALLY COLLABORATED PUBLICATIONS

Institution	Period	Output	FWCI	Publication share
Tawam Hospital	2008-2012	1	0.72	100.0%
Al Marfaq Hospital	2008-2012	1	2.48	100.0%
Higher Colleges of Technology	2008-2012	1	0.67	100.0%
ADWEA	2008-2012	2	0.20	100.0%
Sheikh Khalifa Medical City	2008-2012	1	15.81	100.0%
Alhosn University	2008-2012	1	0.81	100.0%
Al Ain University of Science and Technology	2008-2012	2	0.39	100.0%
Ajman University of Science and Technology	2008-2012	1	0.00	100.0%
Institution	**Period**	**Output**	**FWCI**	**Publication share**
Ministry of Health United Arab Emirates	2013-2017	2	0.87	100.0%
Higher Colleges of Technology	2013-2017	1	0.50	100.0%
Sheikh Khalifa Medical City	2013-2017	3	1.64	100.0%
Alhosn University	2013-2017	1	0.00	100.0%
Al Ain University of Science and Technology	2013-2017	1	1.10	100.0%
Emirates College for Advanced Education	2013-2017	1	0.55	100.0%
Paris Sorbonne University Abu Dhabi	2013-2017	2	0.30	100.0%
Gulf Medical University	2013-2017	2	0.49	100.0%
Dubai Hospital	2013-2017	1	0.23	100.0%
Ajman University of Science and Technology	2013-2017	1	0.22	100.0%
Emirates College of Technology	2013-2017	1	1.40	100.0%
University of Sharjah	2013-2017	286	0.91	78.1%

TOP 5 INSTITUTIONS IN SOCIAL SCIENCES BY NUMBER OF INTERNATIONALLY COLLABORATED PUBLICATIONS

Institution	Period	Output	FWCI	Publication share
United Arab Emirates University	2008-2012	154	1.26	38.1%
American University of Sharjah	2008-2012	141	1.18	40.3%
Khalifa University of Science and Technology	2008-2012	74	1.76	47.1%
Zayed University	2008-2012	72	1.24	55.0%
University of Sharjah	2008-2012	60	0.93	30.5%

Institution	Period	Output	FWCI	Publication share
United Arab Emirates University	2013-2017	255	1.09	49.6%
American University of Sharjah	2013-2017	229	1.40	52.2%
Zayed University	2013-2017	182	1.43	58.9%
NYU Abu Dhabi	2013-2017	167	1.49	66.5%
Khalifa University of Science and Technology	2013-2017	156	2.46	51.7%

TOP 5 INSTITUTIONS IN SOCIAL SCIENCES BY SHARE OF INTERNATIONALLY COLLABORATED PUBLICATIONS

Institution	Period	Output	FWCI	Publication share
Al Marfaq Hospital	2008-2012	1	1.70	100.0%
Ministry of Health United Arab Emirates	2008-2012	1	3.76	100.0%
EAD - Environment Agency Abu Dhabi	2008-2012	1	0.53	100.0%
Dubai Hospital	2008-2012	1	0.72	100.0%
Abu Dhabi Education Council	2008-2012	1	0.00	100.0%

Institution	Period	Output	FWCI	Publication share
Al Marfaq Hospital	2013-2017	2	4.14	100.0%
Ministry of Health United Arab Emirates	2013-2017	1	0.88	100.0%
EAD - Environment Agency Abu Dhabi	2013-2017	1	2.02	100.0%
Sheikh Khalifa Medical City	2013-2017	1	0.57	100.0%
Paris Sorbonne University Abu Dhabi	2013-2017	9	1.46	90.0%

APPENDIX F
TOP 5 UAE INSTITUTIONS BY INTERNATIONAL COLLABORATION, PER SUBJECT AREA

TOP 5 INSTITUTIONS IN HUMANITIES BY NUMBER OF INTERNATIONALLY COLLABORATED PUBLICATIONS

Institution	Period	Output	FWCI	Publication share
United Arab Emirates University	2008-2012	28	1.17	34.6%
American University of Sharjah	2008-2012	7	0.75	14.6%
Zayed University	2008-2012	6	1.30	37.5%
Khalifa University of Science and Technology	2008-2012	5	0.51	55.6%
University of Sharjah	2008-2012	3	0.40	15.8%

Institution	Period	Output	FWCI	Publication share
NYU Abu Dhabi	2013-2017	63	1.93	59.4%
United Arab Emirates University	2013-2017	19	0.65	26.8%
American University of Sharjah	2013-2017	16	1.75	21.3%
Khalifa University of Science and Technology	2013-2017	16	2.20	43.2%
Zayed University	2013-2017	16	1.42	32.7%

TOP 5 INSTITUTIONS IN NATURAL SCIENCES BY SHARE OF INTERNATIONALLY COLLABORATED PUBLICATIONS

Institution	Period	Output	FWCI	Publication share
Ministry of Health United Arab Emirates	2008-2012	1	3.76	100.0%
ADNOC	2008-2012	1	0.77	100.0%
Al Ain University of Science and Technology	2008-2012	1	0.00	100.0%
INSEAD Abu Dhabi	2008-2012	1	1.08	100.0%
Heriot-Watt University Dubai Campus	2008-2012	1	1.37	100.0%

Institution	Period	Output	FWCI	Publication share
Gulf Medical University	2013-2017	2	0.00	100.0%
Dubai Hospital	2013-2017	1	1.23	100.0%
Emirates College of Technology	2013-2017	1	0.29	100.0%
Heriot-Watt University Dubai Campus	2013-2017	1	0.00	100.0%
Higher Colleges of Technology	2013-2017	3	1.88	75.0%

APPENDIX G
SHARE AND IMPACT OF ACADEMIC-CORPORATE PUBLICATIONS PER COUNTRY, SUBJECT AND YEAR

NUMBER AND SHARE (IN PARENTHESES) OF ACADEMIC-CORPORATE COLLABORATION IN THE FIELD OF NATURAL SCIENCES

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	CAGR
UAE	39 (3.8%)	50 (4.2%)	46 (3.4%)	61 (3.8%)	72 (3.8%)	54 (2.8%)	51 (2.2%)	75 (2.5%)	72 (2.2%)	97 (2.6%)	10.7%
CHE	1893 (10.0%)	1931 (9.7%)	1911 (9.2%)	1954 (8.9%)	2047 (8.6%)	2115 (8.6%)	2184 (8.6%)	2224 (8.7%)	2261 (8.8%)	2236 (8.8%)	1.9%
IRL	305 (5.8%)	304 (5.1%)	332 (5.2%)	368 (5.5%)	409 (6.2%)	427 (6.5%)	405 (6.1%)	383 (5.9%)	433 (6.4%)	369 (5.7%)	2.1%
NZL	236 (4.3%)	230 (4.0%)	202 (3.4%)	241 (3.7%)	235 (3.5%)	304 (4.3%)	265 (3.6%)	246 (3.5%)	272 (3.8%)	288 (4.0%)	2.2%
SAU	68 (3.6%)	70 (2.6%)	116 (2.8%)	155 (2.4%)	187 (2.2%)	257 (2.4%)	279 (2.2%)	397 (2.9%)	408 (2.8%)	362 (2.5%)	20.4%
SGP	417 (4.8%)	416 (4.4%)	349 (3.4%)	405 (3.7%)	409 (3.4%)	414 (3.4%)	420 (3.2%)	411 (3.1%)	471 (3.5%)	456 (3.3%)	1.0%
WLD	47472 (4.1%)	47360 (3.8%)	45024 (3.5%)	47372 (3.5%)	47903 (3.4%)	47175 (3.3%)	47239 (3.1%)	46961 (3.1%)	48043 (3.1%)	45637 (2.9%)	-0.4%

FWCI OF ACADEMIC-CORPORATE COLLABORATION IN THE FIELD OF NATURAL SCIENCES

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	CAGR
UAE	1.04	1.61	3.34	1.48	1.54	1.13	1.09	2.19	1.48	0.74	-3.8%
CHE	2.32	2.41	2.14	2.18	2.24	2.07	2.32	2.21	2.42	2.37	0.2%
IRL	2.26	2.09	1.84	2.02	2.13	2.27	1.85	2.16	1.73	1.90	-1.9%
NZL	1.73	2.23	2.39	1.94	1.82	2.02	2.33	2.13	1.97	2.13	2.3%
SAU	0.99	1.14	1.41	1.55	1.43	2.32	2.02	1.93	1.85	1.82	7.1%
SGP	1.96	2.45	3.24	2.31	2.44	2.50	2.00	2.52	2.27	1.83	-0.7%
WLD	1.63	1.68	1.65	1.68	1.61	1.56	1.56	1.54	1.49	1.42	-1.5%

