



**Bibliometric analysis: ASEAN countries and  
their collaboration with the EU28/AC  
(Deliverable 4.1.2, part 1)**

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## List of Abbreviations

Abbreviation/Acronym	Meaning
<b>ASEAN</b>	Association of Southeast Asian Nations
<b>AT</b>	Austria
<b>AU</b>	Australia
<b>BE</b>	Belgium
<b>BN</b>	Brunei Darussalam
<b>BR</b>	Brazil
<b>CA</b>	Canada
<b>CN</b>	China
<b>Co-pub</b>	co-publications
<b>DE</b>	Germany
<b>ES</b>	Spain
<b>EU</b>	European Union
<b>EU28</b>	the 28 EU member states
<b>EU28/AC</b>	the EU28 plus the countries associated to the European Framework

	Programme for Research and Technological Development
<b>FR</b>	France
<b>GB</b>	Great Britain
<b>HK</b>	Hong Kong
<b>ID</b>	Indonesia
<b>IN</b>	India
<b>IR</b>	Israel
<b>IT</b>	Italy
<b>JP</b>	Japan
<b>KH</b>	Cambodia
<b>KR</b>	Korea
<b>LA</b>	Lao PDR
<b>MM</b>	Myanmar
<b>MY</b>	Malaysia
<b>NL</b>	the Netherlands
<b>NZ</b>	New Zealand
<b>PH</b>	the Philippines
<b>PK</b>	Pakistan
<b>pub</b>	publications
<b>RU</b>	Russia
<b>SA</b>	South Africa
<b>SE</b>	Sweden
<b>SG</b>	Singapore
<b>SM</b>	Science Metrics
<b>TH</b>	Thailand
<b>TW</b>	Taiwan
<b>TU</b>	Turkey
<b>UK</b>	United Kingdom
<b>USA</b>	United States of America
<b>VN</b>	Vietnam

## 2 Executive Summary

Over two years from 2014 to 2016, the SEA-EU-NET analysis team carried out analyses of research output of ASEAN<sup>1</sup> Member States. The results we present in the first part of the deliverable at hand stem from an analysis of publication output with a specific focus on collaboration patterns among and with ASEAN countries. The covered time period is 2004 to 2014, i.e. 11 years. The data sources are Web of Science and Scopus.

An analysis of patent application output is covered in the second part of this deliverable.

The major research questions for the study were: How did the publication output in Southeast Asia develop over time? What are thematic and geographic patterns and priorities in Southeast Asian output? By answering these questions, we ultimately aim to contribute relevant evidence to the ASEAN-EU science, technology and innovation policy dialogue.

Before delving into the details, we want to recap a few interesting properties of the ASEAN countries' national research system. They may not just help understand the context better, but help explain the differences in the analysis results. The input in the sense of public and private investments in research and development (R&D) varies greatly between Southeast Asian countries. While in recent years Singapore maintains an R&D intensity (R&D investments/GDP) of over 2 % and Malaysia of 1.1 %, countries like Indonesia or the Philippines invest around 0.1 to 0.2 % of their GDP into R&D. The amount of research personnel in the countries varies accordingly: between two per 10,000 inhabitants up to around 60 to 70 per 10,000 inhabitants. These different levels of input have to be taken into account when interpreting the subsequent data, which show for instance that Southeast Asian countries' contributions to world scientific output differ greatly.

The conclusions of our study are as follows.

### Publications

In 2014, the world publication output has been 2,603,122 documents<sup>2</sup>. Although over the eleven-year period Singapore (SG) had the highest average share of the world-wide output (0.59%), Malaysia (MY) overtook SG in 2010 and arrived at a share of 0.97% in 2014 (vs. 0.16% in 2004). Thailand's (TH) share is up to 0.46% (from 0.24% in 2004), Indonesia (ID) is up to 0.21% (from 0.06% in 2004), Vietnam (VN) is up to 0.14% (from 0.04% in 2004), and the Philippines (PH) are stable around 0.07%. The other ASEAN countries' share of the world overall output is negligible.

In the examined time span of 2004 to 2014, the overall ASEAN scientific output in terms of scholarly publications amounted to ca. 550,000. The yearly output increased three and a half times, i.e. from about 23k (thousand) in 2004 to more than 80k in 2014.

Out of all ASEAN countries, Singapore has the highest number of publications. While this may not come to anyone's surprise, a less known fact might be that Malaysia is growing fastest – relative to 2004 – in terms of its publication output. Interestingly, Malaysia's national publications grew faster

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<sup>1</sup> ASEAN is a supranational confederation of Southeast Asian states, including Brunei, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam

<sup>2</sup> according to Scimago ([www.scimagojr.com](http://www.scimagojr.com), last accessed: March 2016)

than the country's international co-publications. The share of international co-publications started at 35% in 2004, then dropped to 24% around 2009 (around which we noted a burst in the output of national publications), then was rising again until 2014. Thailand shows a similar but less pronounced development: ~44% in 2004, ~37% in 2009, and ~39% in 2014. This is interesting insofar as the situation is typically reversed, especially given the globalisation or internationalisation of scientific research within the past 10-15 years. In the light of an overall strong increase in both publications (especially in the case of Malaysia) and co-publications, this indicates that both countries are making the transition from a small research system with little output highly dependent on international ties to one of stronger national output, and finally to one of internationalised output similar to countries whose research system is more advanced. An example for the latter is Singapore which shows a steady growth that is characteristic for a small, mature research system. Indonesia is somewhat of an exception as international co-publications are growing rather slowly.

Globally, the EU is the strongest partner in co-publication collaboration, followed by the USA, China, Japan, Australia, and India. Taking a closer look at the co-publication output of ASEAN-EU countries, the top three partners are Great Britain, Germany, and France. Great Britain is first in case of Singapore, Malaysia, Thailand, Laos (LA), Myanmar (MM), and the Philippines; France is first in case of Vietnam and Cambodia (KH), the Netherlands first in case of Indonesia; the Netherlands is among the top with Cambodia and Laos (in particular in Clinical Medicine and Biomedical Research), Italy is among the top in case of Singapore, and Belgium in case of Vietnam.

As regards the research areas in Southeast Asian publication output, more than 40% of overall publications were recorded in Applied Sciences, slightly more than 20% each in Health Sciences and Natural Sciences, roughly 7% in Social and Economic Sciences, 4% in General Sciences, and ca. 1% in Arts & Humanities. As regards the more detailed level of research topics, the strongest in terms of number of publications as well as international co-publications are Clinical Medicine, Information & Communication Technologies (ICTs), and Engineering. The global data offered by <http://www.scimagojr.com/> (on the Scopus database) allow comparing this regional thematic portfolio with global research output. The thematic output patterns in Southeast Asia are fairly consistent with global patterns with the exception of a greater relevance of ICTs in Southeast Asian output compared to global output<sup>3</sup>.

The analysis of thematic patterns in output becomes more fruitful when combined with the analysis of geographic patterns. In case of Clinical Medicine, the strongest intra-ASEAN ties are Malaysia-Singapore, Thailand-Singapore, and Malaysia-Thailand. The strongest international co-publications in this field were recorded for Thailand-USA, Thailand-EU, and Singapore-Australia. Clinical Medicine is almost always at the top of each country's co-publication ties; exceptions are Biology and Earth and Environmental Sciences in case of Indonesia-Germany, Physics and Astronomy in case of Vietnam-Germany, and Biology as well as Chemistry in case of Myanmar-Germany. Another noteworthy exception on the intra-ASEAN level is Malaysia-Indonesia, where Clinical medicine is considerably weaker than in other country ties. In case of both Engineering and Information & Communication Technologies, the strongest intra-ASEAN ties are attributed to Indonesia-Malaysia and Malaysia-

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<sup>3</sup> For comparison with other world countries please refer to <http://www.scimagojr.com/countrysearch.php?w=world>

Singapore (other country ties are far behind their output level), the strongest international ties to Singapore-China, Singapore-USA, and Singapore-EU.

## Impact

The top research fields in terms of average citations (per article involving ASEAN countries) are Biomedical Research, Chemistry, General Science & Technology, Enabling & Strategic Technologies, and Physics & Astronomy.

The impact of ASEAN co-publications tends to be higher than that of the overall ASEAN publications. This is certainly true for the top fields that were mentioned above. Co-publications with the EU tend to have a higher impact than the overall international co-publications. The biggest difference was recorded for *General Science & Technology*, where the co-publications with the EU received, on average, about 9 citations more than other international co-publications (~28 with EU vs. ~17). The impact of ASEAN-EU co-publications in *Clinical Medicine* and *Biomedical Research* is also stronger than the regional average.

## 3 Introduction

The present study was conducted by the Centre for Social Innovation (Austria), as a part of a series of analysis carried out within the SEA-EU-NET II project. The study was done in two parts over a period of two years, a preliminary analysis in 2014 to provide early results and stimulate discussions; the final comprehensive report was conducted in 2015/2016.

We present quantitative data on Southeast Asian research output, more concretely indexed journal publications. We specifically focus on identifying geographic and thematic cooperation patterns at country-level. The idea behind this is to gain a better understanding of the ways in which Southeast Asian countries contribute to and are integrated in global knowledge production networks.

The main research questions for the study are:

- How did the publication output in Southeast Asia develop over time?
- What are thematic and geographic patterns and priorities in Southeast Asian publication output?

By answering these questions, we aim to contribute relevant evidence to the ASEAN-EU science, technology and innovation policy dialogues as well as research policy and programme making in both Southeast Asia and Europe.

The study covers the years 2004-2014. The data sources are Web of Science and Scopus. The use of these data allows us to make our analyses as comprehensive as possible, within the obvious limitations of this sort of data, which will be explained in more detail in the methodology section.

## 4 Methodology

This chapter describes the main processes involved in the study underlying this deliverable and presents the analysis results.

The analysis of ASEAN countries co-publication output and their collaboration with EU28/AC in the years 2004 to 2014 is based on the two best known and most comprehensive multidisciplinary academic citation data bases:

- Elsevier's *Scopus*
- Thomson Reuter's *Web of Science* (short: WoS; at present containing the following databases: Science Citation Index Expanded, Social Sciences Citation Index, Arts & Humanities Citation Index)

The study analyses all publications from both databases that featured any affiliation to at least one organisation in an ASEAN country. We pursue the analysis in more detail for those publications that also include affiliations in at least one of the EU28/AC countries. The study does not discriminate by document types, meaning that scientific articles are taken into account the same way as conference proceedings, academic letters, and other document types that were tracked by the both data sources (see Annex I, entry "document types"). The reason for this procedure is the idea that jointly published conference papers can also indicate international cooperation activity, and are therefore of interest to the SEA-EU-NET II project. The following countries are covered in the ASEAN region: Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam<sup>4</sup>. EU28/AC on the other hand covers all twenty-eight EU member states and the associated countries to the EU Framework Programmes.

To understand and adequately interpret the results presented in this deliverable, a few basic terms need to be defined at this point. More details are provided in the Annex 1 (p. 202).

With the term '**record**', we refer to an entry in our database containing the meta-data of a uniquely identified publication. So, as soon as the same publication is identified in both data sources, it is treated as one record.

Throughout the study, we use **full counting** of records instead of fractional counting. This means that a record that is jointly published in a journal by authors from, e.g., Thailand and Indonesia, is counted as 1 publication for Thailand and 1 publication for Indonesia. The advantage of full counting over fractional counting in our context is that we are interested in evidence for international collaboration, not so much as recognitions on the author level. From this point of view, it does not matter whether an Indonesian author publishes with 4 colleagues from Thailand (which, in fractional counting, would mean 0.2 publications for Indonesia) or with 1. The important fact is that there is a contribution from Indonesia. However, in a pair-wise view of the collaboration between Thailand and Indonesia in the above example, the co-publication counts as one jointly produced article, not two. This may become more obvious when collaborating with another country, e.g. the Netherlands. Let us presume authors from Indonesia, Thailand, and the Netherlands worked on a co-publication. If we

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<sup>4</sup> Brunei, which is also country in ASEAN, was excluded from this report, as the number of publications between 2004 and 2014 was simply too small to conduct a profound analysis.

regard the output of a country pairing, e.g. Indonesia and the Netherlands, the count is 1; if we regard the output of another pairing, e.g. Indonesia and Thailand, like in the first example, the count is also 1; if we regard all three together, the count of that collaboration is still just 1. Regarded separately, however, each of these countries has been involved in a co-publication and receives 1 count. To phrase it differently, a *record* is at the centre of collaboration and “knows” which country participated, i.e. if we ask our system to show us all articles in which certain countries were involved, the record would “know” whether or not it is relevant (and should be counted).

For the analysis of output and collaboration per subject area, we use the ontology developed by **Science Metrix**<sup>5</sup>, which assigns each journal (and, by extension, records published in the respective journal) to one thematic field. The ontology distinguishes three levels of detail: research areas (6), research fields (22) and subfields (176).

As indicated already, the study consolidates different ‘**document types**’ from the databases i.e. articles, conference papers, meeting abstracts, reviews, editorials, letters, and others, which are used to describe the units of analysis.

An ‘**affiliation**’ links an author to her/his institution(s). As these can be more than one and also located in different ASEAN countries, all of these affiliations are counted and also included as international co-publications. The number of average authors per (co-)publication typically is significantly higher in some fields (e.g.: Physics) than in others. This skew in author count statistics has to be taken into account (and is indicated in the analyses below).

As a specific sub-chapter of the report deals with the ‘**impact**’ of publications, i.e. number of citations, readers should keep in mind that the impact given below is just a snapshot: since there is a lag between the publication of a work and the occurrence of references to it in later works, the most recent works will typically show no or few citations. The citations of a very recent publication can’t be compared to the ones of a publication which was published some years ago. Secondly, if looking at the citation count of a publication, the scientific field in which this publication was made may carry a decisive role. Natural, Health or Applied Sciences are usually highly cited research areas, whereas others such as Social Sciences or Arts & Humanities tend to have lower citations rates. Direct comparisons between research fields therefore shall be made with caution. We mitigate the distortions by differences in average citation counts per field through the use of field normalisation and benchmarking. We have not calculated overall field-normalised citation counts. Therefore, countries’ average citation counts should only be compared field by field.

Thirdly, in those research fields with small publication numbers the average citation counts tend to fluctuate to a big degree. As an example: If there is only one publication that has been cited 40 times and, later on, there is another one in the same field that has just 2, the average citation drops from 40 to 21. Thus it may be sensible to exclude such cases. We exclude (or at least highlight) average citation counts that are based on a small number of cases.

**Data processing:** The raw data in the citation databases, as we retrieved it (through the databases’ web interfaces), are, to some extent, of limited quality. Errors range from wrong address information

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<sup>5</sup> <http://www.science-metrix.com/en/classification>

to inconsistencies between the records in the two databases. A bundle of software tools was especially developed to assure (1) that the formats of the data allow unification and (2) the rise of quality of metadata of publications tracked in both sources after unification. The steps involved are described in detail in Annex 2 (see p.204)

## 5 Co-publication analysis – overview

This section presents the main results on the ASEAN level. It aims at providing an overview of the main co-publication figures, the development over time, the main research topics, and the impact of the co-publication output, the internationalisation, and the main collaboration partner countries. In-depth results can be found in the chapters that are dedicated to the ASEAN countries individually.

This analysis covers the time span from 2004 and 2014. As described in the *Methodology* section, the analysis is based on the two major citation databases *Scopus* and *Web of Science*.

### 5.1 ASEAN research output – general characterisation

In the period from 2004 to 2014 (11 years), the overall ASEAN scientific output in terms of scholarly publications indexed in either Scopus or Web of Science amounted to ca. 550k (thousand).

The international co-publications, i.e. those publications that were created with at least two authors from different countries (at least one of which is an ASEAN country) amount to ~210k, which constitutes a share of 39% of overall publications. The ASEAN-EU<sup>67</sup> co-publications (~70k) amount to a share of 32% of all international co-publications.

### 5.2 ASEAN research output – development over time

Figure 1 illustrates the development over time. The output increased from about 24 k in 2004 to more than 80k in 2014. The Figure 2 below shows the growth relative to 2004, which shows that the output increased more than three times.

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<sup>6</sup> For the sake of simplicity, as from now on when talking about co-publication volume with the EU, the term EU also includes countries associated to the EU Framework Programme for Research and Technological Development

### ASEAN publications

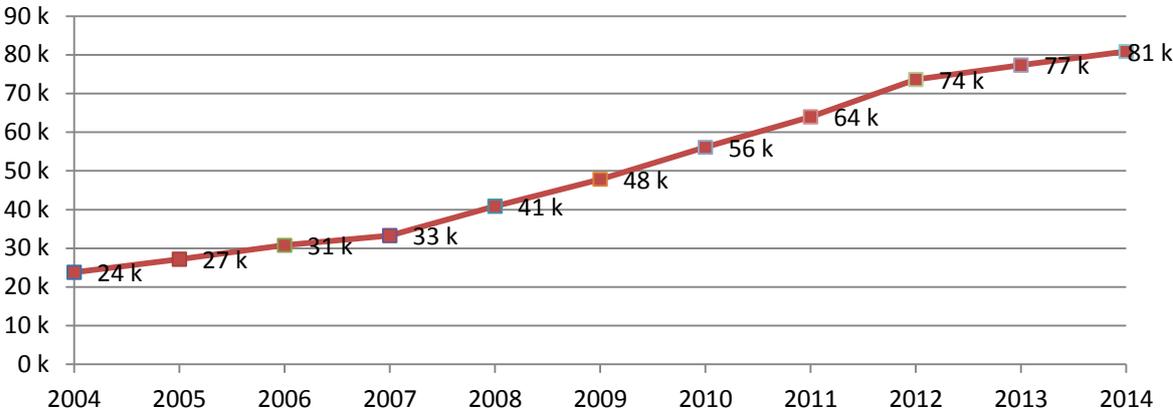


Figure 1: ASEAN overall publications, 2004-2014

### ASEAN publications - growth

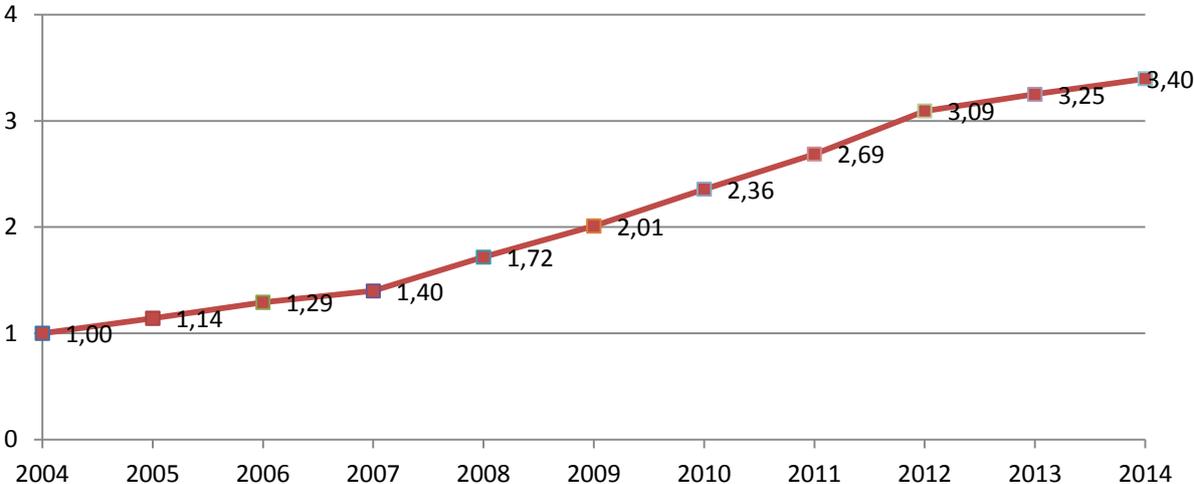


Figure 2: ASEAN overall publications growth relative to 2004, 2004-2014

Examining the growth for the international co-publications, we see that they amounted to ~9k in 2004 and to ~34k in 2014, which means that they increased almost four times (see Figure 3 and Figure 4).

### ASEAN co-publications

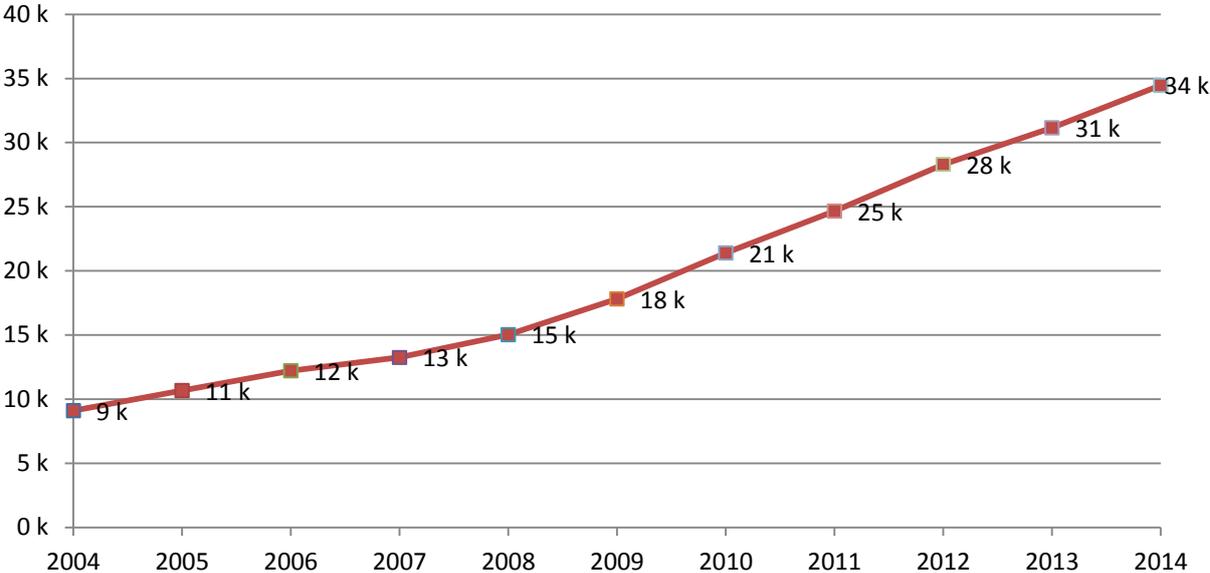


Figure 3: ASEAN international co-publications, 2004-2014

### ASEAN co-publications - growth

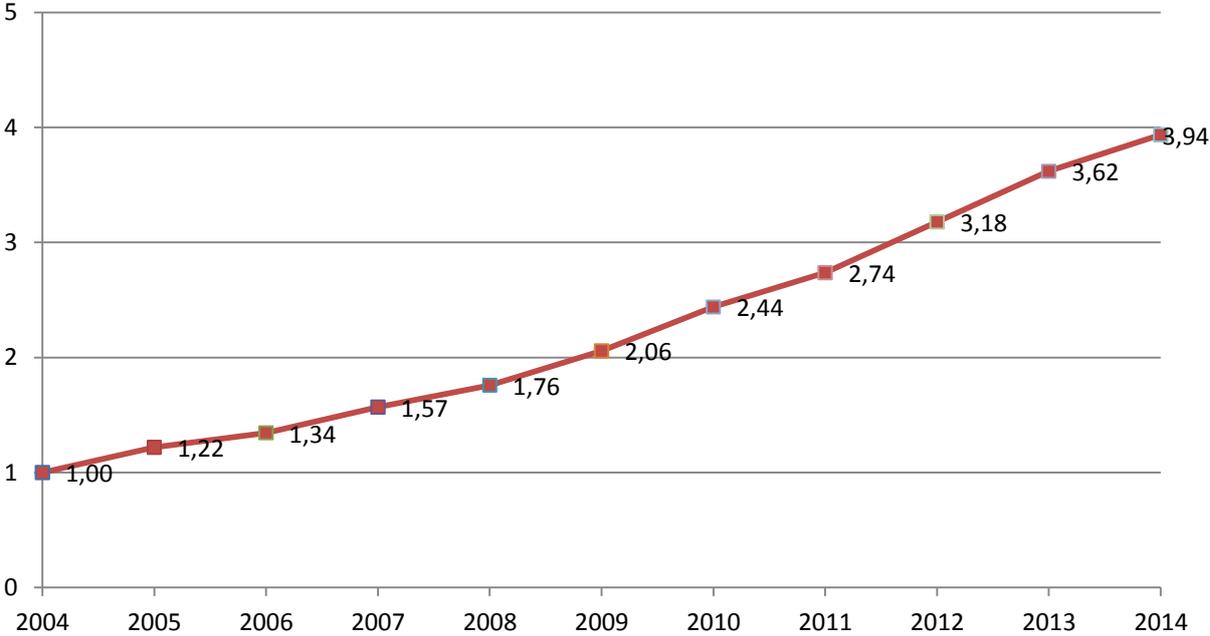


Figure 4: ASEAN international co-publications growth relative to 2004, 2004-2014

The total ASEAN-EU co-publications in the examined time span amount to ~70k, ~3k in 2004 and 11k in 2014. This means that the number of co-publications has increased nearly four times (see Figure 5 and Figure 6).

### ASEAN-EU co-publications

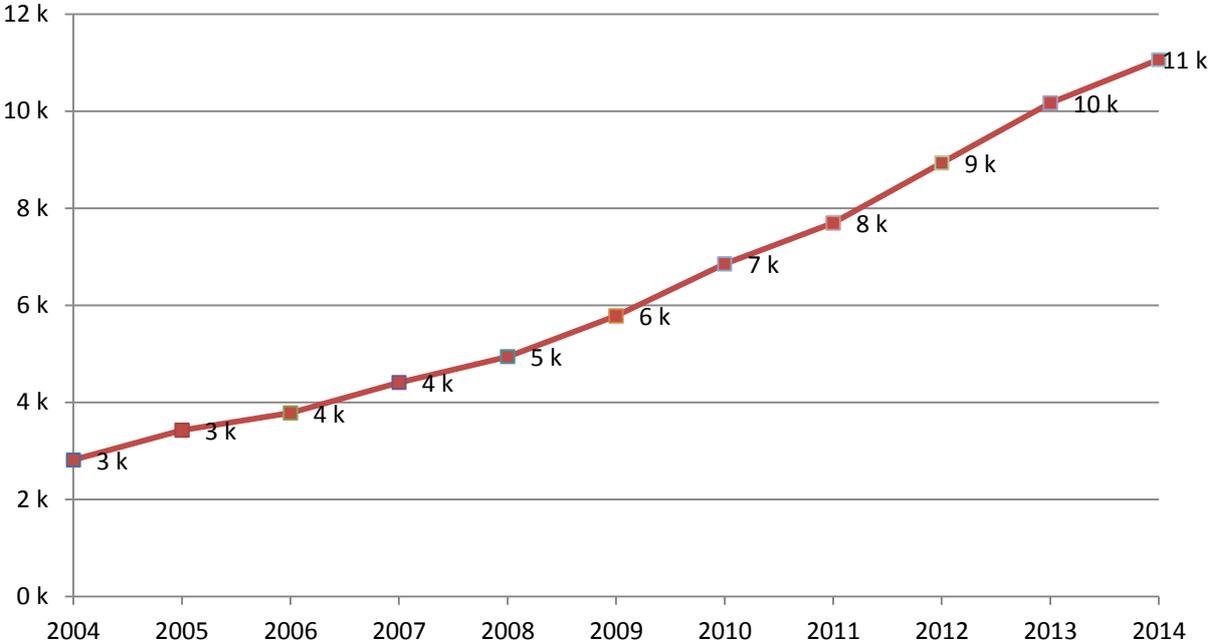


Figure 5: ASEAN-EU co-publications, 2004-2014

### ASEAN-EU co-publications - growth

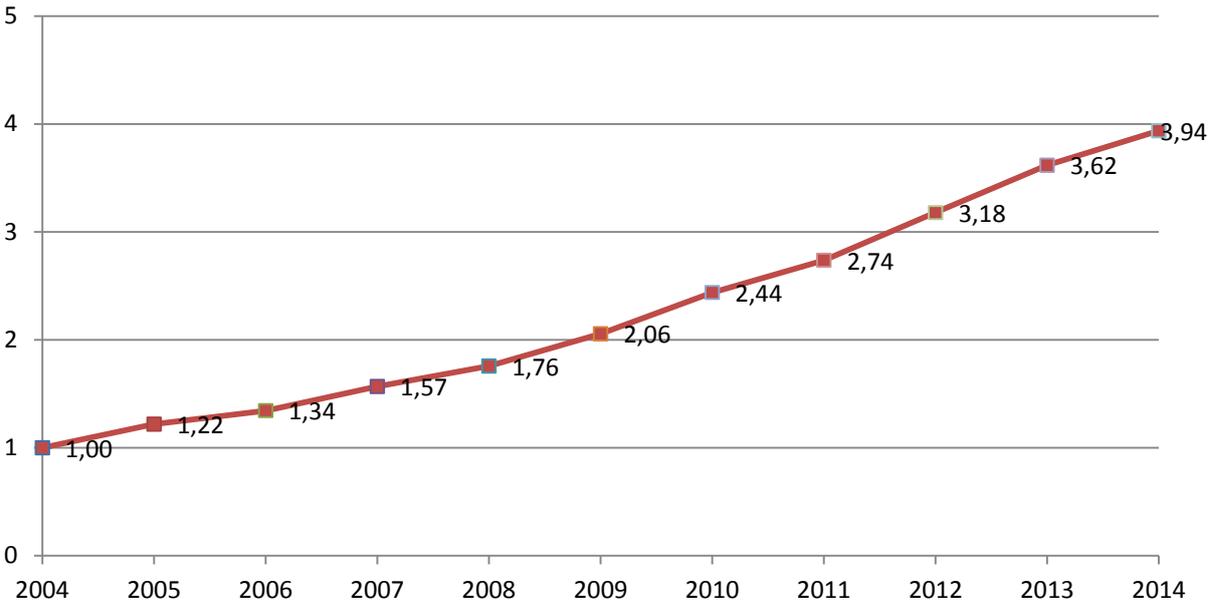


Figure 6: ASEAN-EU co-publications growth relative to 2004, 2004-2014

In the Figure 7 and Figure 8 we compare the overall ASEAN publications, the ASEAN co-publications, and the ASEAN-EU co-publications. Since the level of overall publications is much higher than the other two dimensions, it seems that the latter two are growing more slowly. However, taking a closer look at the growth (see Figure 8) reveals that, although the growth of all three dimensions have mirrored each other for most of the time, the international co-publications as well as the ASEAN-EU co-publications start to grow faster than the overall publications from 2012 onwards. It remains to be seen whether this development will continue – it is expected that it does, judging by observations of other countries with more mature research and innovation systems.

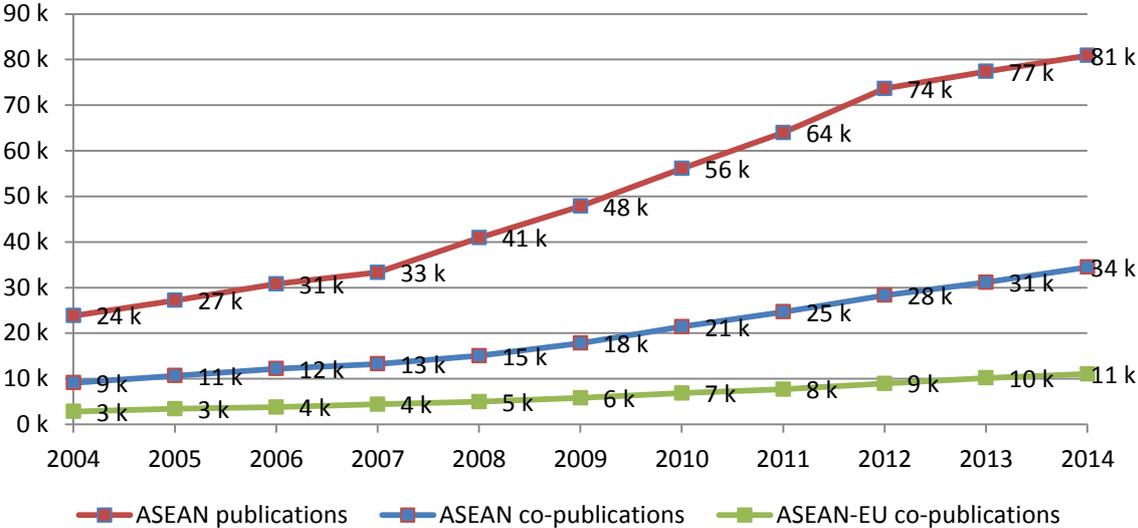


Figure 7: Comparison of the development of ASEAN publications, international co-publications, and co-publications with the EU, 2004-2014

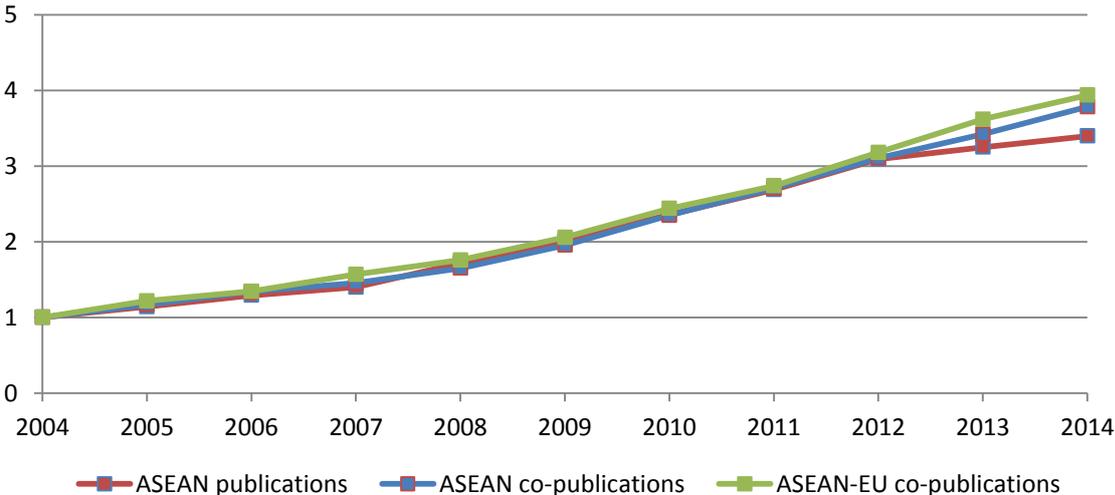


Figure 8: Comparison of the growth of ASEAN publications, international co-publications, and co-publications with the EU, 2004-2014

### 5.3 Main topics in ASEAN research output

More than 40% of overall publications were recorded in the research area Applied Sciences, slightly more than 20% each in Health Sciences and Natural Sciences, roughly 7% in Social and Economic Sciences, 4% in General Sciences, and ca. 1% in Arts & Humanities (see Figure 9). Growth over time is depicted in Figure 10.