APPENDIX G
SHARE AND IMPACT OF ACADEMIC-CORPORATE PUBLICATIONS PER COUNTRY, SUBJECT AND YEAR

NUMBER AND SHARE (IN PARENTHESES) OF ACADEMIC-CORPORATE COLLABORATION IN THE FIELD OF ENGINEERING AND TECHNOLOGY

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	CAGR
UAE	17 (3.6%)	21 (3.4%)	18 (2.6%)	35 (3.8%)	25 (2.4%)	43 (3.5%)	37 (2.9%)	39 (2.4%)	38 (2.0%)	47 (2.3%)	10.7%
CHE	902 (13.7%)	831 (12.7%)	811 (12.1%)	795 (11.2%)	812 (11.2%)	804 (10.9%)	869 (10.8%)	888 (10.5%)	918 (11.3%)	925 (11.5%)	1.9%
IRL	163 (8.0%)	119 (5.8%)	131 (5.8%)	119 (4.9%)	143 (6.2%)	168 (7.1%)	180 (7.1%)	195 (7.7%)	177 (6.8%)	142 (5.7%)	2.1%
NZL	77 (5.1%)	72 (4.7%)	58 (3.6%)	86 (4.5%)	67 (3.7%)	57 (3.1%)	45 (2.2%)	73 (3.7%)	51 (2.5%)	76 (3.6%)	2.2%
SAU	41 (5.3%)	44 (3.5%)	65 (3.8%)	98 (3.4%)	118 (3.2%)	137 (3.1%)	131 (2.3%)	168 (2.6%)	195 (2.8%)	177 (2.5%)	20.4%
SGP	277 (4.8%)	231 (4.1%)	178 (2.9%)	199 (3.3%)	180 (2.8%)	163 (2.4%)	179 (2.4%)	214 (2.8%)	298 (3.8%)	309 (3.9%)	1.0%
WLD	28785 (4.9%)	27417 (4.6%)	26055 (4.2%)	27203 (4.0%)	27702 (4.0%)	26934 (3.7%)	27773 (3.5%)	27286 (3.6%)	27542 (3.6%)	26108 (3.2%)	-0.4%

FWCI OF ACADEMIC-CORPORATE COLLABORATION IN THE FIELD OF ENGINEERING AND TECHNOLOGY

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	CAGR
UAE	0.85	1.52	1.09	0.83	1.85	1.00	0.96	2.20	1.73	0.86	0.2%
CHE	2.15	2.17	2.00	2.22	2.15	2.13	2.22	2.19	2.20	2.03	-0.7%
IRL	2.12	1.83	2.19	2.10	1.99	1.66	2.11	2.11	1.67	1.35	-4.8%
NZL	0.94	1.93	3.18	1.47	1.53	1.74	2.29	1.67	1.08	2.15	9.6%
SAU	1.01	1.03	1.35	1.28	1.32	2.00	2.09	1.82	1.63	1.72	6.1%
SGP	1.87	2.48	3.71	2.51	2.33	2.79	1.74	2.10	2.20	1.67	-1.3%
WLD	1.49	1.51	1.51	1.56	1.48	1.42	1.41	1.34	1.28	1.27	-1.8%

NUMBER AND SHARE (IN PARENTHESES) OF ACADEMIC-CORPORATE COLLABORATION IN THE FIELD OF MEDICAL SCIENCES

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	CAGR
UAE	17 (4.2%)	17 (4.0%)	22 (4.2%)	38 (6.6%)	53 (8.7%)	24 (3.6%)	30 (3.8%)	41 (4.4%)	48 (4.5%)	59 (4.9%)	10.7%
CHE	993 (8.9%)	1045 (8.8%)	1068 (8.5%)	1160 (8.6%)	1243 (8.6%)	1277 (8.4%)	1328 (8.2%)	1416 (8.7%)	1495 (9.1%)	1547 (9.2%)	1.9%
IRL	153 (4.9%)	161 (4.5%)	135 (3.5%)	147 (3.6%)	144 (3.5%)	195 (4.5%)	157 (3.4%)	164 (3.6%)	168 (3.7%)	245 (5.2%)	2.1%
NZL	92 (2.9%)	106 (3.1%)	93 (2.5%)	128 (3.2%)	125 (2.9%)	141 (3.2%)	132 (2.8%)	141 (3.0%)	150 (3.2%)	182 (3.8%)	2.2%
SAU	15 (1.2%)	16 (1.0%)	26 (1.3%)	33 (1.1%)	64 (1.9%)	70 (1.7%)	86 (1.7%)	102 (1.8%)	118 (2.0%)	121 (2.1%)	20.4%
SGP	124 (4.7%)	121 (4.0%)	132 (4.1%)	128 (3.6%)	139 (3.6%)	187 (4.3%)	191 (4.3%)	206 (4.3%)	198 (4.1%)	200 (4.1%)	1.0%
WLD	16659 (2.7%)	16275 (2.5%)	16163 (2.3%)	16851 (2.3%)	17220 (2.3%)	17506 (2.2%)	17948 (2.2%)	18048 (2.2%)	18521 (2.3%)	18004 (2.3%)	-0.4%

FWCI OF ACADEMIC-CORPORATE COLLABORATION IN THE FIELD OF MEDICAL SCIENCES

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	CAGR
UAE	1.67	3.23	1.70	1.49	1.97	14.70	1.52	1.64	2.05	0.95	-6.1%
CHE	2.85	2.94	3.44	3.41	3.24	2.99	2.97	3.29	3.20	3.52	2.4%
IRL	3.86	4.97	3.15	4.21	3.20	5.14	2.43	4.45	4.60	3.53	-1.0%
NZL	5.86	3.68	2.52	4.47	2.91	5.05	3.77	4.54	4.41	4.10	-3.9%
SAU	1.08	2.54	1.53	3.28	2.13	3.47	3.00	2.41	1.89	1.94	6.8%
SGP	3.27	4.13	5.66	4.15	3.05	3.00	3.21	2.50	3.23	3.87	1.9%
WLD	2.17	2.27	2.26	2.22	2.20	2.17	2.15	2.22	2.13	2.16	-0.1%

APPENDIX G
SHARE AND IMPACT OF ACADEMIC-CORPORATE PUBLICATIONS PER COUNTRY, SUBJECT AND YEAR

NUMBER AND SHARE (IN PARENTHESES) OF ACADEMIC-CORPORATE COLLABORATION IN THE FIELD OF HUMANITIES

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	CAGR
UAE	1 (1.3%)	1 (1.0%)	2 (2.0%)	5 (4.1%)	5 (4.4%)	4 (2.8%)	5 (3.7%)	2 (1.4%)	4 (2.4%)	10 (5.1%)	10.7%
CHE	153 (9.1%)	151 (8.5%)	148 (8.2%)	160 (7.6%)	195 (7.6%)	205 (7.4%)	193 (7.1%)	184 (6.9%)	211 (7.6%)	190 (7.0%)	1.9%
IRL	36 (4.9%)	36 (4.4%)	32 (4.1%)	41 (4.7%)	57 (5.5%)	42 (4.1%)	59 (5.8%)	52 (5.4%)	62 (6.1%)	53 (5.2%)	2.1%
NZL	83 (5.6%)	89 (6.3%)	62 (4.2%)	79 (4.9%)	83 (4.6%)	130 (6.9%)	116 (6.0%)	89 (4.7%)	97 (4.9%)	111 (6.0%)	2.2%
SAU	2 (1.1%)	2 (.8%)	2 (.4%)	4 (.6%)	9 (1.2%)	18 (2.0%)	18 (1.8%)	29 (2.4%)	29 (2.5%)	19 (1.7%)	20.4%
SGP	9 (3.9%)	14 (5.4%)	17 (5.1%)	23 (5.3%)	17 (3.3%)	30 (5.0%)	29 (4.5%)	23 (4.2%)	20 (3.7%)	29 (4.8%)	1.0%
WLD	2732 (2.3%)	2429 (2.0%)	2483 (1.9%)	2960 (2.0%)	3177 (2.0%)	3340 (2.0%)	3271 (1.9%)	3202 (1.9%)	3170 (1.9%)	2991 (1.7%)	-0.4%

FWCI OF ACADEMIC-CORPORATE COLLABORATION IN THE FIELD OF HUMANITIES

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	CAGR
UAE	0.59	2.71		0.77	0.00	16.30		1.02	1.48		12.2%
CHE	2.20	2.08	2.64	2.17	2.69	2.59	1.46	2.48	1.65	3.06	3.8%
IRL	4.95	1.19	2.42	1.24	0.42	2.30	8.71	3.02	4.23	1.77	-10.8%
NZL	1.81	1.35	1.26	1.95	0.35		7.25	1.46	1.44	0.70	-10.0%
SAU	3.21				7.35			1.73	1.15	0.00	-100.0%
SGP	8.78	9.47	6.34	0.70	2.60	0.00	1.31	6.58	2.67	5.22	-5.6%
WLD	2.51	1.99	2.17	2.11	2.54	2.26	2.14	2.13	2.37	1.95	-2.7%

(for UAE the CAGR value for FWCI in humanities was calculated for 2008-2016)

APPENDIX H
TOP CORPORATE COLLABORATORS
ACROSS SUBJECT AREAS

TOP 10 CORPORATE PARTNERS IN NATURAL SCIENCES, 2008-2017

Corporate entity	Joint publications	Joint publication FWCI	Partner FWCI
ADCO	151	0.91	0.76
ADNOC	74	0.84	0.76
ExxonMobil	39	1.4	1.53
Etisalat British Telecom Innovation	28	1.14	1.11
TOTAL SA	28	0.93	1.12
Halliburton	27	0.68	1.3
IBM	23	1.59	2.12
Society of Petroleum Engineers International	21	2.31	1.83
Bayer	18	3.23	1.56
British Telecom	16	1.71	1.74

TOP 10 CORPORATE PARTNERS IN ENGINEERING AND TECHNOLOGY, 2008-2012

Corporate entity	Joint publications	Joint publication FWCI	Partner FWCI
ADCO	20	0.42	0.34
Etisalat British Telecom Innovation	15	0.98	0.94
ADNOC	12	1.54	1.36
Intel	12	1	2.4
IBM	11	1.86	2.41
Global Foundries, Inc.	10	1.38	1.68
Electricite de France	8	3.78	1.23
Samsung	7	0.73	1.46
Schlumberger-Doll Research	6	1.27	1.88
Qualcomm Incorporated	6	0.9	2.31

APPENDIX H
TOP CORPORATE COLLABORATORS ACROSS SUBJECT AREAS

TOP 10 CORPORATE PARTNERS IN MEDICAL SCIENCES, 2008-2017

Corporate entity	Joint publications	Joint publication FWCI	Partner FWCI
Hamad Medical Corporation	145	1.13	0.9
Bayer	35	3.3	2.5
Novo Nordisk AS	15	1.04	2.27
Pfizer	13	0.55	1.97
GlaxoSmithKline	11	1.66	2.19
Eli Lilly	11	1.41	2.22
Merck	9	1.92	2.44
Novartis	9	1.47	2.73
TATA Steel	7	0.12	0.38
Boehringer Ingelheim GmbH	3	9.32	3.11

TOP 10 CORPORATE PARTNERS IN AGRICULTURAL SCIENCES, 2008-2017

Corporate entity	Joint publications	Joint publication FWCI	Partner FWCI
International Union for Conservation of Nature and Natural Resources	6	2.8	2.4
Hamad Medical Corporation	4	1.49	1.17
Pfizer	2	4.61	1.64
Monsanto Company	2	2.06	1.45
AECOM	2	1.65	0.76
Merck	2	1.44	1.84
Maersk Oil	2	1.04	1.07
ExxonMobil	2	0.9	1.83
Science Systems and Applications, Inc.	1	3.58	2.7
Biogen IDEC	1	2.69	1.45

TOP 10 CORPORATE PARTNERS IN SOCIAL SCIENCES, 2008-2017

Corporate entity	Joint publications	Joint publication FWCI	Partner FWCI
Etisalat British Telecom Innovation	5	0.5	0.5
British Telecom	4	4.7	1.52
IBM	3	3.16	1.64
ADCO	3	0.87	0.81
Hewlett-Packard	3	0.58	2.3
ADNOC	2	0.63	0.96
Saudi Aramco	2	0	0.6
ExxonMobil	1	5.2	1.59
Hamad Medical Corporation	1	3.76	1.92
AECOM	1	3.45	0.7

TOP 10 CORPORATE PARTNERS IN HUMANITIES, 2008-2012

Corporate entity	Joint publications	Joint publication FWCI	Partner FWCI
International Union for Conservation of Nature and Natural Resources	1	16.3	10.19
Hamad Medical Corporation	1	3.76	1.24
IBM	1	1.02	1.52
ExxonMobil	1	0.77	2.07
ADNOC	1	0.77	0.77

APPENDIX I
RESEARCH LEVELS ACROSS COUNTRIES AND SUBJECTS

In this appendix, we present the number and FWCI of publications per country and per subject area.

OUTPUT FOR UAE

Subject	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Agricultural Sciences	78	96	99	121	113	142	134	144	164	198
Applied research	19	23	27	28	25	38	38	42	36	60
Applied technology	5	13	12	15	16	17	18	13	28	33
Basic scientific research	23	30	27	45	30	34	39	46	47	51
Engineering-technological mix	31	30	33	33	42	53	39	43	53	54
Engineering and Technologies	470	623	685	917	1,031	1,219	1,260	1,599	1,853	2,013
Applied research	38	47	63	93	126	132	200	237	253	299
Applied technology	268	330	374	459	482	607	585	709	888	914
Basic scientific research	26	40	34	70	47	69	65	113	115	113
Engineering-technological mix	138	206	214	295	376	411	410	540	597	687
Humanities	62	34	38	65	64	74	96	128	136	122
Applied research	10	1	1	6	2	4	10	7	8	10
Applied technology	33	23	21	38	45	48	56	86	84	66
Basic scientific research	8	4	9	12	5	12	20	21	22	27
Engineering-technological mix	11	6	7	9	12	10	10	14	22	19
Medical Sciences	401	426	519	573	606	658	787	925	1,058	1,201
Applied research	75	86	98	114	107	135	154	163	194	219
Applied technology	138	158	204	194	216	269	277	348	422	473
Basic scientific research	45	45	63	61	51	67	117	108	127	135
Engineering-technological mix	143	137	154	204	232	187	239	306	315	374
Natural Sciences	1,038	1,200	1,364	1,598	1,900	1,943	2,295	2,954	3,242	3,720
Applied research	150	145	190	221	274	328	393	489	523	634
Applied technology	445	534	653	677	817	830	898	1,147	1,353	1,492
Basic scientific research	154	175	173	243	230	228	353	418	469	529
Engineering-technological mix	289	346	348	457	579	557	651	900	897	1,065
Social Sciences	284	323	428	465	448	530	558	708	833	893
Applied research	8	7	16	24	14	15	33	16	27	26
Applied technology	224	265	345	346	345	427	430	555	659	708
Basic scientific research	14	10	21	37	20	26	31	50	47	63
Engineering-technological mix	38	41	46	58	69	62	64	87	100	96
ALL	1,630	1,891	2,242	2,559	2,930	3,186	3,485	4,364	4,925	5,500
Applied research	204	207	263	303	347	412	506	593	668	775
Applied technology	809	965	1,214	1,235	1,436	1,651	1,629	1,999	2,402	2,591
Basic scientific research	180	206	217	309	265	283	430	513	573	650
Engineering-technological mix	437	513	548	712	882	840	920	1,259	1,282	1,484

CITATION IMPACT FOR UAE

Subject	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Agricultural Sciences	3.87	3.21	3.01	4.5	2.57	5.24	4.71	4.39	3.7	3.76
Applied research	1.13	1.14	0.68	1.43	0.66	1.36	1.12	1.17	1.21	1.19
Applied technology	0.96	0.39	0.22	1.1	0.4	1.06	0.88	1.01	0.42	0.46
Basic scientific research	0.94	1.09	1.22	1.33	0.96	2.01	1.3	1.28	1.17	1.41
Engineering-technological mix	0.84	0.59	0.89	0.64	0.55	0.81	1.41	0.92	0.91	0.7
Engineering and Technologies	6.24	3.65	3.75	4.53	4.41	4.63	4.84	5.14	4.92	4.67
Applied research	0.97	0.78	1.26	1.33	0.77	0.97	1.11	1.31	1.33	1.2
Applied technology	1.09	1.08	1.06	1.27	1.41	1.49	1.61	1.34	1.2	1.1
Basic scientific research	3.21	0.76	0.6	0.86	1.07	0.77	0.98	1.22	1.16	1.02
Engineering-technological mix	0.96	1.04	0.83	1.07	1.16	1.4	1.14	1.27	1.23	1.34
Humanities	4.59	3.01	3.53	2.6	3.03	5.17	5.44	4.8	5.72	4.5
Applied research	1.33	0.77	0.38	0.71	0.61	0.96	1.04	1.7	2.28	2.15
Applied technology	0.98	1.13	0.67	0.76	0.92	1.15	0.93	0.85	1.21	0.9
Basic scientific research	1.16	0.89	1.46	0.18	0.45	2.09	1.81	1.2	1.29	0.54
Engineering-technological mix	1.13	0.22	1.02	0.95	1.06	0.97	1.67	1.06	0.94	0.92
Medical Sciences	5.37	4.06	3.97	4.5	3.96	5.56	5.09	5.44	4.87	3.98
Applied research	1.01	1.33	0.99	1.16	1.16	0.88	1.08	1.19	1.13	0.87
Applied technology	0.87	0.71	0.76	1.09	0.84	2.11	0.85	1.23	0.94	0.9
Basic scientific research	2.55	1.04	1.09	1.36	1.05	1.72	1.65	1.96	1.4	1.3
Engineering-technological mix	0.93	0.97	1.13	0.89	0.92	0.85	1.51	1.06	1.41	0.91
Natural Sciences	4	3.77	4.08	4.2	3.88	4.43	4.67	4.76	4.48	4.34
Applied research	0.96	1.06	0.93	0.93	0.84	1	1.24	1.27	1.11	1.01
Applied technology	0.87	0.94	1.01	1.26	1.07	1.05	1.16	1.13	1.02	0.99
Basic scientific research	1.21	0.77	1.26	1.15	0.96	1.12	1.13	1.2	1.24	1.11
Engineering-technological mix	0.97	0.99	0.88	0.86	1.02	1.26	1.14	1.16	1.11	1.23
Social Sciences	3.04	3.28	3	3.41	3.29	3.71	4.17	4.43	4.27	3.45
Applied research	1.08	0.69	0.67	1	0.3	0.69	0.53	1.17	0.91	0.44
Applied technology	0.86	0.92	1.17	1.12	0.81	1.19	1.02	1.03	1.01	0.77
Basic scientific research	0.48	0.69	0.51	0.48	1.05	0.78	1.5	0.99	1.42	0.83
Engineering-technological mix	0.61	0.99	0.66	0.8	1.13	1.06	1.12	1.24	0.93	1.41
ALL	3.9	3.71	3.86	4.14	3.86	4.61	4.88	4.73	4.54	4.23
Applied research	0.95	1.09	0.92	1.05	0.91	0.97	1.19	1.24	1.12	1.04
Applied technology	0.85	0.89	0.94	1.19	1.03	1.32	1.16	1.12	0.99	0.96
Basic scientific research	1.22	0.81	1.15	1.02	0.94	1.13	1.29	1.23	1.23	1.09
Engineering-technological mix	0.88	0.92	0.85	0.88	0.98	1.18	1.24	1.14	1.2	1.15

APPENDIX I
RESEARCH LEVELS ACROSS COUNTRIES AND SUBJECTS

In this appendix, we present the number and FWCI of publications per country and per subject area.