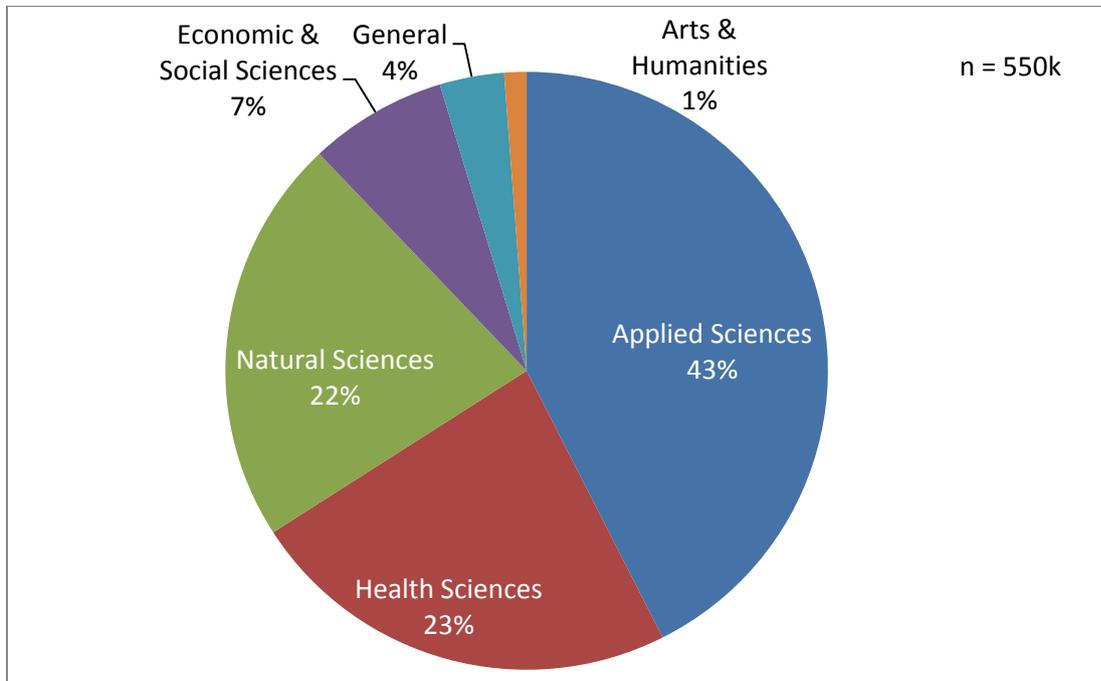


Figure 9: Share of research areas in ASEAN publications, 2004-2014

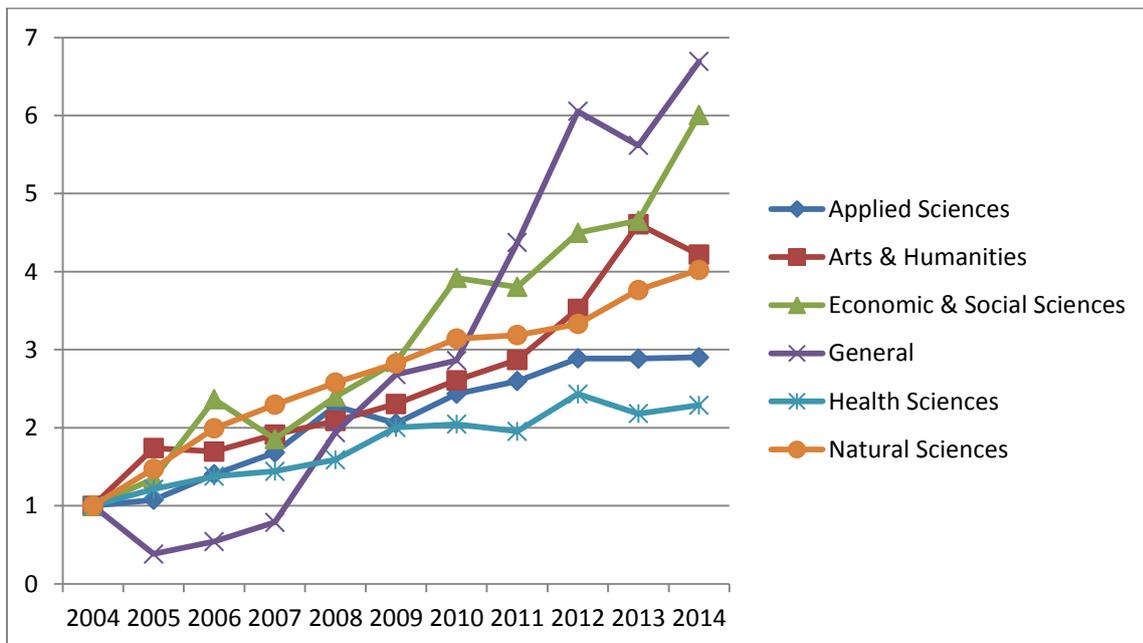


Figure 10: Growth over time of research areas in ASEAN publications, 2004-2014

Broken down into research fields<sup>8</sup>, five account for more than 50% of all ASEAN publications: Clinical Medicine (15 %), ICT (13 %), Engineering (13 %), Enabling and Strategic Technologies (12 %), and Physics and Astronomy (7 %) (see Figure 11).

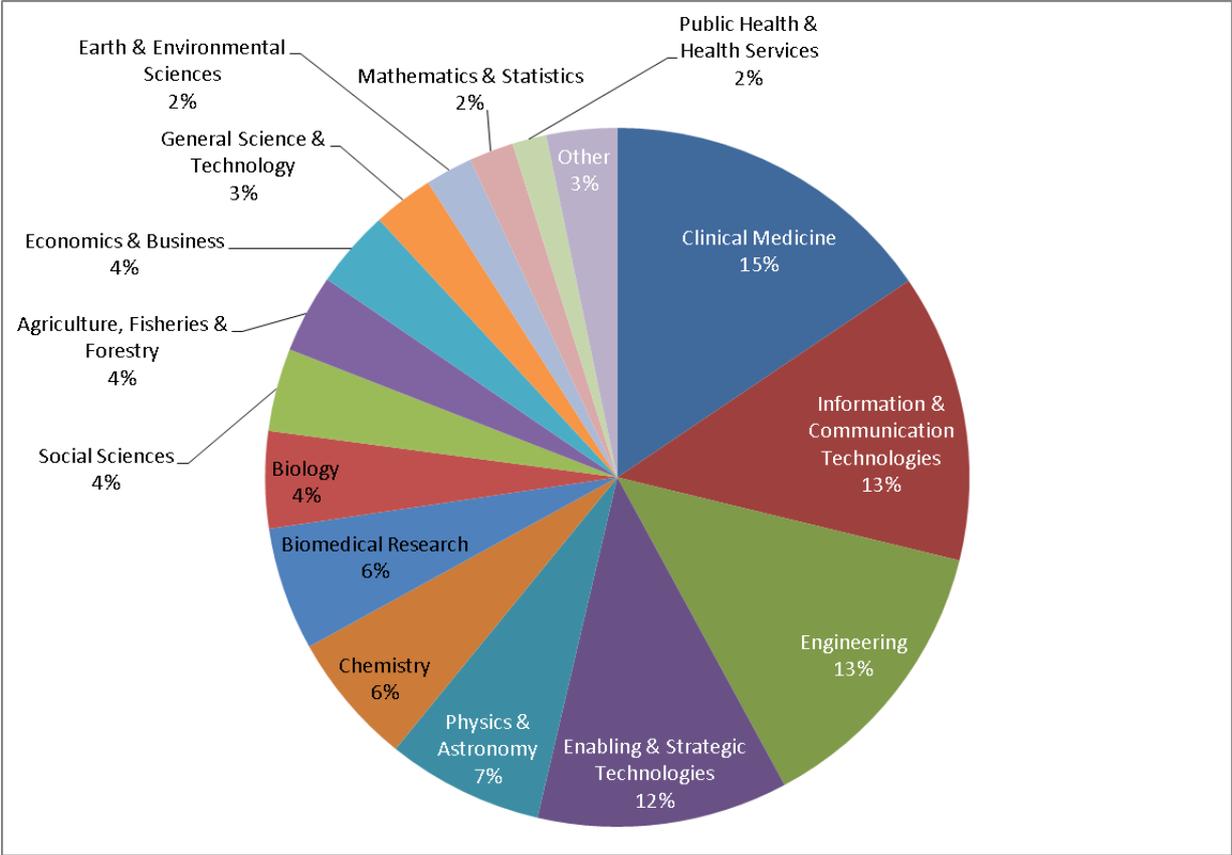


Figure 11: Share of research fields in ASEAN publications

When observing the development over time, the top three in terms of publication output are growing fairly steadily; the field of Enabling & Strategic Technologies reports strongest growth from 2009 onwards (see Figure 12). Chemistry, Biomedical Research, Biology, Economics & Business, and Agriculture, Fisheries & Forestry seem to be stagnating in recent years.

<sup>8</sup> Classification using the Science Metrix Ontology (cf. *Methodology* chapter)

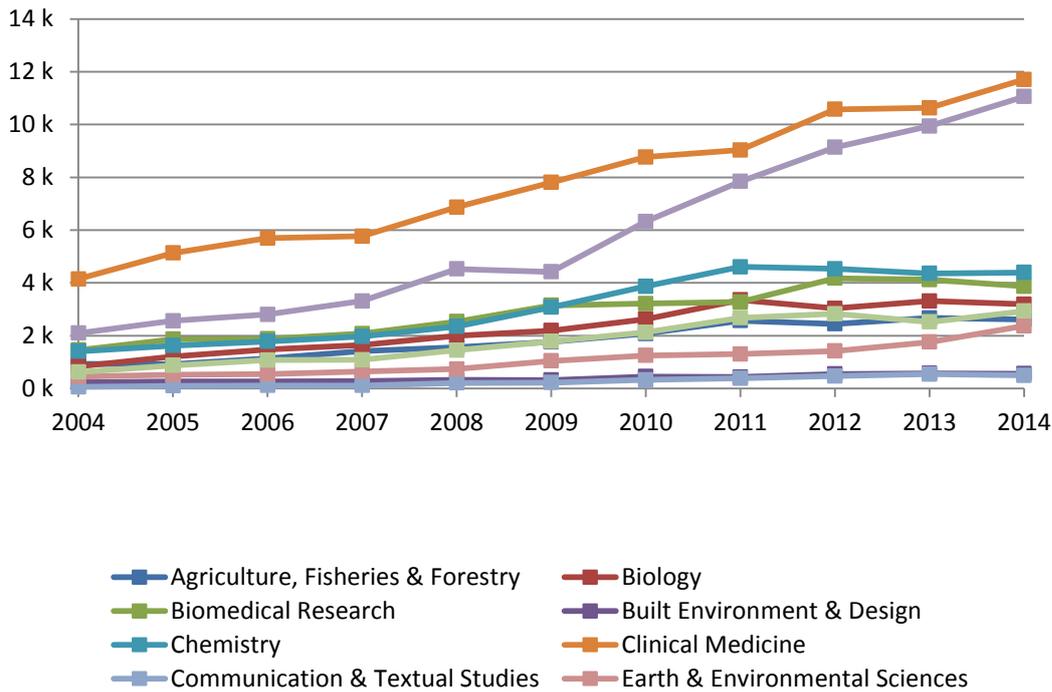


Figure 12: Development over time of the top ten research fields in terms of number of ASEAN overall publications, 2004-2014

To closer examine the fields with fewer publications, we eliminate the stronger ones. This way, we can see that Earth & Environmental Sciences are continuously growing while other fields exhibit at least some oscillations in the studied years (see Figure 13).

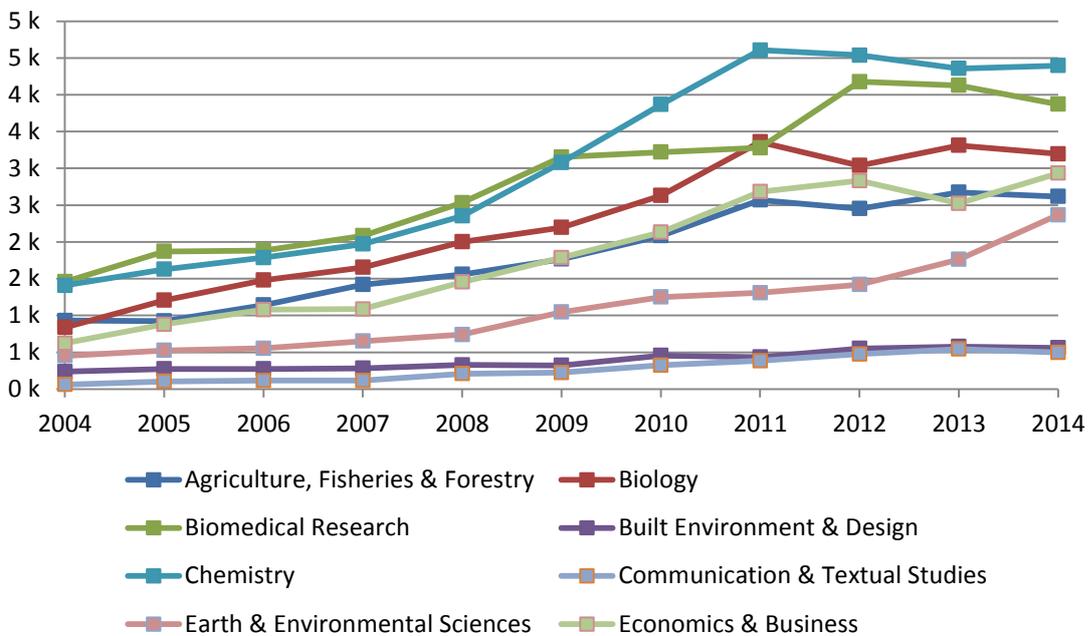


Figure 13: Development over time of the top research fields in terms of ASEAN overall publication, without Clinical Medicine and Enabling & Strategic Technologies; 2004-2014

Comparing the ASEAN international co-publications with the ASEAN-EU co-publications in terms of research field shares shows that there are no significant differences (see Figure 14). The minor ones are that more ASEAN-EU publications seem to be in Clinical Medicine (26% with EU vs. 23% international) and Physics & Astronomy (7% with EU vs. 5% international), while ASEAN international co-publications seem to “favour” Engineering (7% international vs. 5% with EU).

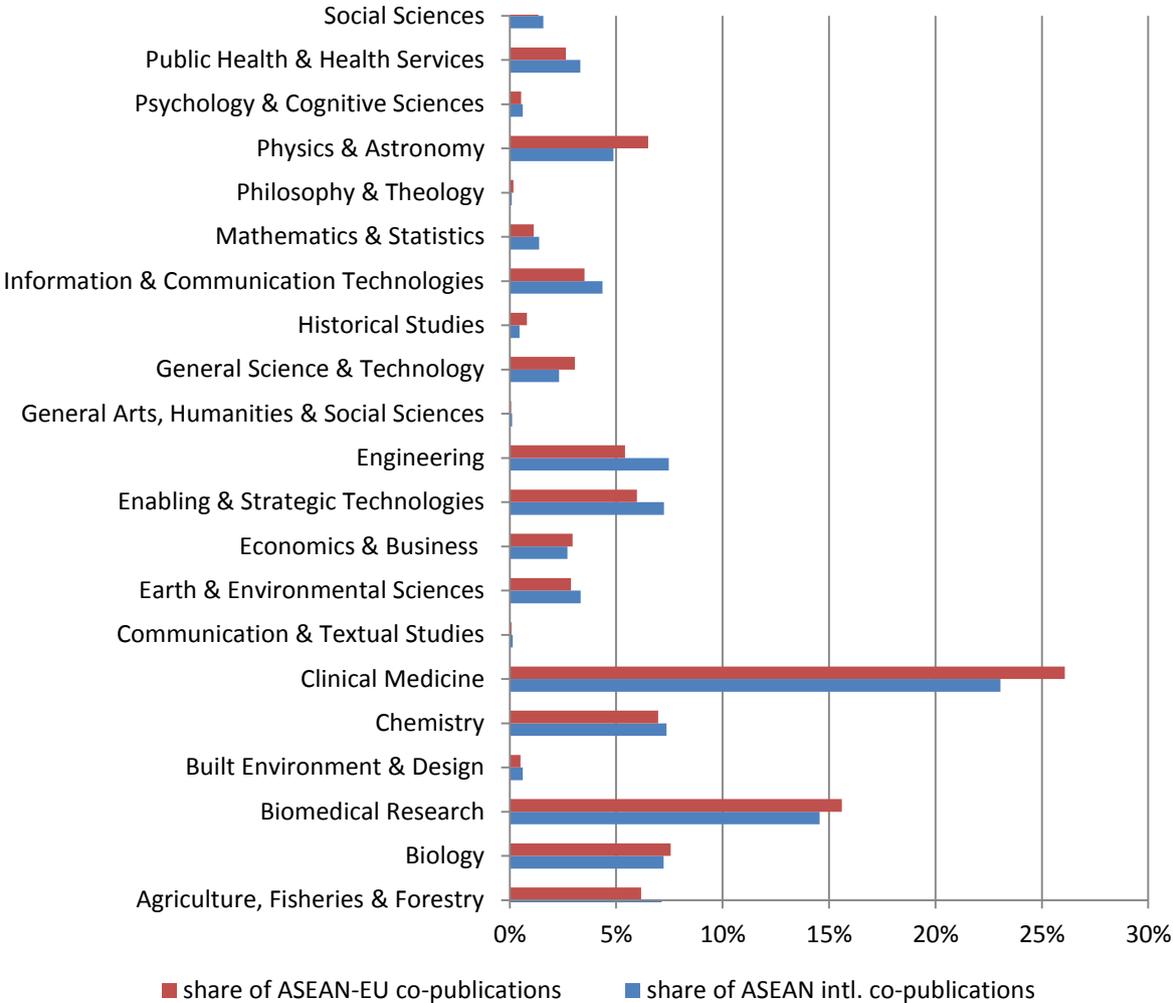


Figure 14: Comparing share of research topics of ASEAN international co-publications and ASEAN-EU co-publications, 2004-2014

### 5.4 Impact of ASEAN research output

The impact of scholarly publications is often measured by using *citations* as a proxy, i.e. the higher the number of citations an article accumulates over time the higher its impact<sup>9</sup>. According to our data analysis, the top research fields of ASEAN publications in terms of average citations (per article) are Biomedical Research (11.82), Chemistry (9.47), General Science & Technology (7.74), Enabling &

<sup>9</sup> Oftentimes, citations also are used to indicate quality or excellence. That being said, citations are not perfect and are continuously being debated by the scientific community; new indicators for impact may arise in the context of Open Science in the medium to long-term future.