OUTPUT FOR SWITZERLAND

Subject	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Agricultural Sciences	1,687	1,777	1,804	2,114	2,568	2,785	2,719	2,654	2,782	2,701
Applied research	389	436	437	420	564	659	592	614	593	630
Applied technology	142	148	152	214	259	315	367	365	444	376
Basic scientific research	654	660	677	934	977	1,049	1,047	942	917	883
Engineering-technological mix	502	533	538	546	768	762	713	733	828	812
Engineering and Technologies	6,546	6,510	6,684	7,118	7,272	7,377	8,061	8,431	8,138	8,060
Applied research	1,472	1,581	1,524	1,554	1,819	1,891	1,932	2,103	1,959	2,063
Applied technology	1,676	1,530	1,673	1,659	1,601	1,807	2,030	1,923	1,900	1,797
Basic scientific research	1,471	1,468	1,665	1,856	1,526	1,526	1,869	2,030	1,979	2,034
Engineering-technological mix	1,927	1,931	1,822	2,049	2,326	2,153	2,230	2,375	2,300	2,166
Humanities	485	605	674	737	931	928	1,136	1,067	1,204	1,113
Applied research	65	77	96	84	116	116	121	129	148	135
Applied technology	226	286	289	340	411	445	559	541	588	556
Basic scientific research	139	182	203	217	262	243	293	274	323	306
Engineering-technological mix	55	60	86	96	142	124	163	123	145	116
Medical Sciences	11,114	11,770	12,477	13,494	14,458	15,214	16,063	16,227	16,355	16,761
Applied research	2,191	2,289	2,425	2,393	2,561	2,773	2,839	2,845	2,821	2,776
Applied technology	3,495	3,609	3,885	4,153	4,263	4,953	5,286	5,229	5,550	5,784
Basic scientific research	2,094	2,277	2,399	2,598	2,397	2,641	2,975	3,032	2,655	2,598
Engineering-technological mix	3,334	3,595	3,768	4,350	5,237	4,847	4,963	5,121	5,329	5,603
Natural Sciences	18,879	19,816	20,718	21,972	23,695	24,469	25,489	25,547	25,646	25,406
Applied research	4,823	4,947	5,164	5,035	5,858	6,264	6,284	6,149	6,180	6,239
Applied technology	2,690	2,875	3,026	3,043	3,229	3,740	4,058	3,778	3,898	3,757
Basic scientific research	7,609	8,013	8,574	9,390	8,911	9,344	9,871	10,323	10,195	10,130
Engineering-technological mix	3,757	3,981	3,954	4,504	5,697	5,121	5,276	5,297	5,373	5,280
Social Sciences	2,341	2,508	2,812	3,018	3,270	3,572	3,933	3,949	4,187	4,245
Applied research	170	187	178	187	225	229	237	264	274	253
Applied technology	1,461	1,570	1,807	1,852	1,963	2,290	2,597	2,513	2,719	2,782
Basic scientific research	372	398	432	570	477	558	625	667	663	671
Engineering-technological mix	338	353	395	409	605	495	474	505	531	539
ALL	28,889	30,303	32,086	34,364	36,764	38,475	40,092	40,424	40,992	41,057
Applied research	6,001	6,183	6,427	6,387	7,217	7,760	7,806	7,743	7,788	7,791
Applied technology	7,301	7,646	8,371	8,651	8,989	10,457	11,231	10,830	11,307	11,355
Basic scientific research	8,770	9,226	9,838	10,969	10,229	10,784	11,502	12,009	11,836	11,739
Engineering-technological mix	6,817	7,248	7,450	8,357	10,329	9,474	9,553	9,842	10,061	10,172

CITATION IMPACT FOR SWITZERLAND

Subject	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Agricultural Sciences	6.99	6.49	6.95	6.4	5.83	5.83	5.99	5.99	5.71	6.14
Applied research	1.65	1.9	1.55	1.58	1.46	1.54	1.68	1.52	1.44	1.48
Applied technology	1.74	1.47	1.89	1.36	1.21	1.15	1.25	1.45	1.22	1.27
Basic scientific research	2.08	1.68	1.87	1.76	1.55	1.62	1.59	1.55	1.53	1.89
Engineering-technological mix	1.52	1.44	1.63	1.7	1.61	1.51	1.47	1.48	1.51	1.49
Engineering and Technologies	7.41	7.44	7.16	7.53	7.17	7.46	7.33	6.91	6.79	6.94
Applied research	1.93	1.6	1.75	1.93	1.71	1.79	1.71	1.62	1.69	1.49
Applied technology	1.92	2.02	2.14	2.2	1.98	2.02	1.95	1.92	1.61	1.92
Basic scientific research	1.81	1.96	1.68	1.63	1.73	1.85	1.94	1.84	1.99	1.94
Engineering-technological mix	1.74	1.86	1.59	1.77	1.75	1.81	1.74	1.53	1.5	1.6
Humanities	6.42	9.62	5.84	5.89	5.97	9.55	5.69	4.96	5.38	6.26
Applied research	2.6	5.88	1.79	2.09	2.01	5.5	1.9	1.85	1.89	2.14
Applied technology	1.31	1.27	1.4	1.36	1.62	1.45	1.34	1.11	1.35	1.75
Basic scientific research	1.38	1.16	1.31	1.12	1.1	1.37	1.54	0.94	1.15	1.43
Engineering-technological mix	1.14	1.32	1.35	1.33	1.24	1.23	0.92	1.07	1	0.94
Medical Sciences	7.13	7.28	7.39	7.77	7.27	7.16	7.13	7.58	7.59	7.43
Applied research	1.8	1.82	1.91	1.96	1.74	1.85	1.78	1.82	1.69	1.7
Applied technology	1.57	1.51	1.36	1.62	1.49	1.49	1.4	1.52	1.5	1.49
Basic scientific research	1.8	1.85	1.78	2	1.82	1.76	1.83	1.9	2	1.82
Engineering-technological mix	1.96	2.11	2.35	2.19	2.23	2.06	2.12	2.34	2.41	2.42
Natural Sciences	7.18	7.37	7.36	7.29	7.11	7.11	6.96	7.27	6.86	7
Applied research	1.77	1.69	1.69	1.81	1.67	1.79	1.71	1.89	1.65	1.56
Applied technology	1.95	1.98	2.03	1.91	1.91	1.79	1.77	1.77	1.65	1.74
Basic scientific research	1.71	1.8	1.74	1.68	1.72	1.72	1.79	1.82	1.86	1.89
Engineering-technological mix	1.76	1.9	1.9	1.88	1.83	1.81	1.69	1.79	1.7	1.82
Social Sciences	6.33	5.95	5.76	6.07	6.74	6.08	5.54	10.36	6.36	6.85
Applied research	1.7	1.29	1.39	1.33	2.09	1.45	1.4	5.78	1.99	1.8
Applied technology	1.49	1.57	1.53	1.65	1.7	1.47	1.48	1.53	1.51	1.69
Basic scientific research	1.69	1.4	1.36	1.4	1.37	1.52	1.32	1.5	1.48	1.75
Engineering-technological mix	1.45	1.7	1.48	1.69	1.57	1.65	1.33	1.55	1.38	1.62
ALL	7.06	7.18	7.19	7.39	7.1	7.06	7.01	7.31	7.12	7.17
Applied research	1.79	1.72	1.77	1.85	1.69	1.79	1.74	1.89	1.68	1.62
Applied technology	1.7	1.69	1.63	1.76	1.68	1.63	1.58	1.59	1.53	1.59
Basic scientific research	1.72	1.8	1.74	1.74	1.71	1.72	1.79	1.82	1.87	1.87
Engineering-technological mix	1.86	1.97	2.05	2.04	2.03	1.93	1.91	2.01	2.04	2.09

APPENDIX I
RESEARCH LEVELS ACROSS COUNTRIES AND SUBJECTS

In this appendix, we present the number and FWCI of publications per country and per subject area.

OUTPUT FOR NEW ZEALAND

Subject	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Agricultural Sciences	1,485	1,419	1,467	1,597	1,794	1,868	1,931	1,909	1,989	1,855
Applied research	352	357	373	379	436	544	467	503	524	440
Applied technology	144	98	136	131	163	149	185	180	206	203
Basic scientific research	516	549	562	650	621	681	696	700	687	626
Engineering-technological mix	473	415	396	437	574	494	583	526	572	586
Engineering and Technologies	1,506	1,546	1,605	1,909	1,810	1,843	2,014	1,957	2,036	2,091
Applied research	240	265	262	312	297	314	314	348	386	383
Applied technology	608	619	660	739	711	774	843	795	811	901
Basic scientific research	233	253	248	315	196	250	314	306	279	297
Engineering-technological mix	425	409	435	543	606	505	543	508	560	510
Humanities	366	438	453	596	603	595	637	644	675	685
Applied research	46	51	50	66	70	74	67	79	81	84
Applied technology	206	235	269	343	342	363	414	410	414	434
Basic scientific research	82	96	98	135	111	91	93	112	122	104
Engineering-technological mix	32	56	36	52	80	67	63	43	58	63
Medical Sciences	3,203	3,469	3,644	4,037	4,347	4,458	4,671	4,727	4,662	4,783
Applied research	493	515	568	566	658	677	687	719	675	677
Applied technology	1,372	1,491	1,495	1,680	1,788	1,843	1,934	1,953	2,027	2,127
Basic scientific research	521	572	674	701	657	719	801	763	669	666
Engineering-technological mix	817	891	907	1,090	1,244	1,219	1,249	1,292	1,291	1,313
Natural Sciences	5,517	5,762	5,994	6,468	6,676	7,018	7,283	6,934	7,208	7,162
Applied research	1,133	1,253	1,364	1,316	1,515	1,613	1,517	1,542	1,570	1,547
Applied technology	1,258	1,253	1,274	1,292	1,287	1,497	1,584	1,439	1,535	1,668
Basic scientific research	2,020	2,155	2,236	2,485	2,244	2,423	2,626	2,596	2,550	2,447
Engineering-technological mix	1,106	1,101	1,120	1,375	1,630	1,485	1,556	1,357	1,553	1,500
Social Sciences	1,854	1,885	2,126	2,486	2,284	2,356	2,419	2,518	2,673	2,648
Applied research	85	113	126	136	126	133	131	137	152	114
Applied technology	1,439	1,443	1,616	1,909	1,689	1,820	1,899	1,968	2,097	2,100
Basic scientific research	174	176	207	246	214	189	204	236	242	225
Engineering-technological mix	156	153	177	195	255	214	185	177	182	209
ALL	9,627	10,191	10,691	11,916	12,095	12,399	12,932	12,690	13,129	13,144
Applied research	1,556	1,674	1,787	1,786	1,977	2,093	2,030	2,074	2,103	2,069
Applied technology	3,692	3,899	4,145	4,604	4,490	4,766	5,046	4,937	5,199	5,357
Basic scientific research	2,375	2,534	2,647	3,003	2,661	2,840	3,038	3,064	2,996	2,892
Engineering-technological mix	2,004	2,084	2,112	2,523	2,967	2,700	2,818	2,615	2,831	2,826

CITATION IMPACT FOR NEW ZEALAND

Subject	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Agricultural Sciences	4.65	4.79	5.37	4.89	5.04	5.03	5.26	5.32	5.41	5.11
Applied research	1.19	1.34	1.35	1.16	1.34	1.32	1.38	1.25	1.25	1.19
Applied technology	0.91	0.87	1.33	0.96	1.03	1.08	1.06	1.53	1.46	1.12
Basic scientific research	1.15	1.36	1.22	1.33	1.35	1.14	1.4	1.16	1.26	1.28
Engineering-technological mix	1.39	1.21	1.47	1.45	1.32	1.49	1.42	1.38	1.43	1.52
Engineering and Technologies	5.38	5.29	5.61	5.29	4.86	4.67	4.33	4.46	5.09	6.1
Applied research	1.2	1.36	1.39	1.16	1.12	1.07	0.99	1.14	1.36	1.47
Applied technology	1.51	1.27	1.32	1.4	1.43	1.33	1.18	1.18	1.14	1.4
Basic scientific research	1.35	1.44	1.31	1.22	1.11	0.98	1.02	0.98	1.52	1.88
Engineering-technological mix	1.32	1.22	1.58	1.5	1.21	1.29	1.15	1.17	1.07	1.35
Humanities	6.32	10.93	5.69	7.07	5.6	13.3	5.77	5.9	5.51	6.59
Applied research	1.87	6.97	1.35	2.46	1.67	9.05	2.02	2.02	2.06	2.8
Applied technology	1.4	1.27	1.45	1.43	1.58	1.39	1.21	1.62	1.36	1.17
Basic scientific research	1.08	1.43	1.59	1.36	0.92	1.47	0.91	1.07	1.09	0.94
Engineering-technological mix	1.96	1.26	1.3	1.83	1.44	1.4	1.64	1.21	1.01	1.69
Medical Sciences	6.62	6.14	5.96	5.96	5.65	5.9	6.01	6.21	6.17	6.34
Applied research	1.99	1.28	1.56	1.29	1.26	1.38	1.45	1.39	1.22	1.36
Applied technology	1.26	1.52	1.17	1.27	1.36	1.36	1.27	1.54	1.32	1.53
Basic scientific research	1.25	1.39	1.48	1.34	1.25	1.31	1.54	1.27	1.38	1.2
Engineering-technological mix	2.12	1.96	1.76	2.07	1.78	1.85	1.75	2.01	2.26	2.26
Natural Sciences	4.95	5.3	5.59	5.03	5.21	5.56	5.04	5.04	5.19	5.51
Applied research	1.31	1.47	1.34	1.19	1.25	1.69	1.26	1.27	1.33	1.35
Applied technology	1.12	1.15	1.29	1.19	1.4	1.17	1.14	1.14	1.16	1.29
Basic scientific research	1.28	1.39	1.42	1.32	1.37	1.26	1.37	1.4	1.42	1.51
Engineering-technological mix	1.25	1.3	1.54	1.34	1.19	1.44	1.27	1.23	1.27	1.37
Social Sciences	4.32	4.08	4.54	4.73	4.54	5.27	4.36	5.43	5.17	5.66
Applied research	0.93	0.99	1.24	1.12	0.96	1.62	1.05	1.45	1.37	1.79
Applied technology	1.22	1.16	1.23	1.23	1.21	1.26	1.21	1.28	1.23	1.2
Basic scientific research	0.91	0.93	0.87	1.27	1.04	1.04	0.92	1.38	1.45	1.39
Engineering-technological mix	1.26	0.99	1.21	1.11	1.34	1.35	1.18	1.32	1.13	1.28
ALL	5.61	5.57	5.59	5.48	5.36	5.77	5.3	5.65	5.72	5.98
Applied research	1.54	1.43	1.41	1.27	1.26	1.62	1.33	1.35	1.35	1.39
Applied technology	1.21	1.26	1.21	1.24	1.31	1.28	1.2	1.33	1.24	1.31
Basic scientific research	1.23	1.34	1.39	1.32	1.33	1.25	1.33	1.35	1.4	1.46
Engineering-technological mix	1.63	1.54	1.58	1.66	1.46	1.62	1.44	1.62	1.73	1.82

APPENDIX I
RESEARCH LEVELS ACROSS COUNTRIES AND SUBJECTS

In this appendix, we present the number and FWCI of publications per country and per subject area.

OUTPUT FOR SAUDI ARABIA

Subject	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Agricultural Sciences	184	243	459	708	755	919	1,022	1,220	1,177	1,113
Applied research	55	85	168	214	247	308	387	485	433	424
Applied technology	8	5	29	46	42	62	56	75	81	70
Basic scientific research	54	66	132	264	213	265	304	370	350	304
Engineering-technological mix	67	87	130	184	253	284	275	290	313	315
Engineering and Technologies	767	1,269	1,722	2,907	3,694	4,390	5,616	6,387	6,968	7,160
Applied research	134	288	384	653	955	1,284	1,653	2,011	2,075	2,116
Applied technology	277	392	495	717	724	1,075	1,299	1,357	1,497	1,657
Basic scientific research	69	164	276	623	835	646	955	1,164	1,270	1,227
Engineering-technological mix	287	425	567	914	1,180	1,385	1,709	1,855	2,126	2,160
Humanities	16	20	26	58	108	128	176	179	168	136
Applied research	1	3	3	5	5	8	11	10	14	13
Applied technology	9	10	15	29	59	90	105	124	116	82
Basic scientific research	2	4	3	8	10	5	24	10	13	10
Engineering-technological mix	4	3	5	16	34	25	36	35	25	31
Medical Sciences	1,294	1,598	2,063	2,897	3,431	4,069	5,139	5,537	5,991	5,797
Applied research	241	348	465	716	901	1,125	1,421	1,543	1,692	1,451
Applied technology	508	586	661	840	913	1,125	1,467	1,546	1,681	1,766
Basic scientific research	96	136	263	421	449	525	765	805	890	826
Engineering-technological mix	449	528	674	920	1,168	1,294	1,486	1,643	1,728	1,754
Natural Sciences	1,879	2,678	4,099	6,362	8,408	10,849	12,830	13,850	14,596	14,339
Applied research	435	689	1,007	1,537	2,337	3,273	3,741	4,165	4,429	4,241
Applied technology	499	665	909	1,160	1,352	2,071	2,349	2,490	2,480	2,681
Basic scientific research	430	570	1,098	2,002	2,389	2,611	3,436	3,775	3,934	3,653
Engineering-technological mix	515	754	1,085	1,663	2,330	2,894	3,304	3,420	3,753	3,764
Social Sciences	192	234	284	444	512	638	842	947	1,053	1,124
Applied research	13	20	21	33	46	60	71	61	81	95
Applied technology	135	162	198	298	330	431	555	653	709	745
Basic scientific research	6	12	14	27	33	19	59	51	52	65
Engineering-technological mix	38	40	51	86	103	128	157	182	211	219
ALL	3,163	4,247	6,142	9,186	11,685	14,587	17,236	18,637	19,759	19,573
Applied research	581	912	1,323	2,027	2,868	3,840	4,552	5,130	5,383	5,197
Applied technology	1,112	1,403	1,813	2,338	2,674	3,755	4,272	4,484	4,698	4,920
Basic scientific research	483	638	1,206	2,187	2,536	2,792	3,703	4,083	4,270	4,007
Engineering-technological mix	987	1,294	1,800	2,634	3,607	4,200	4,709	4,940	5,408	5,449