Strategic Technologies (6.65), and Physics & Astronomy (6.49). As said above, comparing average citations between fields is not useful as citation cultures vary. It is more interesting to benchmark within the same field.

Across all fields, the impact of co-publications tends to be higher than that of the overall publications. .Co-publications with the EU tend to be higher again than the overall international co-publications (see Table 1). The top fields impact fields are as follows: General Science & Technology 16.91 (28.76 with EU), Biomedical Research 14.75 (18.08 with EU), Clinical Medicine 12.55 (17.77 with EU), and Chemistry 9.25 (10.46 with EU).

research fields	avg. citations internatl. co- publications	avg. citations ASEAN-EU co- publications
Agriculture, Fisheries & Forestry	6.7	7.24
Biology	7.39	9.12
Biomedical Research	14.75	18.08
Built Environment & Design	5.26	5.32
Chemistry	9.25	10.46
Clinical Medicine	12.55	17.77
Communication & Textual Studies	2.52	1.97
Earth & Environmental Sciences	7	8.93
Economics & Business	6.34	5.45
Enabling & Strategic Technologies	8.56	8.28
Engineering	5.95	5.95
General Arts, Humanities & Social Sciences	1.24	1.21
General Science & Technology	16.91	28.76
Historical Studies	5.22	6.31
Information & Communication Technologies	5.02	5.08
Mathematics & Statistics	5.32	5.01
Philosophy & Theology	2.02	2.23
Physics & Astronomy	8.26	9.28
Psychology & Cognitive Sciences	7.16	7.54
Public Health & Health Services	6.34	7.81
Social Sciences	3.01	3.14
Visual & Performing Arts	0.71	0.7

Table 1: Comparison of impacts (ASEAN international co-publications vs. ASEAN-EU co-publications)

## 5.5 Main collaboration partners, thematic collaboration patterns and impact comparison of the ASEAN region

The strongest collaboration partner of ASEAN countries is the EU28/AC (see Figure 15). Next up are the USA, China, Japan, and Australia.

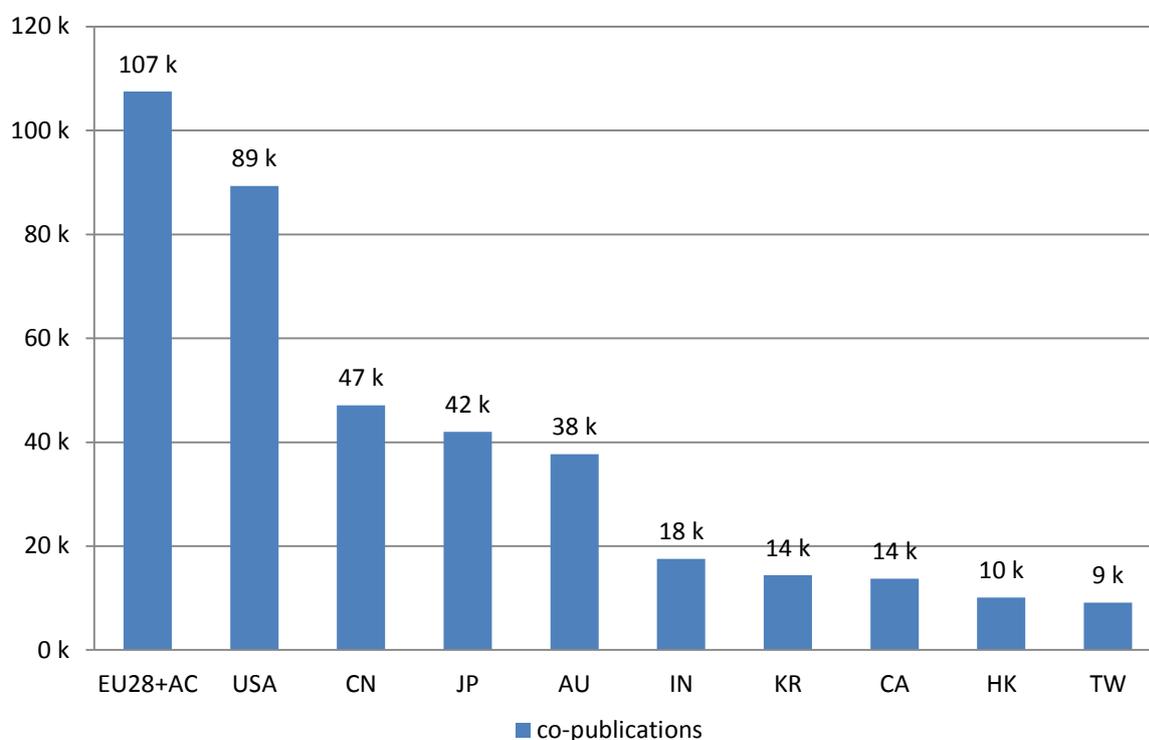


Figure 15: Main collaboration partners of ASEAN countries in terms of co-publication output, 2004-2014

In terms of impact, the situation is slightly different (see Table 2). South Africa, Brazil, and Israel seem to lead the field; the EU and the USA can be found further down the list. This is to be expected, as the initial scientific exchanges with a third country typically take place in research fields of mutual strengths, while an extensive collaboration further down the road might take place in all kinds of research fields, i.e. more as a sign of mutual interests. This relates to another factor that should be kept in mind when interpreting this data: If co-publications with a smaller country are focused on specific fields, this can affect average citation counts as the various research fields can have a vastly different citation culture – depending on whether those specific fields belong to the higher or lower cited ones, on average, a skewness in that direction may occur. That said, co-publications with Israel in the area of health sciences amount to an average citation of roughly 47, in general science to roughly 34; however, the number of co-publications in the latter area is fairly low (~ 50 vs. ~ 600 in health sciences). For co-publications involving South Africa, the average citation in general sciences is slightly higher (~ 56), as is the number of co-publications, which still is fairly low, though (~ 70); the average citation in health sciences amounts to 40 (for ~ 900 co-publications), which is slightly less than Israel, but still fairly high.

country/region	co- publications	citations	avg. citations
SA	2,668	87,152	32.67
BR	4,379	142,900.5	32.63
IL	2,238	59,793.9	26.72
CA	13,761	300,219.6	21.82
HK	10,106	2,16413	21.41
RU	3,325	66,784.6	20.09
NZ	5,505	100,413.9	18.24
TW	9,122	1,59145	17.45
TU	2,495	42,604.2	17.08
USA	89,353	1,398,270.3	15.65
KR	14,432	218,277.1	15.12
AU	37,684	520,204.5	13.8
EU28/AC	107,486	1,439,509.9	13.39
CN	47,095	611,954.5	12.99
PK	3,753	44,072.8	11.74
JP	42,033	445,430.1	10.6

Table 2: Strongest collaboration partners in terms of average citations

## 6 Co-publication analysis on ASEAN country level

### 6.1 Introduction

After the previous chapter has provided an overview of the developments on the ASEAN level, the subsequent chapters offer in-depth results on each ASEAN country level. Starting with the development of the national publication output, the chapters cover topics such as collaboration links with other countries – ASEAN, EU, and world-wide –, thematic strengths, and the impact in terms of average citations.

## 6.2 Malaysia

### Output over time

Malaysia has produced an overall amount of 173,652 publications (indexed in either Scopus or Web of Science) in the years 2004 to 2014. A breakdown per year is given in the

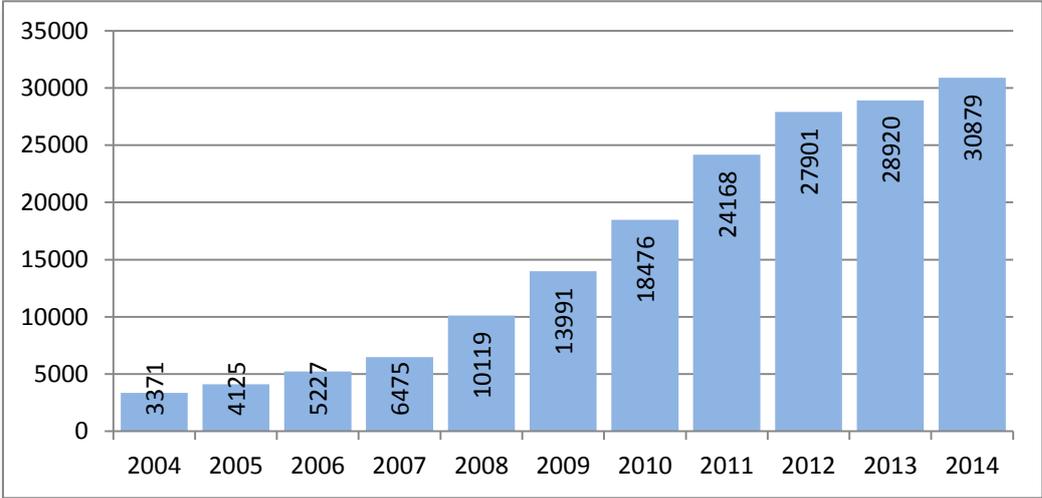


Figure 16. The annual publication output of Malaysia increased notably from 2004 to 2014. Whereas in 2004, Malaysian authors published 3,371 scientific publications, in 2014 the annual publication output amounted to 30,879 publications. This more than tenfold increase is visible both in Malaysia’s domestic publications as well as its international co-publications.

An average Malaysian publication involves 5.41 authors from 1.47 different countries and is cited 2.98 times. Of these 173,652 publications, 51,488 publications are co-publications, that is, they include at least one author affiliated in another country. Around 13,000 of these co-publications involve at least one author affiliated in an EU28/AC country. Around 7,000 involve at least one author based in another ASEAN country. However, it is important to mention that both of the mentioned quantities of co-publications with the EU28/AC and the ASEAN countries are not exclusively limited to the involvement of authors from the respective region. A co-publication with an author from the EU28/AC can also include an author from the ASEAN region and vice versa.

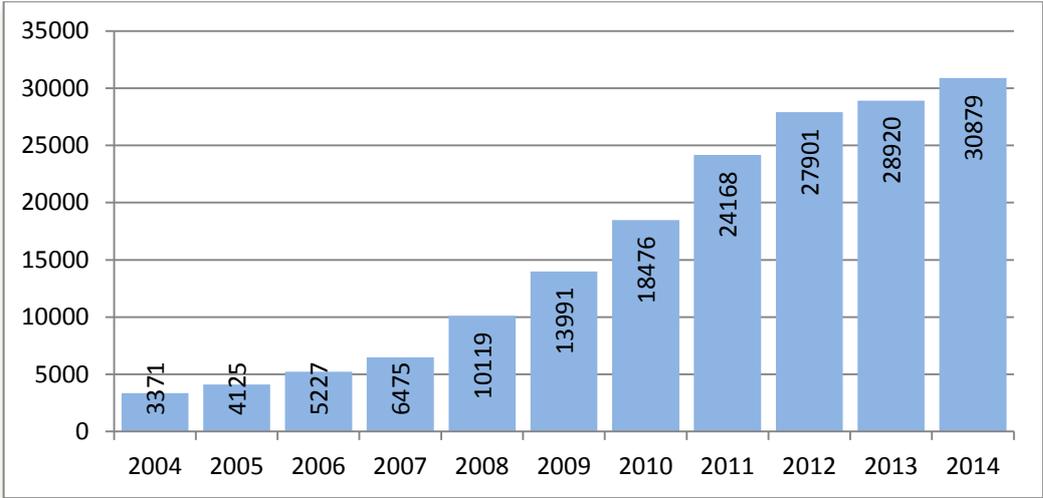


Figure 16: Malaysia's publication output, 2004-2014

The following Figure 17 shows the development of the Malaysia co-publications. Similar to the overall publication output of Malaysia, also this trend is very positive. The co-publication output steadily increased within the period 2004-2014 – from 1,161 co-publications in 2004 to 10,439 co-publications in 2014. In fact, around 1/3 of Malaysia’s scientific publications in 2014 were international co-publications.

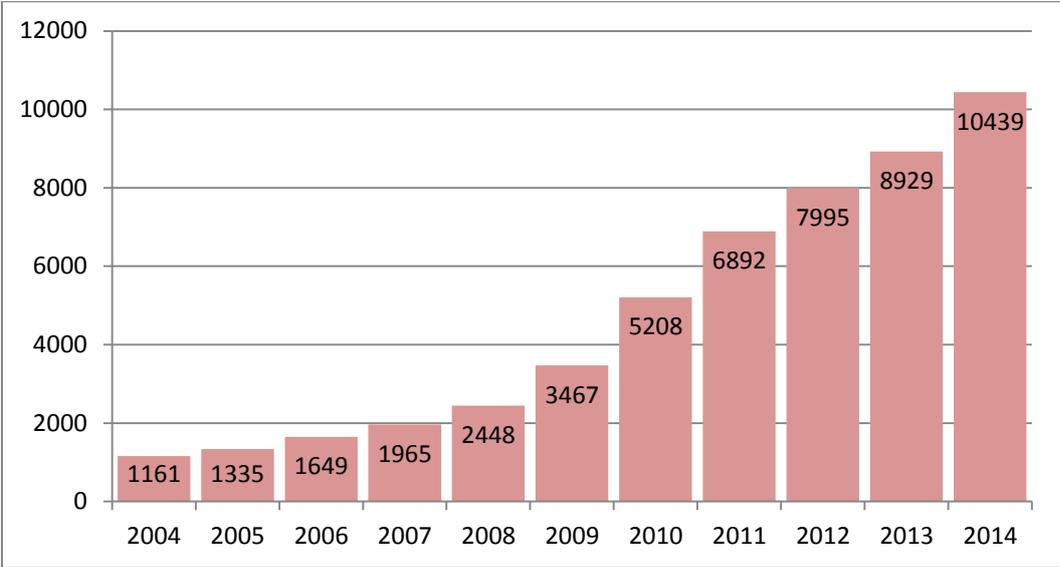


Figure 17: Malaysia's co-publication output, 2004-2014

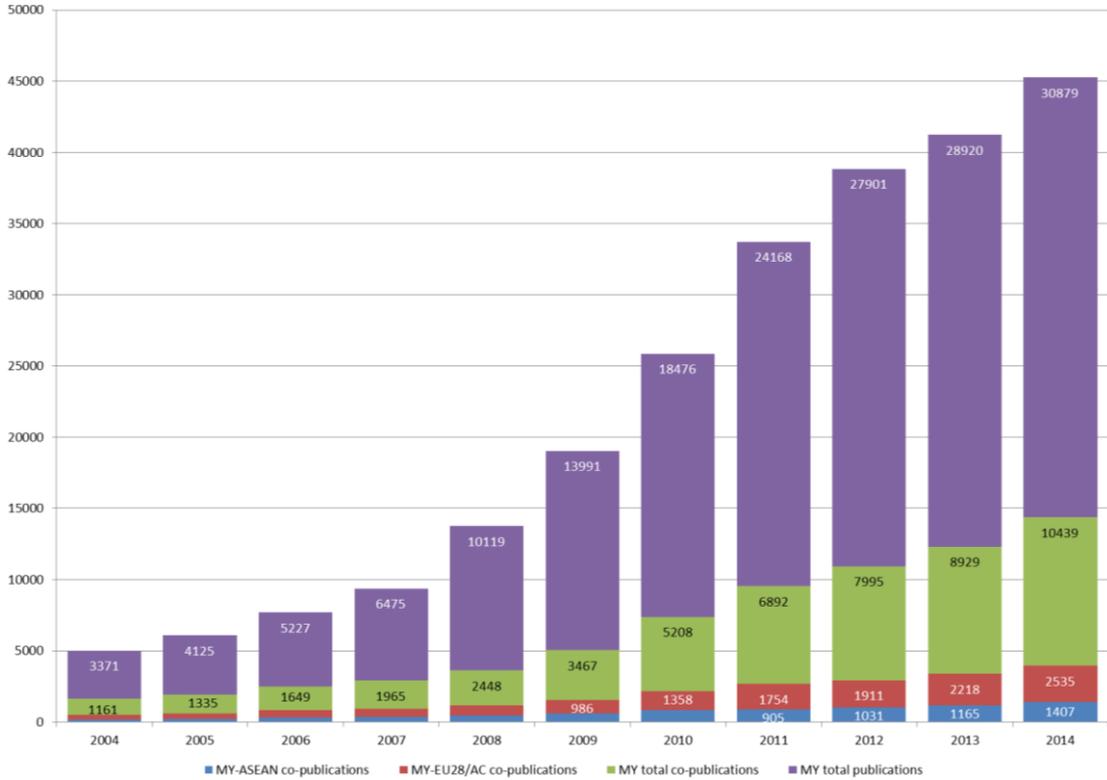


Figure 18: Overview of the share of Malaysia’s international co-publications and total co-publications on MY total publication output, 2004-2014-

Figure 18 compares the annual output of Malaysia’s overall publications, co-publications, co-publications with the EU28/AC and co-publications with other ASEAN countries in absolute numbers, which helps us to understand the proportions of Malaysia’s overall publication output – how many of all Malaysian publications are co-publications, how many are regional co-publications with ASEAN etc. Please note: The bars must not be read cumulative, but separately. In other words: Adding Malaysia’s total co-pubs (green) with co-pubs with ASEAN (blue) and with co-pubs with the EU28/AC (red) does not result in Malaysia’s total publication output (purple), as this quantity also comprises non-co-publications. As regards the numbers in yearly MY-ASEAN co-publications, the figure does not show them for the years 2004 – 2010. The respective blue part of the chart is too small to display them. The MY-ASEAN co-publications amounted to the following numbers in the years concerned: 152 (2004), 215 (2005), 292 (2006), 365 (2007), 445 (2008), 583 (2009), 814 (2010).