CITATION IMPACT FOR SAUDI ARABIA

Subject	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Agricultural Sciences	1.61	2.21	3.29	2.96	3.71	3.54	3.85	4.7	4.87	4.87
Applied research	0.28	0.8	0.67	0.74	1.13	0.99	1.02	1.48	1.54	1.09
Applied technology	0.44	0.17	1.14	0.65	0.57	0.62	0.74	0.91	0.97	1.11
Basic scientific research	0.52	0.68	1	0.91	1.29	1.06	1.17	1.18	1.29	1.42
Engineering-technological mix	0.36	0.56	0.48	0.66	0.73	0.87	0.92	1.13	1.07	1.26
Engineering and Technologies	3.13	3.76	4.27	4.66	5.01	5.31	6.32	6.43	6.73	8.78
Applied research	0.72	0.88	1.29	1.23	1.58	1.52	1.77	1.74	1.69	2.21
Applied technology	0.75	1.03	1.18	1.17	1.38	1.41	1.31	1.33	1.36	1.68
Basic scientific research	0.77	0.92	0.77	1.12	0.8	1.13	1.87	1.81	1.85	2.47
Engineering-technological mix	0.89	0.93	1.04	1.15	1.25	1.25	1.38	1.56	1.84	2.42
Humanities	4.95	2.55	3.72	4.33	4.75	5.37	6.46	3.84	6.69	6.1
Applied research	1	1.14	1.35	2.81	2	1.82	2.47	0.93	0.82	2.12
Applied technology	1.41	0.55	0.51	0.67	1.08	1.31	1.23	1.26	1.25	1.26
Basic scientific research	1.32	0.12	0.97	0.4	0.84	0.63	1.44	0.58	2.58	1.47
Engineering-technological mix	1.22	0.73	0.89	0.46	0.82	1.62	1.33	1.07	2.05	1.25
Medical Sciences	2.8	3.13	3.47	4.11	4.36	6.72	4.75	4.55	5.26	4.76
Applied research	0.75	0.78	1.05	1.13	1.21	1.06	1.14	1.18	1.2	1.17
Applied technology	0.69	0.68	0.59	0.92	0.94	0.85	0.81	0.74	0.85	0.89
Basic scientific research	0.63	0.81	1.04	1.18	1.37	3.82	1.56	1.52	1.55	1.66
Engineering-technological mix	0.73	0.86	0.79	0.88	0.85	0.99	1.23	1.11	1.66	1.04
Natural Sciences	3.08	3.62	4.12	4.48	4.53	5.09	5.12	5.78	6.2	7.18
Applied research	0.82	1.02	1.17	1.23	1.28	1.22	1.38	1.53	1.48	1.75
Applied technology	0.82	0.89	0.96	1.02	1.14	1.14	1.07	1.24	1.32	1.51
Basic scientific research	0.65	0.85	1.1	1.1	0.98	1.61	1.42	1.56	1.5	1.86
Engineering-technological mix	0.79	0.86	0.89	1.13	1.13	1.13	1.26	1.45	1.89	2.06
Social Sciences	2.64	2.4	3.98	4.04	3.81	4.24	4.46	6.74	5.65	5.26
Applied research	0.33	0.55	1.71	1.32	0.69	1.02	0.88	1.37	1.22	1.35
Applied technology	0.81	0.66	0.75	0.94	0.9	1.04	1.23	1.11	1.03	1.07
Basic scientific research	0.34	0.37	0.73	0.54	1.31	0.86	0.82	3.12	2.18	1.26
Engineering-technological mix	1.17	0.81	0.79	1.25	0.91	1.32	1.53	1.13	1.22	1.57
ALL	2.91	3.43	3.84	4.26	4.41	4.92	5.07	5.41	5.7	6.45
Applied research	0.81	0.96	1.12	1.18	1.27	1.2	1.35	1.46	1.43	1.64
Applied technology	0.74	0.8	0.83	0.97	1.1	1.05	1.04	1.06	1.1	1.25
Basic scientific research	0.63	0.83	1.06	1.08	1	1.57	1.45	1.55	1.53	1.82
Engineering-technological mix	0.73	0.84	0.82	1.03	1.04	1.1	1.23	1.35	1.64	1.75

APPENDIX I
RESEARCH LEVELS ACROSS COUNTRIES AND SUBJECTS

In this appendix, we present the number and FWCI of publications per country and per subject area.

OUTPUT FOR SINGAPORE

Subject	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Agricultural Sciences	228	260	334	437	510	602	638	551	536	608
Applied research	49	56	69	99	119	135	143	126	120	143
Applied technology	11	9	22	33	24	46	58	60	81	94
Basic scientific research	135	161	179	238	264	323	309	221	215	240
Engineering-technological mix	33	34	64	67	103	98	128	144	120	131
Engineering and Technologies	5,736	5,671	6,102	6,086	6,512	6,720	7,369	7,710	7,756	7,992
Applied research	1,524	1,481	1,732	1,630	1,952	1,996	2,009	2,166	2,046	2,013
Applied technology	1,694	1,593	1,582	1,506	1,428	1,784	2,015	1,984	2,082	2,217
Basic scientific research	563	608	743	908	758	857	1,224	1,372	1,318	1,354
Engineering-technological mix	1,955	1,989	2,045	2,042	2,374	2,083	2,121	2,188	2,310	2,408
Humanities	169	195	285	277	334	318	429	418	443	427
Applied research	4	12	17	12	31	31	23	42	32	25
Applied technology	114	111	145	164	182	196	269	254	258	264
Basic scientific research	32	35	47	55	50	41	64	54	82	69
Engineering-technological mix	19	37	76	46	71	50	73	68	71	69
Medical Sciences	2,639	3,003	3,242	3,530	3,839	4,313	4,454	4,762	4,818	4,871
Applied research	533	606	651	719	752	870	850	963	909	912
Applied technology	786	920	913	1,081	1,092	1,300	1,413	1,466	1,565	1,637
Basic scientific research	520	578	675	711	703	839	902	912	856	833
Engineering-technological mix	800	899	1,003	1,019	1,292	1,304	1,289	1,421	1,488	1,489
Natural Sciences	8,752	9,429	10,301	10,901	11,876	12,313	13,120	13,251	13,616	13,627
Applied research	2,360	2,390	2,664	2,686	3,167	3,432	3,350	3,374	3,241	3,150
Applied technology	2,161	2,264	2,434	2,337	2,356	2,849	3,081	2,948	3,279	3,354
Basic scientific research	1,906	2,203	2,491	3,045	2,797	2,997	3,565	3,743	3,650	3,586
Engineering-technological mix	2,325	2,572	2,712	2,833	3,556	3,035	3,124	3,186	3,446	3,537
Social Sciences	1,288	1,364	1,464	1,587	1,755	1,826	1,996	2,167	2,188	2,118
Applied research	67	77	95	97	109	136	128	130	133	108
Applied technology	906	958	1,035	1,077	1,200	1,315	1,441	1,547	1,509	1,499
Basic scientific research	101	136	148	178	155	129	192	212	220	202
Engineering-technological mix	214	193	186	235	291	246	235	278	326	309
ALL	12,189	12,948	14,390	15,167	16,495	17,322	18,147	18,543	19,182	19,136
Applied research	2,739	2,770	3,111	3,093	3,616	3,906	3,784	3,929	3,799	3,685
Applied technology	3,866	4,115	4,416	4,537	4,649	5,509	5,839	5,675	6,150	6,238
Basic scientific research	2,163	2,459	2,837	3,420	3,121	3,318	3,953	4,179	4,153	4,061
Engineering-technological mix	3,421	3,604	4,026	4,117	5,109	4,589	4,571	4,760	5,080	5,152