To understand the annual growth of Malaysia’s publications and both international and regional co-publications, we need a complementary chart though. Figure 19 illustrates this annual growth (always compared to the numbers of the year 2004 which are set to 100%) of Malaysia’s overall publications, co-publications, co-publications with the EU28/AC and co-publications with other ASEAN countries in a comprehensive manner by using trend lines. It is interesting to notice that Malaysia has a bigger co-publication output with EU28/AC than with ASEAN countries, but the annual growth of Malaysia-EU co-publications is much weaker – it is actually the weakest of all (green trend line in the chart below). While Malaysia’s publications, total co-publications and co-publications with ASEAN all raised around 800% in total output during 2004-2014 (blue, red and purple trend line), the growth of Malaysia’s co-publications with EU28/AC “only” went up to around 640% until 2014.

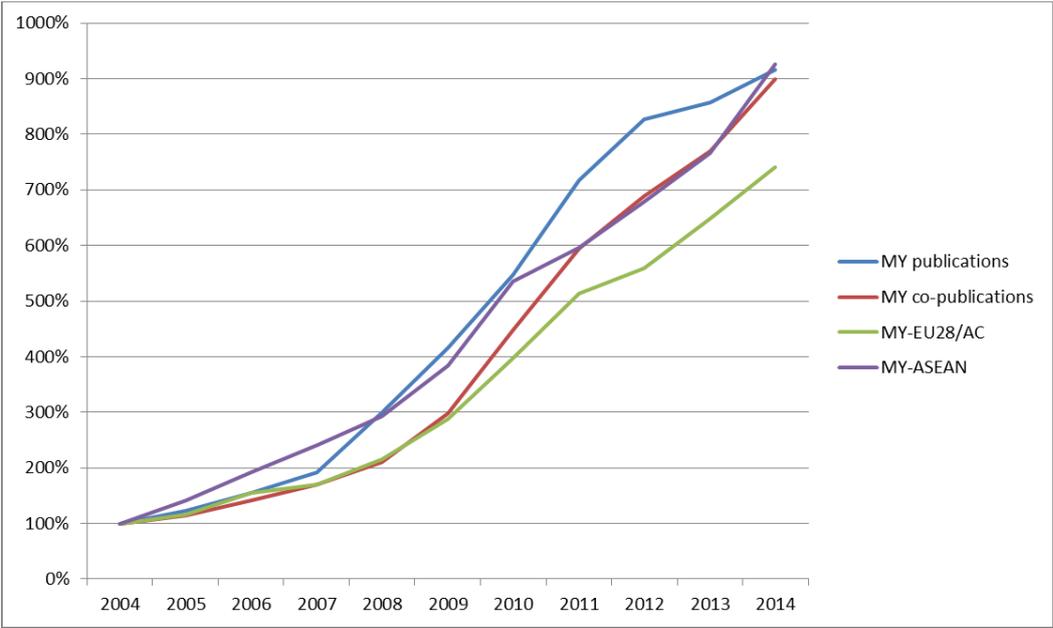


Figure 19: Overview of the growth of Malaysian total (co-)publication output, 2004-2014

**Analysis of research topics in Malaysian research output**

On this level, we look at the main research areas, fields and sub-fields of Malaysia’s publication and co-publication output from 2004-2014. Figure 20 shows to which research areas the Malaysian publications from 2004-2014 apply. Most of the Malaysian publications are published in the area of “Applied Sciences”, which accounts for 80,423 of all Malaysian scientific publications. This makes up around 46% of all publications. The second biggest area is “Natural Sciences”, including around 38,000 (22%) of all Malaysian publications. The third most publications belong to the “Health Sciences” (around 27,000, which is 16%). Following then are “Economic & Social Sciences” (around 15,000, 9%), “General Sciences” (around 11,000, 6%) and “Arts and Humanities” (around 2,000, 1%).

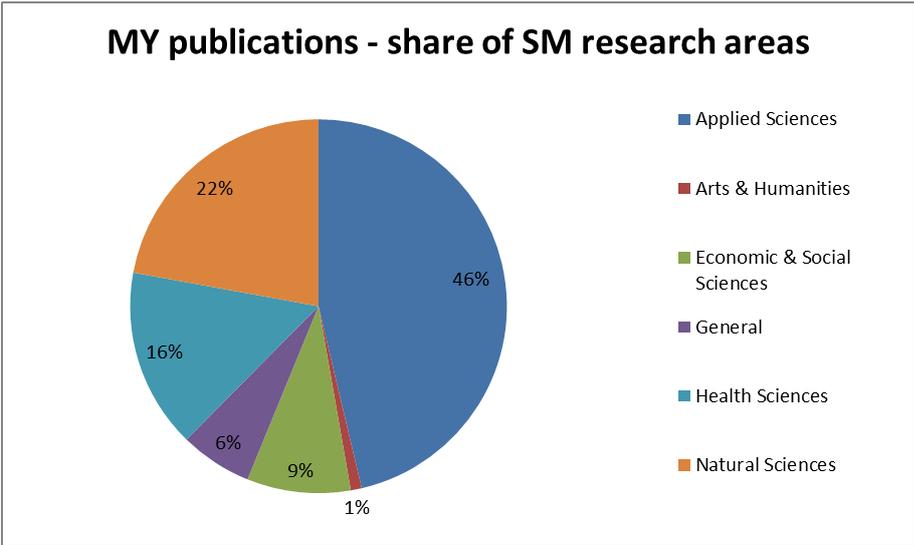


Figure 20: Research areas in Malaysian publications, 2004-2014

As a next step, we look at the Malaysian publications on the level of the SM fields (see Figure 21). The distribution of in these fields is more detailed; it distinguishes 22 fields (SM2). The research field with the highest output on this level is “Engineering” (approx. 26,000 publications; ~15%), followed by “Enabling and Strategic Technologies” (approx. 24,000; ~14%) and “Information and Communication Technologies” (approx. 23,500; ~14%). These top 3 research fields count for nearly the half of all Malaysian publications. Little surprisingly these fields belong to the Applied Sciences, which, as pictured above, are the biggest research area in Malaysian scientific publications. With “Clinical Medicine” comes a field from the Health Sciences next (18,328; ~11%), followed by two fields of the Natural Sciences – “Chemistry” (13,895; ~8%) and “Physics and Astronomy” (10,332; ~6%).

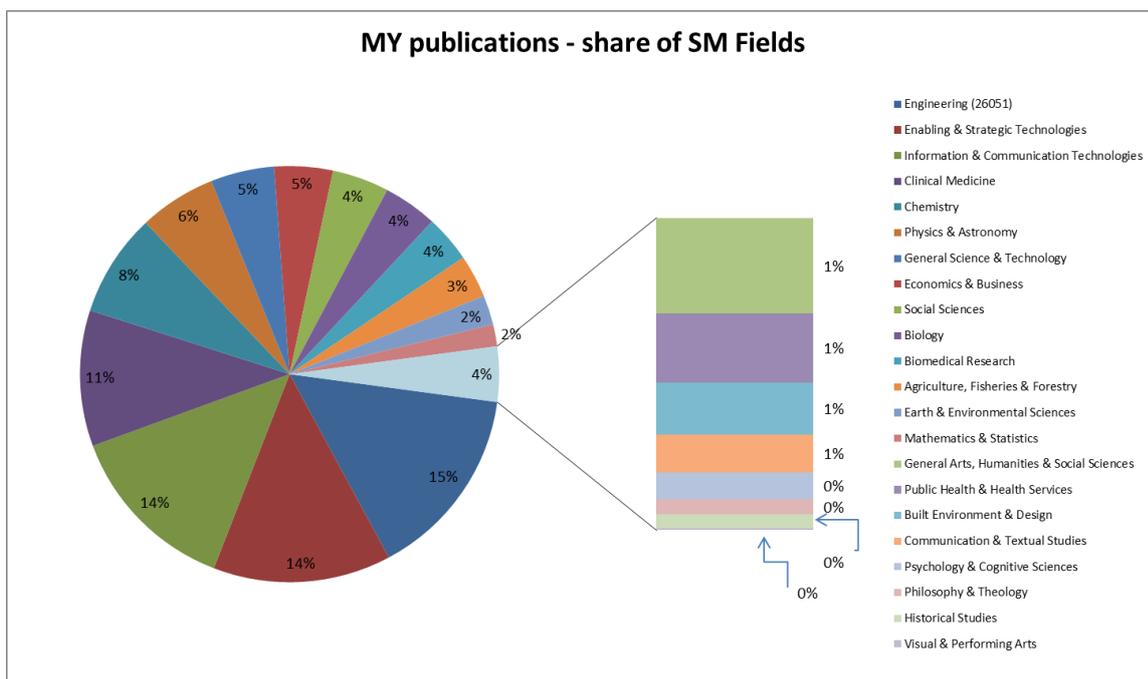


Figure 21: SM research fields of Malaysian publications, 2004-2014

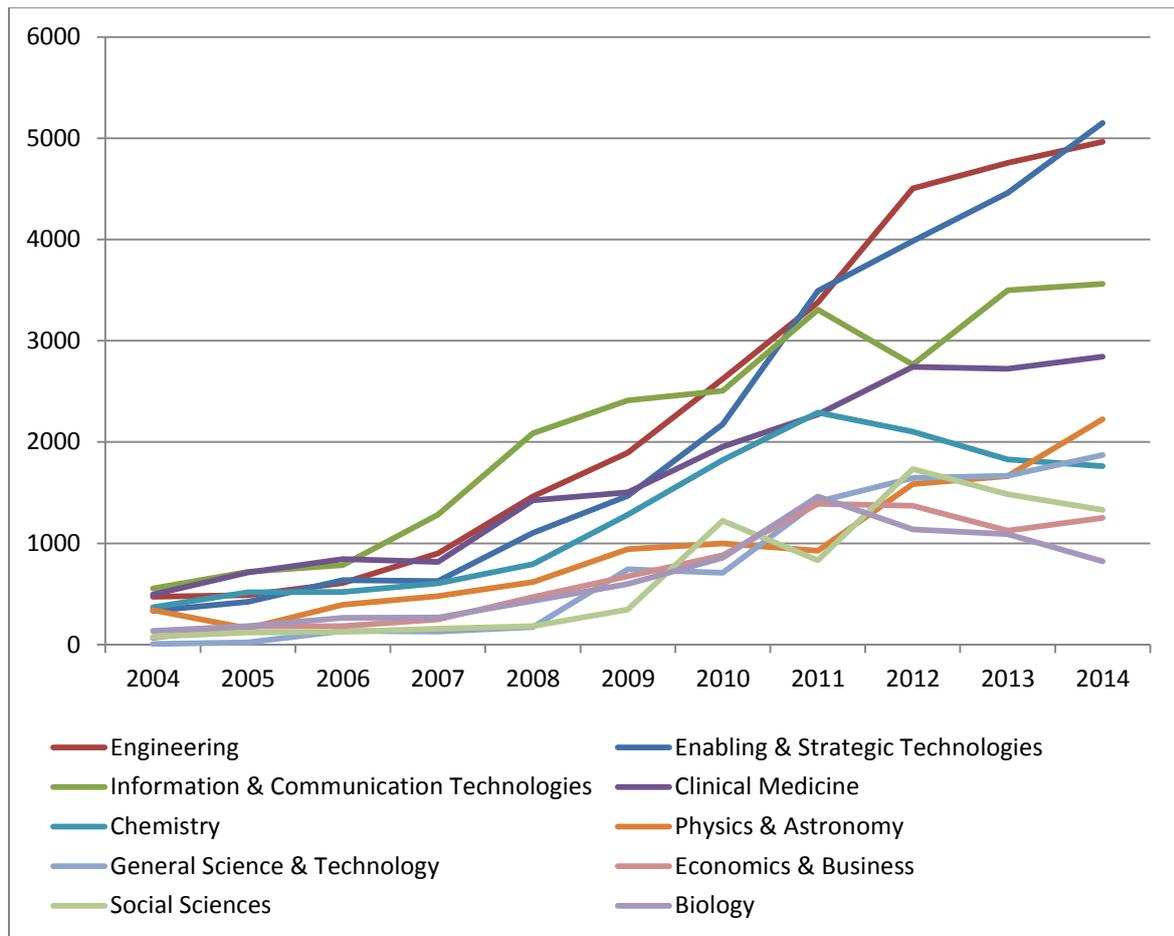


Figure 22 shows the development of Malaysia’s SM Fields over time. To make the figure better comprehensible, only the top 10 SM fields are depicted. Engineering (dark blue line) and Enabling & Strategic Technologies (dark red) are boosting since the beginning of our analysis period. Other fields experience ups and downs, e.g. Social Sciences or Biology.

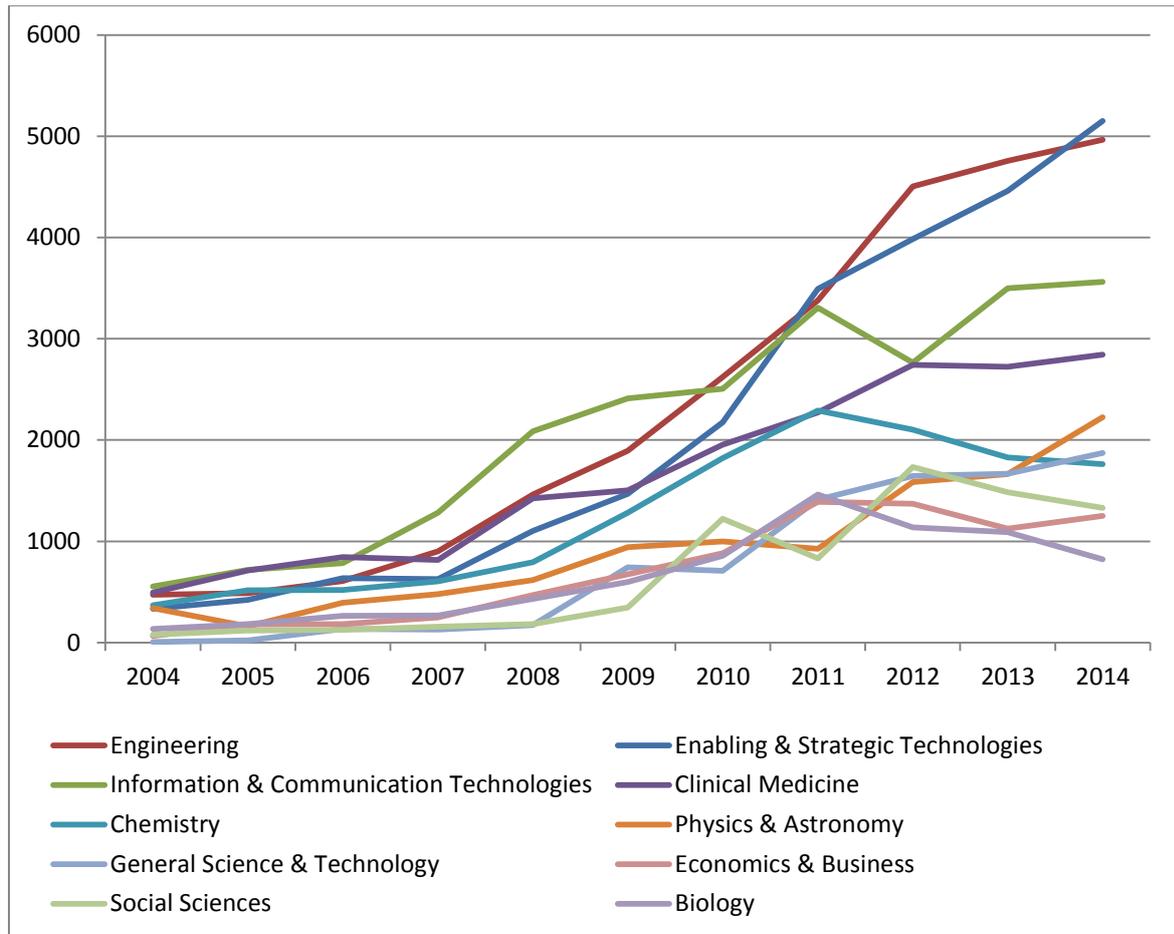


Figure 22: Annual development of the top 10 SM fields of Malaysian publications, 2004-2014

The following Figure 23 shows the top 15 (according to publication numbers) SM fields of total Malaysian co-publication from between 2004-2014. The three leading research fields are similar to the ones in Malaysian publication output. Most Malaysian international co-publications were published in the field of Chemistry, which counts 6,721 co-publications (around 13% of all Malaysia's international co-publications). Compared to Malaysia's total publication output in Chemistry, which is 13,895, nearly 50% of all Malaysian publications in Chemistry include at least one foreign author. It is followed by Engineering with around 6,716 co-publications (~13%) and Enabling & Strategic Technologies with 6,607 co-publications (~13%). In Engineering, 25.78% of all country publications are co-publications with involvement of at least one foreign author, in Enabling & Strategic Technologies 27.69% of all national publications are co-publications. The full number of Malaysian international co-publications in the period 2004-2014 is 51,488.