CITATION IMPACT FOR SINAGPORE

Subject	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Agricultural Sciences	7.06	5.36	5.44	7.27	5.63	4.65	4.96	4.28	5.18	5.89
Applied research	1.57	1.61	1.53	1.63	1.65	1.34	1.39	1.14	1.55	1.64
Applied technology	2.52	0.94	1.12	0.82	1.3	0.98	1.1	0.84	1.16	1.1
Basic scientific research	1.23	1.19	1.28	1.7	1.3	1.07	1.32	1	1.24	1.51
Engineering-technological mix	1.74	1.62	1.51	3.13	1.38	1.25	1.16	1.3	1.24	1.64
Engineering and Technologies	6.48	7.01	7.29	8.01	8.62	8.98	7.83	7.63	8.04	7.93
Applied research	1.51	1.5	2.06	1.92	2.55	2.11	2.15	1.9	2.02	2.18
Applied technology	1.65	1.78	1.87	2	2.21	2.52	1.97	1.96	2.04	1.92
Basic scientific research	1.86	2.21	1.93	2.58	2.44	2.71	2.15	2.22	2.32	2.26
Engineering-technological mix	1.46	1.52	1.43	1.5	1.42	1.64	1.56	1.56	1.66	1.57
Humanities	5.88	5.45	4.51	5.69	6.85	5.9	5.82	7.87	6.34	6.9
Applied research	0.52	1.05	0.49	1.19	2.04	1.41	1.42	1.85	1.61	2.34
Applied technology	2.33	1.7	1.48	1.76	1.86	1.44	1.77	1.57	1.35	1.54
Basic scientific research	1.2	1.29	1.06	1.22	1.13	0.99	1.21	1.51	1.55	1.52
Engineering-technological mix	1.83	1.41	1.49	1.52	1.82	2.06	1.42	2.94	1.83	1.5
Medical Sciences	6.18	6.45	6.71	6.64	7.03	6.6	6.75	6.19	6.68	6.55
Applied research	1.56	1.56	2.15	1.72	2.13	1.86	1.77	1.78	1.89	1.81
Applied technology	1.27	1.38	1.4	1.25	1.43	1.25	1.26	1.17	1.25	1.37
Basic scientific research	1.63	1.82	1.53	1.88	1.75	1.71	1.67	1.69	1.67	1.61
Engineering-technological mix	1.72	1.69	1.63	1.79	1.72	1.77	2.06	1.54	1.87	1.77
Natural Sciences	6.06	6.49	7.02	7.11	7.62	7.46	7.15	7.3	7.5	7.18
Applied research	1.43	1.53	1.95	1.74	2.24	1.98	1.97	1.9	1.88	1.93
Applied technology	1.55	1.71	1.65	1.86	2.02	1.98	1.88	1.87	1.91	1.81
Basic scientific research	1.54	1.6	1.67	1.9	1.8	1.83	1.75	1.9	1.95	1.79
Engineering-technological mix	1.54	1.65	1.76	1.61	1.56	1.67	1.56	1.63	1.77	1.65
Social Sciences	4.84	4.9	5.48	5.36	5.38	5.26	5.02	5.64	5.82	5
Applied research	0.79	1.17	0.88	0.88	1.08	1.26	0.94	1.4	1.36	1.28
Applied technology	1.37	1.49	1.5	1.6	1.52	1.46	1.56	1.5	1.38	1.4
Basic scientific research	1.23	1.04	1.16	1.56	1.33	0.96	0.98	1.12	1.42	1.13
Engineering-technological mix	1.45	1.21	1.95	1.31	1.45	1.58	1.53	1.62	1.67	1.19
ALL	5.92	6.3	6.67	6.83	7.36	7.23	7.07	6.99	7.25	6.96
Applied research	1.41	1.47	1.85	1.69	2.21	1.94	1.92	1.85	1.87	1.89
Applied technology	1.48	1.55	1.58	1.66	1.8	1.79	1.7	1.65	1.69	1.66
Basic scientific research	1.51	1.66	1.6	1.87	1.78	1.82	1.73	1.87	1.92	1.76
Engineering-technological mix	1.52	1.62	1.64	1.61	1.57	1.68	1.72	1.62	1.77	1.65

APPENDIX J
TOP 20 TOPICS FOR UAE

In this appendix, we will provide a detailed breakdown of top 10 countries (by output) and top 10 institutions (by output and FWCI) in the 20 topics listed in Chapter 5. For ranking of institutions, we applied a publication threshold based on the global output number of the topic.

Where there are three or less institutions meet the threshold, these are indicated with a * in the output ranking rather than presenting a separate table

Global output	Publication threshold
<100	5
100-499	20
>500	30

Jurassic; reservoir; sequence stratigraphic
Topic output: 445   *Topic FWCI: 0.55*

Institution	Scholarly Output	FWCI
United Arab Emirates	78	0.64
Saudi Arabia	62	0.51
United States	56	1.13
United Kingdom	52	0.78
Iran	43	0.64
Kuwait	35	0.52
Oman	33	0.53
France	27	0.8
China	23	0.34

Institution	Scholarly Output	FWCI
Saudi Aramco *	23	0.25
King Fahd University of Petroleum and Minerals *	22	0.64
University of Tehran	18	0.89
Khalifa University of Science and Technology	17	0.42
Shell	16	0.47
Research Institute of Petroleum Exploration and Development	15	0.33
ADCO	12	0.45
ADNOC	11	0.09
CNRS	11	1.6
Sultan Qaboos University	11	0.58

Industry; Petroleum engineering; digital oilfield
Topic output: 1,240   *Topic FWCI: 0.35*

Institution	Scholarly Output	FWCI
United States	427	0.59
United Kingdom	79	0.21
Kuwait	64	1.63
United Arab Emirates	54	0.28
Russian Federation	42	0.26
China	36	0.19
Norway	36	0.9
Saudi Arabia	30	0.26
Brazil	24	0.33
Malaysia	24	0.22

Institution	Scholarly Output	FWCI
Halliburton *	46	2.42
Shell	25	0.44
Saudi Aramco	22	0.35
Chevron Energy Technology Company	21	0.07
Statoil ASA	17	0.43
Fondazione Eni Enrico Mattei	14	0.47
Petronas	14	0.07
ADCO	13	0.19
BP plc	13	0.51
Norwegian University of Science and Technology	13	1.61

APPENDIX J
TOP 20 TOPICS FOR UAE

Anodes; Aluminum; metal pad
Topic output: 765   *Topic FWCI: 0.76*

Institution	Scholarly Output	FWCI
China	188	0.62
Canada	140	0.99
Norway	104	0.84
United States	100	1
Australia	65	1.11
United Arab Emirates	51	1.32
France	42	0.6
New Zealand	41	1.12
Russian Federation	40	0.39
Germany	39	1.16

Institution	Scholarly Output	FWCI
Northeastern University China	62	0.71
SINTEF	57	1.09
Alcoa Technical Center	56	0.74
Central South University	56	0.56
Norwegian University of Science and Technology	48	0.78
University of Auckland	40	1.14
Rio Tinto	38	0.98
Universite du Quebec a Chicoutimi	34	1.16
CSIRO	26	1.54
Universite de Sherbrooke	23	1

Institution	Scholarly Output	FWCI
Universite du Quebec a Chicoutimi	34	1.16
University of Auckland	40	1.14
SINTEF	57	1.09
Rio Tinto	38	0.98
Norwegian University of Science and Technology	48	0.78
Alcoa Technical Center	56	0.74
Northeastern University China	62	0.71
Central South University	56	0.56

Institution	Scholarly Output	FWCI
United Arab Emirates	47	0.62
United States	28	0.69
United Kingdom	26	0.63
Lebanon	10	1.47
Netherlands	10	0.68
Saudi Arabia	10	0.8
Canada	8	0.62
France	8	1.16
Malaysia	8	0.12
Qatar	7	0

Institution	Scholarly Output	FWCI
American University of Sharjah	10	0.77
United Arab Emirates University	10	1.12
American University of Beirut	8	1.8
Zayed University	8	0.58
Maastricht University	6	0.34
University of Khartoum	6	0.34
Sultan Qaboos University	5	0.46
Abu Dhabi University	3	1.37
King Abdulaziz University	3	0.59
Qatar University	3	0

APPENDIX J
TOP 20 TOPICS FOR UAE

Water; coral reef; Arab Emirates
Topic output: 183   *Topic FWCI: 0.76*

Institution	Scholarly Output	FWCI
United Arab Emirates	43	1.39
Iran	34	0.16
Kuwait	26	0.96
United Kingdom	24	1.07
United States	22	1.21
Australia	13	1.26
Qatar	11	1.01
Iraq	9	0.44
Canada	8	0.95
Germany	8	0.51

Institution	Scholarly Output	FWCI
NYU Abu Dhabi	16	1.71
Kuwait Institute for Scientific Research	13	0.72
Islamic Azad University	11	0.18
United Arab Emirates University	11	1.36
Khalifa University of Science and Technology	8	1.72
Centre for the Environment Fisheries and Aquaculture Science	7	1.63
James Cook University Queensland	7	2.04
CNRS	6	1.08
IRD	6	1.08
Kuwait University	6	1.49

Web services; Social networking (online); Websites
Topic output: 110   *Topic FWCI: 0.89*

Institution	Scholarly Output	FWCI
United Arab Emirates	33	1.05
France	25	1.06
Brazil	15	0.89
China	14	1.32
Serbia	13	0.86
Canada	9	1.03
United States	9	1.33
Australia	8	1.39
Italy	7	0.46
Russian Federation	7	0.44

Institution	Scholarly Output	FWCI
Zayed University *	28	0.95
Universite Claude Bernard Lyon 1	15	1.22
Universidade Federal Rural de Pernambuco	9	0.53
Concordia University	8	1.13
Samara National Research University	7	0.44
Universidade Federal de Pernambuco	7	1.38
Khalifa University of Science and Technology	5	1.58
University of Adelaide	5	1.5
CNR	4	0.04
University of Sfax	4	0.92

APPENDIX K
DETAILED BREAKDOWN OF MOBILITY

In this appendix we provide a detailed breakdown of mobility numbers presented in Chapter 6.

Migratory — researchers who stay abroad or in the UAE for two years or more (Total Outflow and Total Inflow), further subdivided into those where the researcher remained abroad (Outflow and Inflow) or where they subsequently returned to their original country (Returnees Outflow and Returnees Inflow).

▶ *Outflow:* active UAE researchers whose Scopus author data for the period 1996–2017 indicate that they have migrated from the UAE to another country (or countries) for at least two years without returning to the UAE.

▶ *Returnees Outflow:* active UAE researchers whose Scopus author profile data for the period 1996–2017 indicate that they have migrated to the UAE from another country (or countries) for at least two years, and then subsequently migrated to another country (or countries) for at least two years.

▶ *Total Outflow:* the sum of Outflow and Returnees Outflow groups.

▶ *Inflow:* active UAE researchers whose Scopus author data for the period 1996–2017 indicate that they have migrated to the UAE from another country (or countries) for at least two years without leaving the UAE.