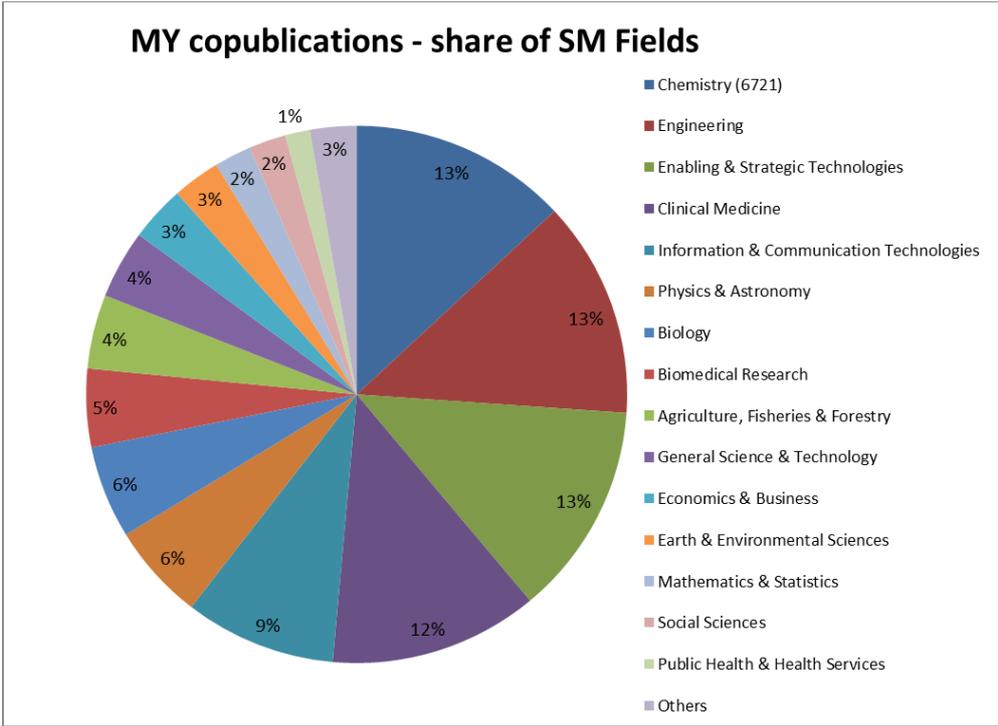


Figure 23: SM research fields of Malaysian co-publications, 2004-2015

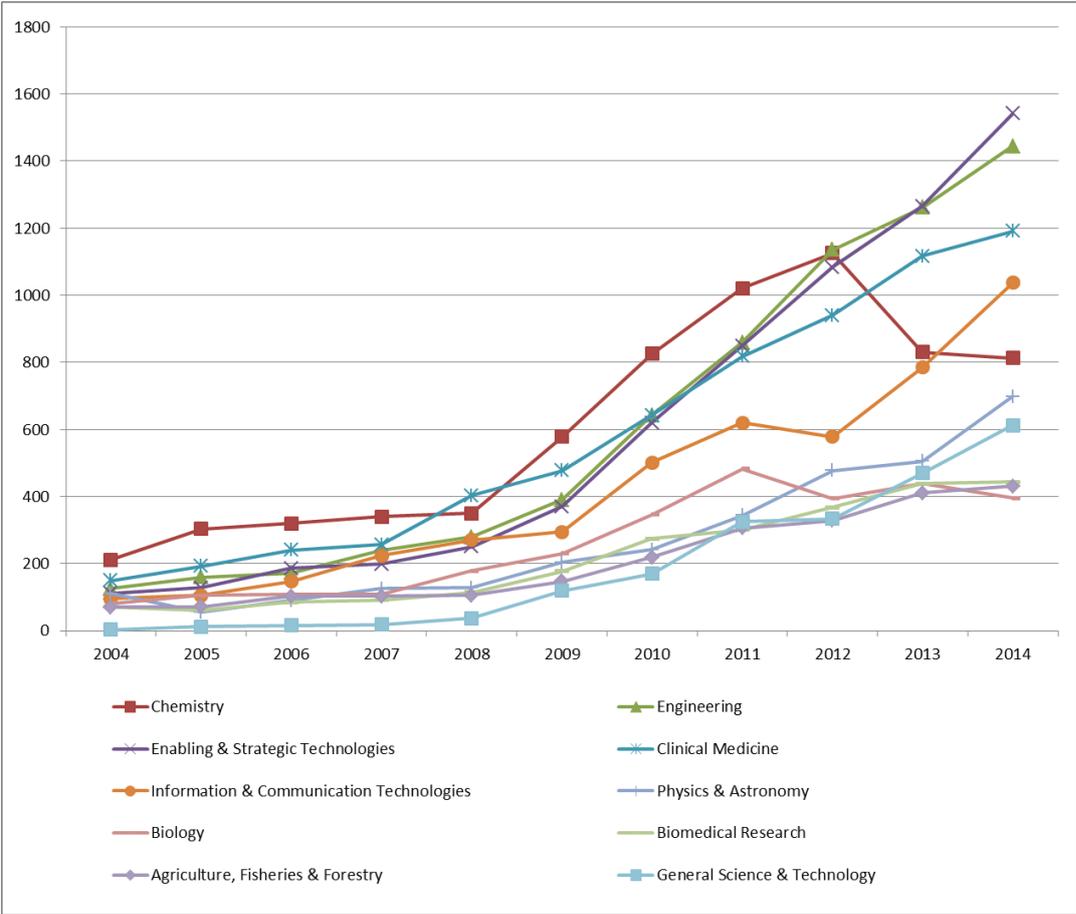


Figure 24: Annual development of the top 10 SM fields of Malaysian co-publications, 2004-2014

Figure 24 shows the annual development of Malaysian co-publications between 2004 and 2014. Depicted are only the top-10 research fields and the increase of published co-publications in these fields per year. The number of co-pubs in the strongest research field, Chemistry, significantly dropped in 2012. Nevertheless, Chemistry is still the research field with most co-pubs altogether (6.721), as mentioned in Figure 23 above already. Significantly positive developments can be observed in Enabling & Strategic Technologies (purple graph), Engineering (green graph) and Clinical Medicine (turquoise). Also ICT grew prominently from 2012 to 2014.

Following paragraphs focus on the Malaysian co-publications involving at least one author from another ASEAN region country. In particular, Figure 25 illustrates the top 15 SM Fields in Malaysian-ASEAN co-publications from 2004-2014. The three leading research fields in this overview are Clinical Medicine, Chemistry and Engineering. Engineering was also among the top 3 in Malaysia's total co-publication output, whereas Clinical Medicine and Chemistry seem to have an especially strong stand in the MY-ASEAN scientific cooperation. In Clinical Medicine 1,475 co-publications were produced between MY-ASEAN, this is 20% of all MY-ASEAN co-publications (total number is 7,374). MY-ASEAN co-publications in Chemistry sum up to 834 (~11.3%), MY-ASEAN co-publications in Engineering sum up to 833 (~11.3%).

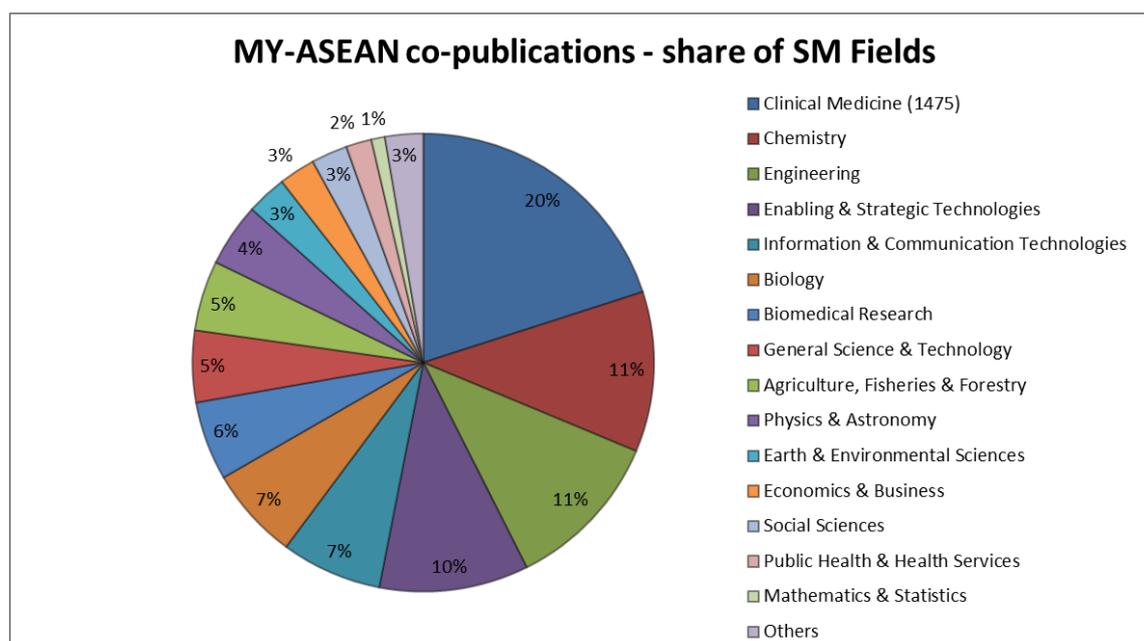


Figure 25: SM fields of Malaysian co-publications with ASEAN countries, 2004-2014

The direct comparison with the top 15 SM research fields in MY-EU28/AC co-publications (see Figure 26) allows identifying similarities at a first glance. **Clinical Medicine and Engineering are the two strongest fields** in both collaborations. Third strongest in MY-ASEAN co-publications is Chemistry, whereas in MY-EU28/AC co-publications it is Enabling & Strategic Technologies. Looking at the other end, those fields in which least co-publications have been published are Physics & Astronomy, Biomedical Research and Social Sciences in MY-ASEAN co-publications, and Social Sciences, Public Health & Health Services and Mathematics & Statistics in MY-EU28/AC co-publications. **Social Sciences are in both collaborations among the smallest fields** with least co-publications.

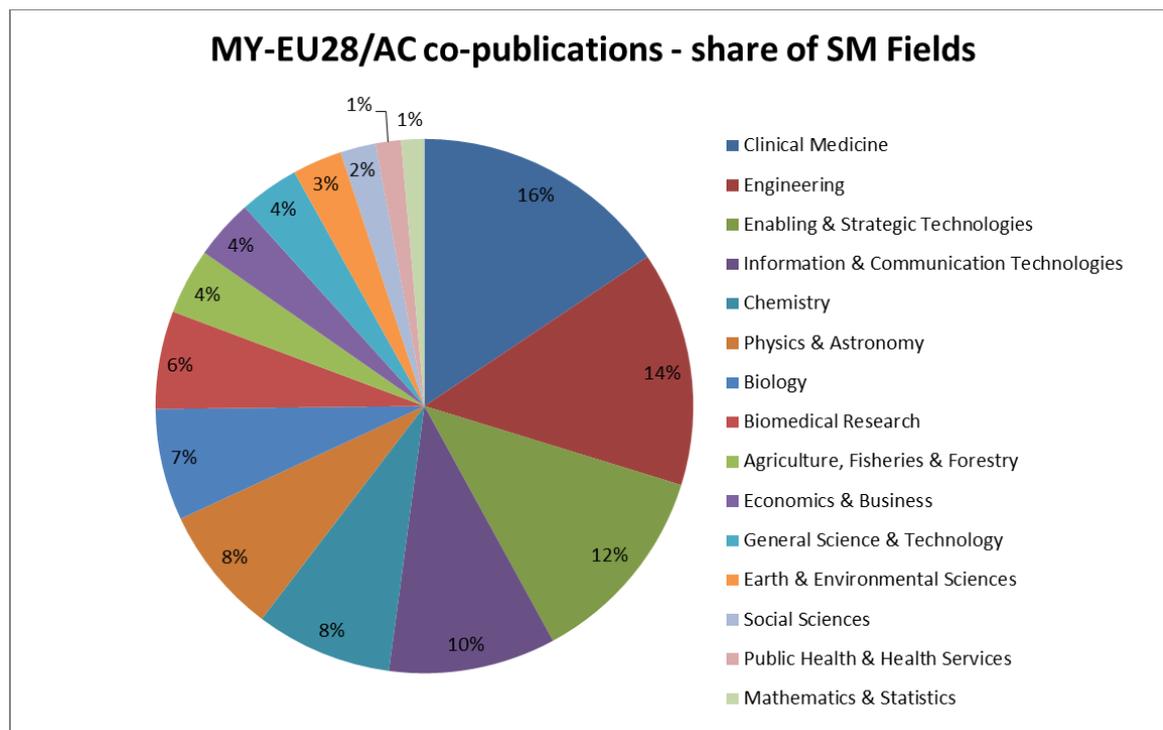


Figure 26: SM fields of Malaysian co-publications with EU28/AC countries, 2004-2014

### Strongest collaboration linkages – within the ASEAN region and the EU

Regarding Malaysia’s intraregional collaboration with other ASEAN states and internationally with the EU28/AC, the most important co-publication partner countries for Malaysia are – in descending order – Great Britain, Indonesia, Singapore, Thailand, Germany, France, the Netherlands, Italy, the Philippines and Spain. Co-publications with Great Britain are cited more than 7 times/co-publication, with Indonesia more than 5 times/co-publication, whereas the co-publications with Singapore and Thailand are cited more than 9 times. Within this list of top collaboration partners, the co-publications with the Philippines are cited most often (more than 15 times per co-publication). The Table 3 below gives a detailed overview of the top 10 collaboration countries of Malaysia in regards to its collaboration with the two regions of ASEAN and EU28/AC. Highlighted in green are the top values of each category.

**Most co-publications:** Malaysia- Great Britain with 7,220

**Highest citation count per co-publication:** Malaysian-Philippines co-publications with around 15.40 citations per co-publication

**Most involved countries in co-publications:** The Malaysian-Spain co-publications in average included the most countries - around 13 countries participated in a MY-ESP co-publication

**Most involved authors in co-publications:** The Malaysia-Spain co-publications in average included also the most authors – around 345 authors participated in a MY-ESP co-publication

	Publications	mean citation corr.	mean country count	mean author count
GBR	7,220	7.07	3.90	41.00
IND	2,829	5.11	3.31	7.11
SGP	2,321	9.91	4.53	10.26
THA	1,914	9.23	6.27	71.79
GER	1,569	11.67	8.37	170.88
FRA	1,438	10.73	7.93	167.8
NDL	1010	14.66	8.32	143.07
ITA	935	14.49	12.09	283.23
PHI	886	15.35	6.5	14.07
ESP	756	11.26	13.35	345.27

Table 3: Malaysia’s top 10 collaboration countries within ASEAN and with the EU (Source: WoS+Scopus)

### Collaboration linkages – within the ASEAN region in detail

This chapter is dedicated to the collaboration linkages of Malaysia with the ASEAN region only. By looking at Malaysia’s collaboration with ASEAN compared to the analysis of Malaysia’s co-publication activity with the EU28/AC, which is touched upon in the next chapter, we can point out differences as well as commonalities.

First we’ll look at Malaysia’s collaboration within the ASEAN region in general. After the collaboration patterns with ASEAN countries in total are introduced, the top 3 countries within this collaboration are analysed in more detail. The development of joint co-publications with Malaysia over time and the strongest research fields of their scientific cooperation are shown.

Figure 27 shows the MY-ASEAN co-publications in total from 2004-2014 – with other ASEAN countries together, Malaysia has produced 7,374 co-publications. Please note: If you sum up all co-publications with the single countries, you receive a number higher than the one just mentioned (8,777). As co-publications with one ASEAN partner country potentially could also include another ASEAN partner, some of the co-publications in the chart are automatically counted twice. Therefore the total number is higher, but in fact the net number of 7,374 is the correct one.

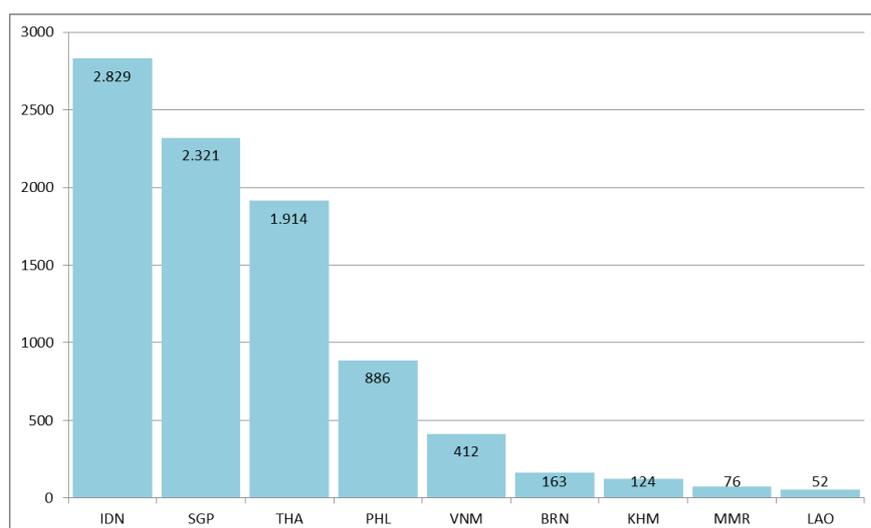


Figure 27: Malaysian co-publications with ASEAN countries, 2004-2014

The strongest collaboration partner for Malaysia in the ASEAN region is Indonesia with 2,829 joint co-publications. Second strongest partner is Singapore with 2,321 and third strongest partner is Thailand

with 1,914 joint co-publications. The grade of cooperation certainly has to do with the performance of the research systems of the countries – Indonesia, Singapore and Thailand all have rather developed national research systems.

Looking at the development of Malaysia’s co-publications with its three strongest collaboration partners from ASEAN (see Figure 28), the overall positive trend is evident. All three collaborations started with less than 100 co-publications in 2004. Whereas the development until 2008 was rather moderate, from that point of time the joint co-publications boosted in all three cases.

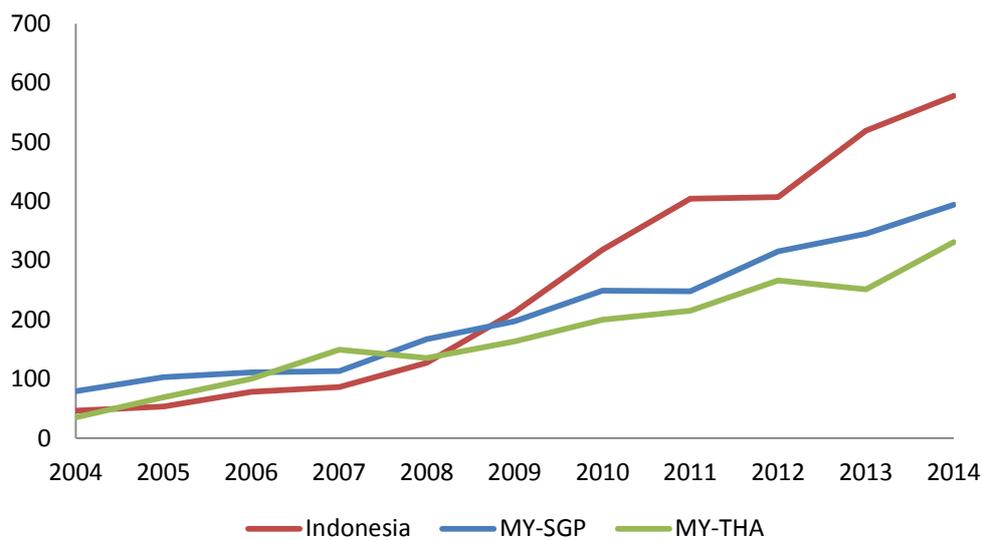


Figure 28: Malaysia's co-publications with the three strongest ASEAN collaboration countries and their development over time, 2004-2014

### Top 3 SM fields

The next step is to analyse the joint research fields in Malaysia’s cooperation with Indonesia, Singapore and Thailand. With the help of this analysis, it is possible to find out whether the single country co-operations also show common patterns and to which degree they might be similar.

#### Malaysia – Indonesia:

1. Engineering: 405 co-publications
2. Enabling & Strategic Technologies: 400
3. Clinical Medicine: 346

#### Malaysia – Singapore:

1. Clinical Medicine: 833
2. Engineering: 279
3. Information & Communication Technologies: 184

#### Malaysia – Thailand:

1. Clinical Medicine: 501
2. Chemistry: 460

3. Biomedical Research: 161

Clinical Medicine is among the top 3 fields in each of the three co-operations. Engineering is in two of three co-operations among the top 3 and the eighth strongest field in the third case (Malaysia-Thailand). Other fields among the top 3 are Enabling & Strategic Technologies, Information & Communication Technologies, Chemistry and Biomedical Research. If one of these fields is among the top 3 only in one of the three co-operations (Enabling & Strategic Technologies in Malaysia - Indonesia, ICT in Malaysia -Singapore and Chemistry and Biomedical Research in Malaysia -Thailand), it does not follow far behind in the other cases (e.g. Enabling & Strategic Technologies is on fourth position in Malaysia -Singapore and on sixth position in Malaysia -Thailand).

Following three pie charts (Figure 29, Figure 30 and Figure 31) depict the total share of all SM research fields for Malaysia -Indonesia, Malaysia -Singapore and Malaysia -Thailand. To make the pie chart easier to read, the strongest research field (on the top) is given in brackets.

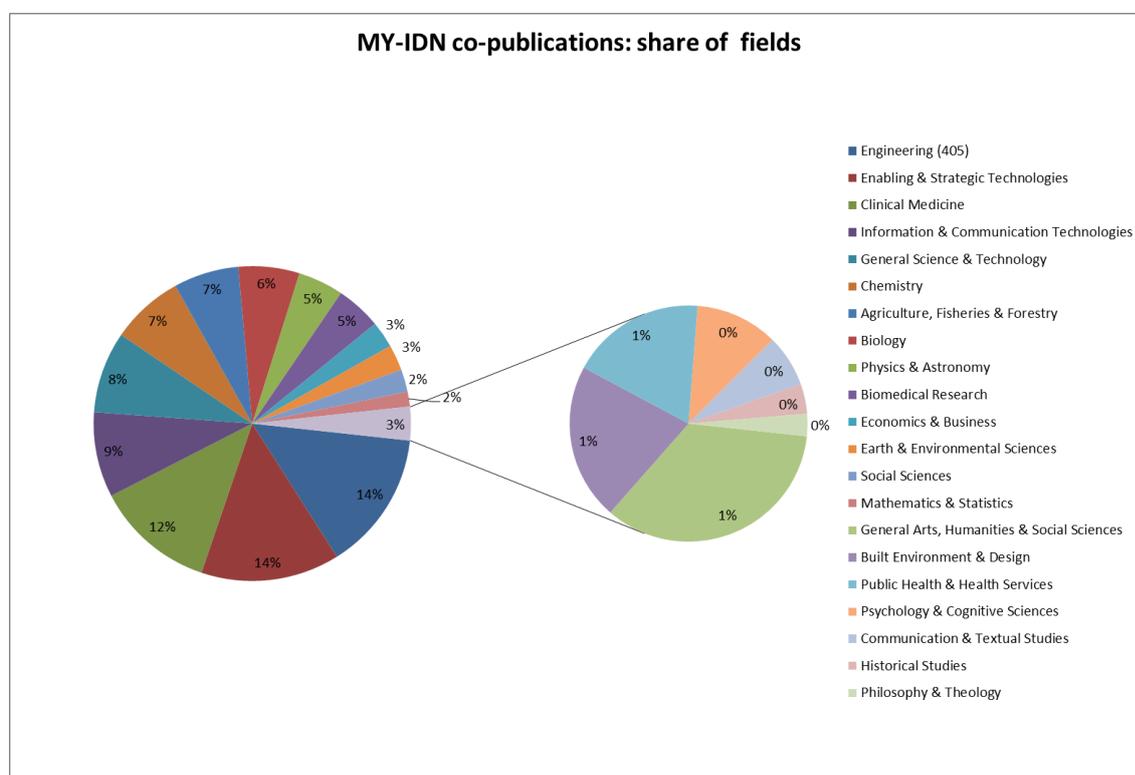


Figure 29: SM research fields of Malaysia-Indonesia co-publications, 2004-2014

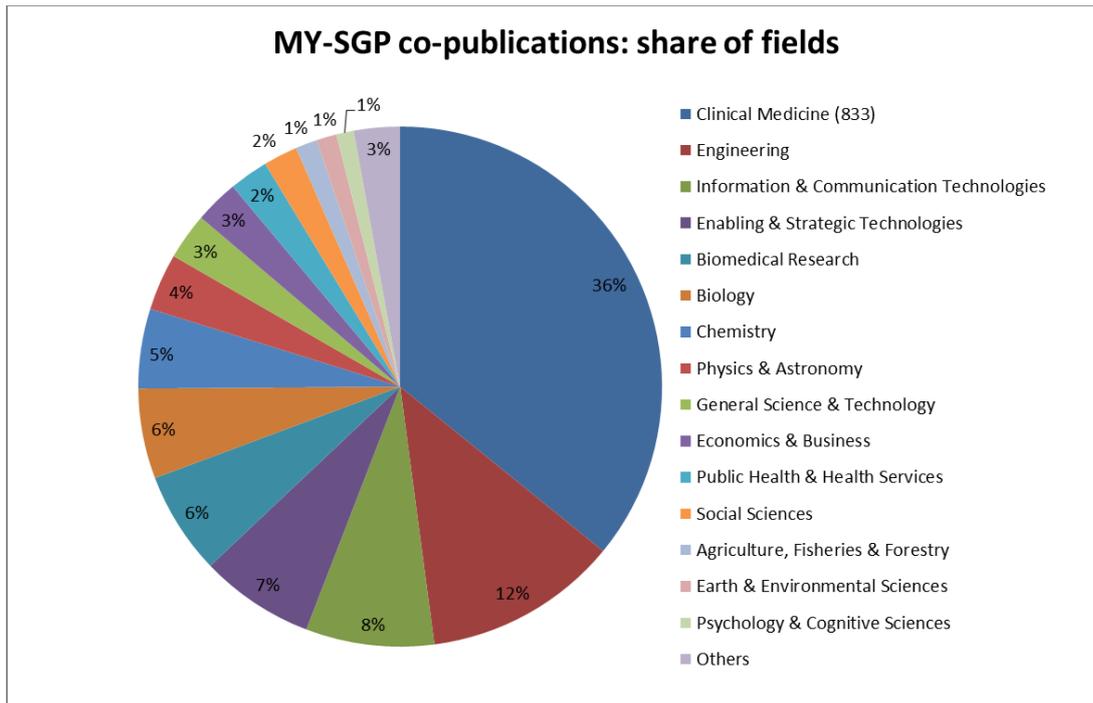


Figure 30: SM research fields of Malaysia-Singapore co-publications, 2004-2014

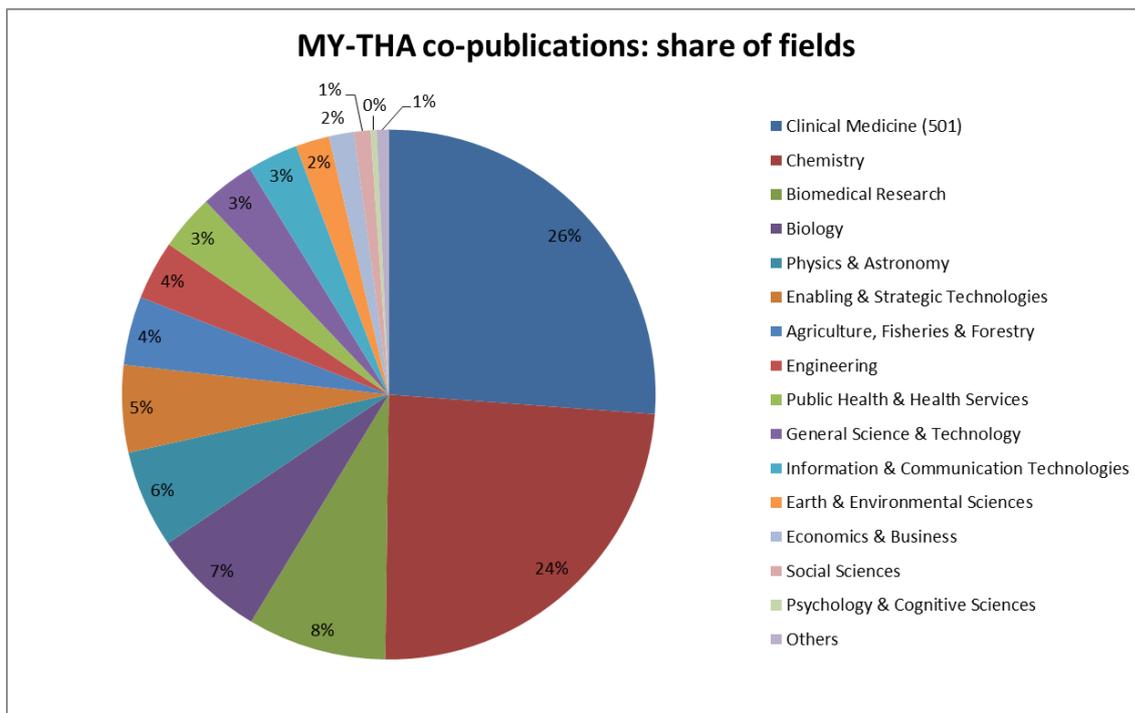


Figure 31: SM research fields of Malaysia-Thailand co-publications, 2004-2014

**Collaboration linkages – with the EU28/AC countries in detail**

This chapter is dedicated to the collaboration linkages of Malaysia with the EU’s 28 member states and countries associated to the 7<sup>th</sup> Framework Programme. It follows the same structure as the previous chapter on MY-ASEAN co-operation. First we’ll look at Malaysia’s collaboration with EU28/AC in general. After these figures are introduced, again the top 3 countries within this collaboration are analysed more in detail.

Figure 32 shows the MY-EU28/AC co-publications in total from 2004-2014, distributed on the top 15 partner countries. The total number of MY-EU28/AC co-publications is 13,345. The top 3 countries in publishing with Malaysia are Great Britain with 7,220, Germany with 1,569 and France with 1,438 joint co-publications. The list closes with Liechtenstein, which has exactly one joint co-publication in the observed time period. The strongest collaboration partners and their number of co-publications with Malaysia can be retrieved from the figure below.

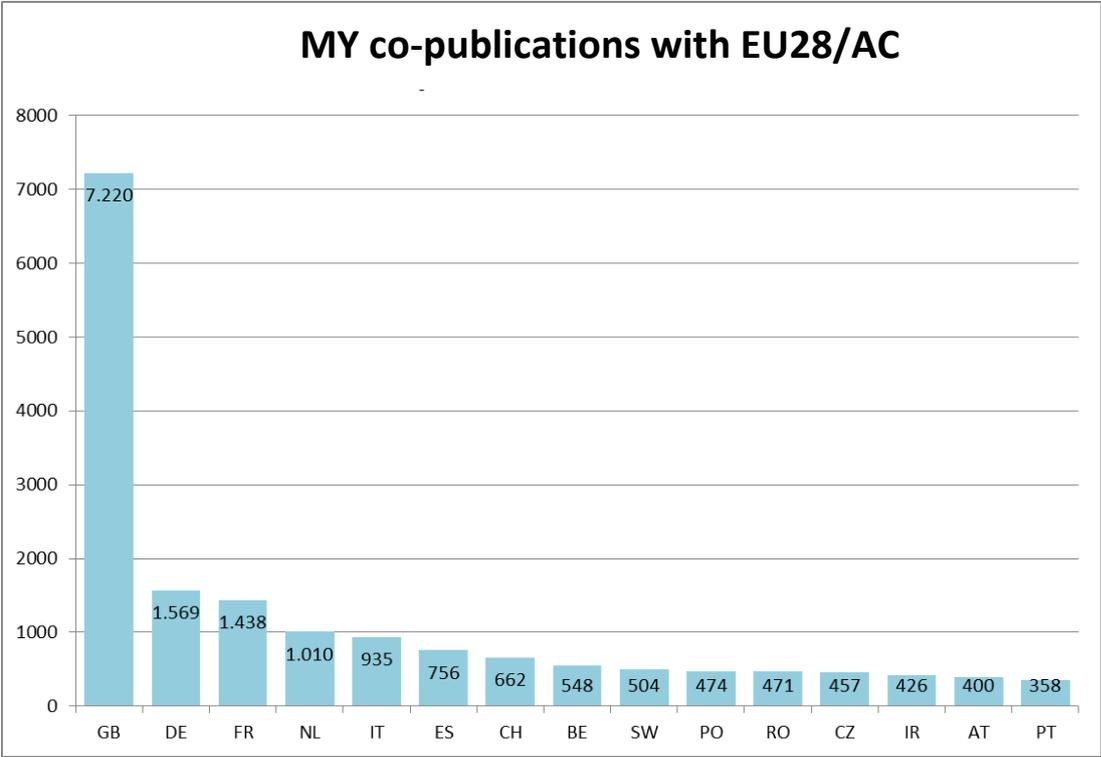


Figure 32: Malaysia’s co-publications with EU28/AC, 2004-2014

Great Britain’s co-publications with Malaysia fill up to 54% of all Malaysia-EU28/AC co-publications. MY-DE co-publications count for around 12% and MY-FR co-publications for around 11% of all co-publications. Thus, there is an evident predominance of the Malaysian-British relationship within this scientific cooperation framework.