▶ *Returnees Inflow:* active UAE researchers whose Scopus author data for the period 1996 –2017 indicate that they have migrated from the UAE to another country (or countries) for at least two years, and then subsequently migrated back to the UAE for at least two years.

▶ *Total Inflow:* the sum of Inflow and Returnees Inflow groups.

Transitory — researchers who stay abroad or in the UAE for less than two years (Total Transitory), further subdivided into those who mostly published under a UAE (Transitory (mainly UAE)) or a non-UAE (Transitory (mainly non-UAE)) affiliation.

▶ *Transitory (mainly UAE):* active UAE researchers whose Scopus author data for the period 1996 –2017 indicate that they are based in another country (or countries) for less than two years at a time but are predominantly based in the UAE.

▶ *Transitory (mainly non-UAE):* active UAE researchers whose Scopus author data for the period 1996 –2017 indicate that

they are based in the UAE for less than two years at a time but are predominantly based in another country (or countries).

▶ *Total Transitory:* the sum of Transitory (mainly UAE) and Transitory (mainly non-UAE) groups. Non-migratory — researchers with only UAE affiliations in Scopus during the period 1996 –2017.

Non-migratory: active UAE researchers whose Scopus author data for the period 1996 –2017 indicate that they have not published under an affiliation outside the UAE.

In the analysis period, a larger number of researchers came to the UAE than those that left, although the outflow group is associated with higher productivity, seniority and field-weighted citation impact than the inflow group, on average.

The UAE had a considerably higher share of researchers moved into the UAE and left after two years in the country (returnees outflow), compared to those that left the UAE and returned after two years (returnees inflow) and the former group is associated with higher productivity and citation impact.

In terms of transitory researchers, nearly five times the number of researchers primarily based outside the UAE showed transitory mobility (45.6%), compared to the mainly UAE based transitory researchers (9.3%). Transitory researchers based mainly outside the UAE showed on average higher productivity, seniority and citation impact.

UAE
1996 - 2017
6793 active researchers

Outflow

Researchers	3.1%
Relative Productivity	0.85
Relative length of service	0.98
FWCI	1.38

Returnees Outflow

Researchers	7,8%
Relative Productivity	1.03
Relative length of service	1.31
FWCI	1.44

Transitory (mainly non-UAE)

Researchers	45.6%
Relative Productivity	1.27
Relative length of service	1.08
FWCI	1.68

Transitory (mainly UAE)

Researchers	9.3%
Relative Productivity	0.50
Relative length of service	0.66
FWCI	1.03

Returnees Inflow

Researchers	1.0%
Relative Productivity	0.84
Relative length of service	1.03
FWCI	1.19

Non-migratory

Researchers	13.7%
Relative Productivity	0.47
Relative length of service	1.50
FWCI	1.18

Inflow

Researchers	19.5%
Relative Productivity	0.73
Relative length of service	1.21
FWCI	1.25

Total Outflow

Researchers	10.9%
Relative Productivity	0.99
Relative length of service	1.22
FWCI	1.43

Total Transitory

Researchers	54.9%
Relative Productivity	1.19
Relative length of service	1.01
FWCI	1.65

Total Inflow

Researchers	20.5%
Relative Productivity	0.73
Relative length of service	1.20
FWCI	1.24

UAE

Non UAE

APPENDIX L
METHODOLOGY AND DATA SOURCES

METHODOLOGY AND RATIONALE

Our methodology is based on the theoretical principles and best practices developed in the field of quantitative science and technology studies, particularly in science and technology indicators research. The Handbook of Quantitative Science and Technology Research: The Use of Publication and Patent Statistics in Studies of S&T Systems (Moed, Glänzel, and Schmoch, 2004) gives a good overview of this field and is based on the pioneering work of Derek de Solla Price (1978), Eugene Garfield (1979) and Francis Narin (1976) in the USA, and Christopher Freeman, Ben Martin and John Irvine in the UK (1981, 1987), and in several European institutions including the Centre for Science and Technology Studies at Leiden University, the Netherlands, and the Library of the Academy of Sciences in Budapest, Hungary.

The analyses of research performance data in this report are based on recognized advanced indicators (e.g., the concept of relative citation impact rates), many of which have been adopted by organizations such as THE. Our base assumption is that such indicators are useful and valid, though imperfect and partial measures, in the sense that their numerical values are determined by research performance and related concepts, but also by other, influencing factors that may cause systematic biases. In the past decade, the field of indicators research has developed a best practices which state how indicator results should be interpreted and which influencing factors should be taken into account. Our methodology builds on these practices.

ARTICLE TYPES

For all research performance analyses, only the following document types are considered:

- ▶ Article
- ▶ Review
- ▶ Conference Proceeding
- ▶ Books
- ▶ Book chapters

COUNTING

All analyses make use of whole counting rather than fractional counting. For example, if a publication has been co-authored by one author from UAE and one author from Country A, then that publication counts once towards both the publication count of UAE and the publication count of Country A. Total counts for each country are the unique count of publications.

DATA SOURCE

Scopus is Elsevier's abstract and citation database of peer-reviewed literature, covering 62 million documents published in over 22,500 journals, book series and conference proceedings by some 6,000 publishers, and the database of choice for several university rankings, including THE.

Scopus coverage is multi-lingual and global: approximately 21% of titles in Scopus are published in languages other than English (or published in both English and another language). In addition, more than half of Scopus content originates from outside North America, representing many countries in Europe, Latin America, Africa and the Asia Pacific region.

Scopus coverage is also inclusive across all major research fields, with 6,900 titles in the Physical Sciences, 6,400 in the Health Sciences, 4,150 in the Life Sciences, and 6,800 in the Social Sciences (the latter including some 4,000 Arts & Humanities related titles). Titles which are covered are predominantly serial publications (journals, trade journals, book series and conference material), but considerable numbers of conference publications are also covered from stand-alone proceedings volumes (a major dissemination mechanism, particularly in the computer sciences). Acknowledging that a great deal of important literature in all fields (but especially in the Social Sciences and Arts & Humanities) is published in books, Scopus has begun to increase book coverage in 2013, covering more than 120,000 books in 2016.

1 Moed H., Glänzel W., & Schmoch U. (2004). Handbook of Quantitative Science and Technology Research, Kluwer: Dordrecht.

2 de Solla Price, D.J. (1977–1978). "Foreword, Essays of an Information Scientist, Vol. 3, v–ix.

3 Garfield, E. (1979). Is citation analysis a legitimate evaluation tool? Scientometrics, 1 (4), 359-375.

4 Pinski, G., & Narin, F. (1976). Citation influence for journal aggregates of scientific publications: Theory with application to literature of physics. Information Processing & Management 12 (5): 297–312.

5 Irvine, J., Martin, B. R., Abraham, J. & Peacock, T. (1987). Assessing basic research: Reappraisal and update of an evaluation of four radio astronomy observatories. Research Policy, 16(2-4), 213-227.

For this report, a static version of the Scopus database covering the period 2008-2017 inclusive was aggregated by country, institution, and subject area:

The 27 MAIN SCOPUS SUBJECT AREAS

General (multidisciplinary journals such as Nature and Science)	Immunology and Microbiology
Agricultural and Biological Sciences	Materials Science
Arts and Humanities	Mathematics
Biochemistry, Genetics and Molecular Biology	Medicine
Business, Management and Accounting	Neuroscience
Chemical Engineering	Nursing
Chemistry	Pharmacology, Toxicology and Pharmaceutics
Computer Science	Physics and Astronomy
Decision Sciences	Psychology
Earth and Planetary Sciences	Social Sciences
Economics, Econometrics and Finance	Veterinary Sciences
Energy	Dentistry
Engineering	Health Professions
Environmental Science	

Scholarly output is the count of publications with at least one author from that institution (according to the affiliation listed in the authorship by-line). All analyses make use of 'whole' rather than 'fractional' counting: an article representing international collaboration (with at least two different countries listed in the authorship by-line) is counted once each for every institution listed in a different country.

CAGR (Compound Annual Growth Rate) is defined as the year-over-year constant growth rate over a specified period of time. Starting with the first value in any series and applying this rate for each of the time intervals yields the amount in the final value of the series.

CAGR $(t_0, t_n) = (V(t_n)/V(t_0))$ 1/ t_n -t_0 – 1
$V(t_0)$: start value
$V(t_n)$: finish value
t_n -t_0 : number of years

Citation is a formal reference to earlier work made in an article or patent, frequently to other journal articles. A citation is used to credit the originator of an idea or finding and is usually used to indicate that the earlier work supports the claims of the work citing it. The number of citations received by an article from subsequently-published articles is a proxy of the quality or importance of the reported research.

FWCI (Field-Weighted Citation Impact) is an indicator of mean citation impact, and compares the actual number of citations received by an article with the expected number of citations for articles of the same document type (article, review or conference proceeding paper), publication year and subject field. Where the article is classified in two or more subject fields, the harmonic mean of the actual and expected citation rates is used. The indicator is therefore always defined with reference to a global baseline of 1.0 and intrinsically accounts for differences in citation accrual over time, differences in citation rates for different document types (reviews typically attract more citations than research articles, for example) as well as subject-specific differences in citation frequencies overall and over time and document types. It is one of the most sophisticated indicators in the modern research evaluation toolkit. FWCI is most reliable when calculated for large numbers of papers. When calculated for smaller corpora, FWCI values may be disproportionately affected by a few high impact papers, and must therefore be regarded with caution.

International Collaboration (i.e., research collaboration) in this report is indicated by articles with at least two different countries listed in the authorship affiliation by-line.

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