Looking at the development over time of Malaysia’s co-publications with Great Britain (see Figure 33), Germany and France, the overall positive trend is eye-striking for the Malaysian-British co-publications. The growth is steady and started boosting since 2009. Concerning the other two countries, growth is rather moderate. Only from 2013 to 2014, the growth of Malaysia-Germany and Malaysia-France co-publications accelerated noticeably.

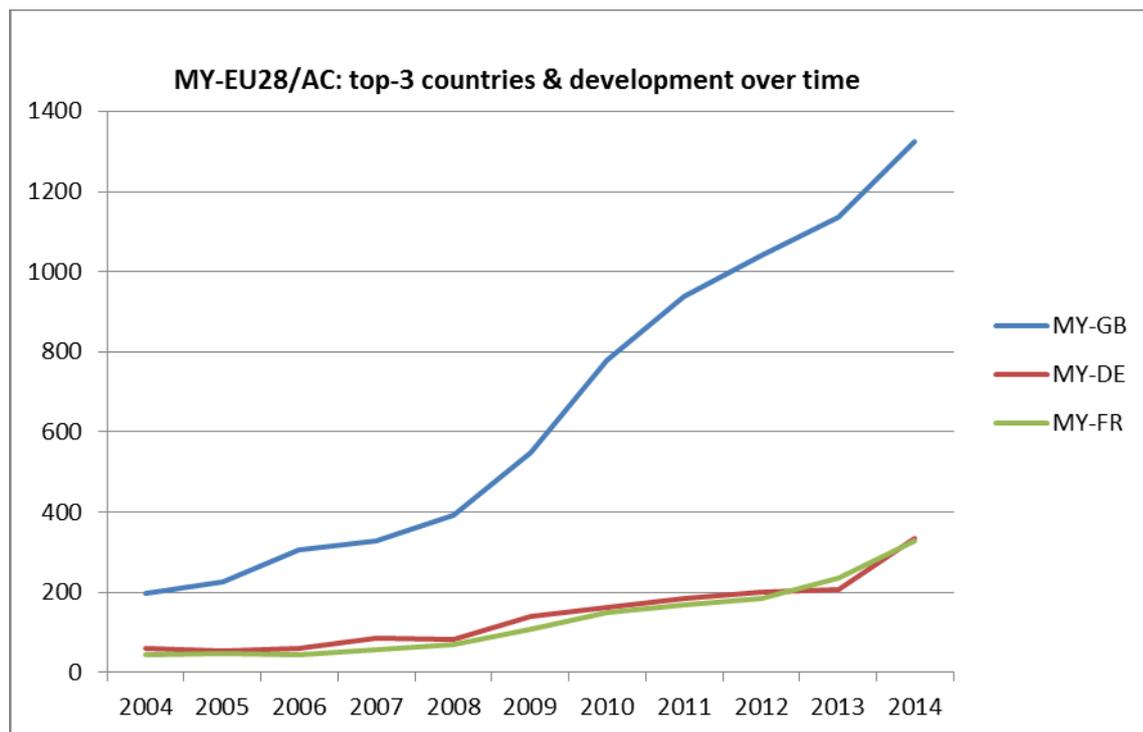


Figure 33: Malaysia’s co-publications with the three strongest EU28/AC collaboration partner countries and their development over time, 2004-2014

### Top 3 fields

The analysis of the strongest research fields in Malaysia’s cooperation with the three countries shows strengths in the mutual cooperation. Comparing this analysis with the previous Malaysia-ASEAN co-publication results, similar patterns of strong research fields in all top 3 countries are noticeable.

#### Malaysia – Great Britain:

1. Clinical Medicine: 1,079 co-publications
2. Engineering: 1,047
3. Enabling & Strategic Technologies: 779

#### Malaysia – Germany:

1. Clinical Medicine: 269
2. Physics & Astronomy: 260
3. Enabling & Strategic Technologies: 167

#### Malaysia – France:

1. Clinical Medicine: 245
2. Chemistry: 190
3. Physics & Astronomy: 155

Clinical Medicine is the strongest research field in all three cases. Enabling & Strategic Technologies and Physics & Astronomy are in two of the three cases among the top 3 fields.

The following three pie charts (Figure 34, Figure 35 and Figure 36) depict the share of SM research fields within the three collaboration cases. Thus, we receive an overview about the complete list of fields in which a joint Malaysian-British, Malaysian-German and Malaysian-French co-publication was published. Also here we added the number of co-publications to the strongest research field in the right column. The three strongest fields of the three country cases were already mentioned before – these figures below now allow a detailed observation of all fields, with which further comparisons between the countries can be made.

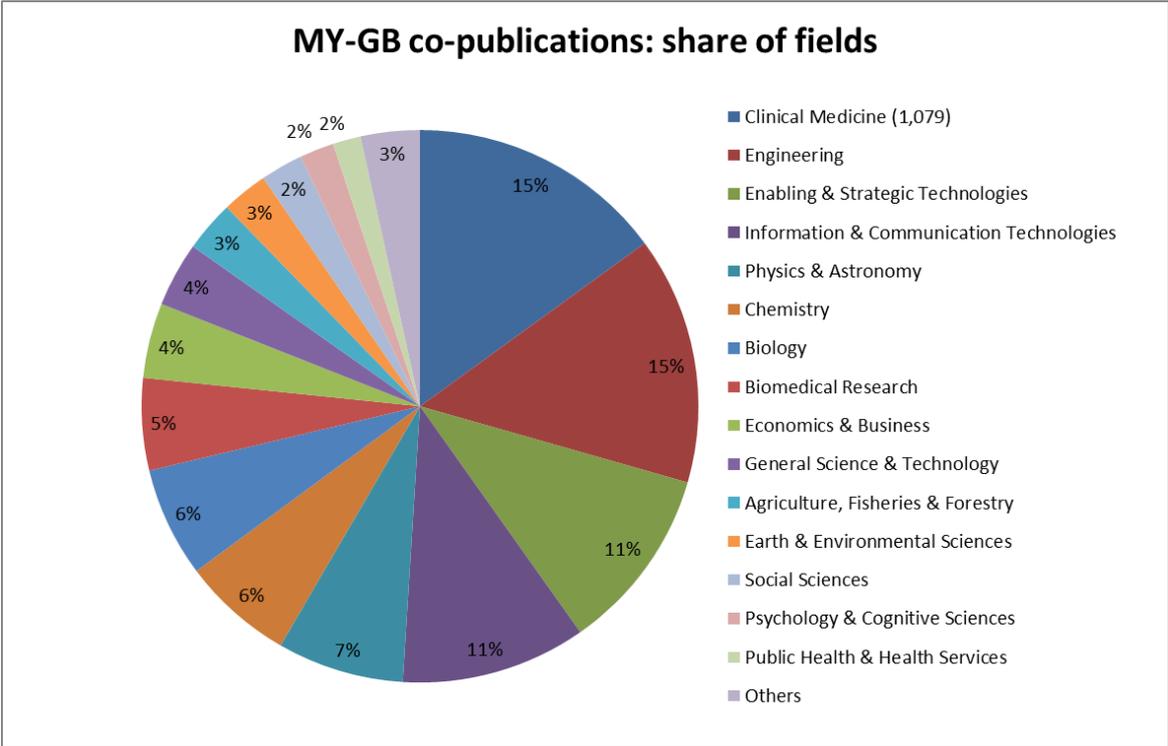


Figure 34: SM research fields of Malaysia-Great Britain co-publications, 2004-2014

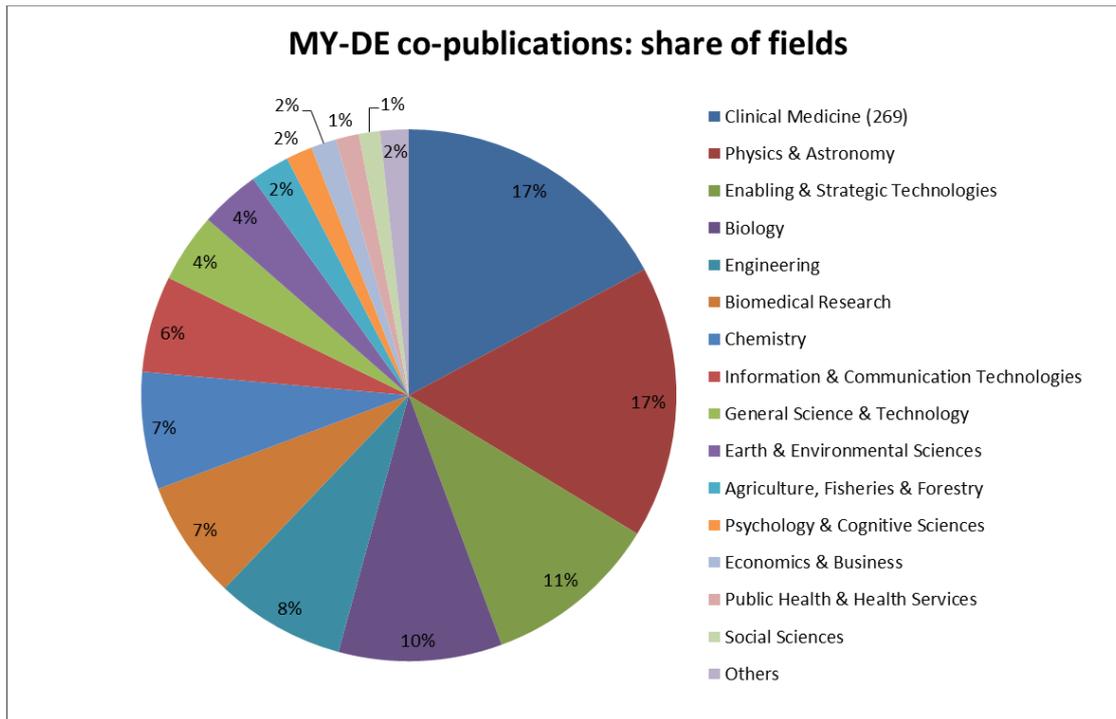


Figure 35: SM research fields of Malaysia-Germany co-publications, 2004-2014

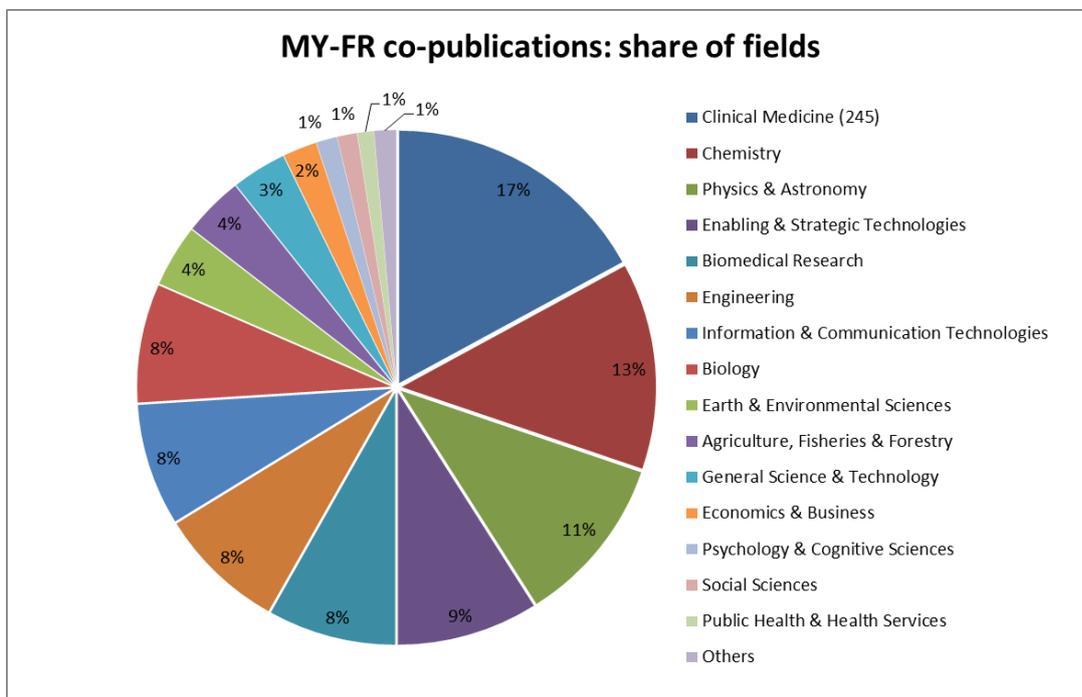


Figure 36: SM research fields of Malaysia-France co-publications, 2004-2014

## Impact Analysis

This chapter presents findings on the impact of Malaysia’s co-publications with ASEAN and EU28/AC. As “impact”, we understand the citation count per publication - the more often a publication is cited, the higher is its impact.

### Malaysia’s citation count

Within the analysed time span of 2004 to 2014, the average citation of a publication involving at least one author from Malaysia amounts to 2.98, i.e. each publication has been cited on average 2.98 times. Works co-authored with at least one author from a foreign country are cited more often: 4.63 is the number of average citations for internationally co-authored works. Works co-authored with at least one author from EU28/AC are cited 6.81 times on average and co-publications with at least one author from an ASEAN country are cited 6.75 times on average.

Table 4 below gives an overview of these data more in detail. In a direct comparison and based on the citation count in the respective research field, Malaysia’s publications, international co-publications, co-publications with ASEAN and co-publications with EU28/AC are listed. The numbers highlighted in green highlight the top citation count in the respective category.

### *Overview of average citation count per SM research field: Comparison of Malaysia’s publications, international co-publications, co-publications with ASEAN and co-publications with EU28/AC*

Malaysia’s co-publications with the EU28/AC most often show the highest citation count among all the research fields. This is followed by Malaysia’s co-publications with ASEAN countries and Malaysia’s general international co-publications. For the strongest partnerships within the respective research field please refer to the numbers in the table highlighted in green.

In this framework, Malaysia-ASEAN co-publications in Philosophy & Theology (15.1) and Psychology & Cognitive Sciences (13.63) have the highest impact. They are followed by Malaysia-ASEAN co-publications in Communication and Textual Studies (12.16 compared to 8.47 for Malaysia-EU28/AC), Philosophy, Physics and Psychology and Malaysia-EU28/AC co-publication in Earth & Environmental Sciences (12.24 compared to 6.5 in Malaysia-ASEAN co-publications), General Arts, Humanities & Social Sciences (8.04 compared to 2.33) and Mathematics & Statistics.

	MY pubs	MY co-publications	MY-ASEAN co-pubs	MY-EU28/AC co-pubs
<b>Agriculture, Fisheries &amp; Forestry</b>	5.04	5.09	11.49	<b>11.87</b>
<b>Biology</b>	3.59	<b>5.95</b>	4.74	5.02
<b>Biomedical Research</b>	5.41	<b>7.93</b>	4.34	5.08
<b>Built Environment &amp; Design</b>	3.24	3.92	<b>5.85</b>	2.34
<b>Chemistry</b>	4.1	4.49	2.23	<b>7.04</b>
<b>Clinical Medicine</b>	4.26	7.02	<b>8.61</b>	4.78
<b>Communication &amp; Textual Studies</b>	0.89	1.05	<b>12.16</b>	8.47
<b>Earth &amp; Environmental Sciences</b>	4.18	5.95	6.5	<b>12.24</b>
<b>Economics &amp; Business</b>	1.71	3.31	5.55	<b>8</b>

<b>Enabling &amp; Strategic Technologies</b>	4.1	5.03	3.61	4.3
<b>Engineering</b>	2.3	3.73	7.41	7.3
<b>General Arts, Humanities &amp; Social Sciences</b>	0.55	0.73	2.33	8.04
<b>General Science &amp; Technology</b>	1.93	3.48	1.8	1.97
<b>Historical Studies</b>	2.49	5.13	4.93	5.52
<b>Information &amp; Communication Technologies</b>	1.4	2.1	3.11	4.45
<b>Mathematics &amp; Statistics</b>	2.56	3.04	1.63	8.51
<b>Philosophy &amp; Theology</b>	0.77	1.94	15.1	4.51
<b>Physics &amp; Astronomy</b>	2.6	3.94	10.7	9.34
<b>Psychology &amp; Cognitive Sciences</b>	4.62	6.48	13.63	0.77
<b>Public Health &amp; Health Services</b>	2.65	3.54	0.91	0.95
<b>Social Sciences</b>	0.91	1.65	2.78	3.62
<b>Visual &amp; Performing Arts</b>	0.97	0.85	0	2

Table 4: Overview of average citations of different SM research fields: Malaysia publications, co-publications, ASEAN co-publications and EU28/AC co-publications (all SM fields are included, irrespective of the number of publications or co-publications. Strongest partnership is highlighted in green)

### Impact of SM research fields of Malaysia's co-publications with ASEAN countries

Table 5 shows the average number of citations each Malaysian co-publication involving at least one author from at least one ASEAN country in the different Science-Matrix research fields. Values marked with red are below 50% of the average citation the overall Malaysian co-publications received in the same time frame; values marked in green are more than 50% higher than the average value of citations of the overall Malaysian co-publications.

**Malaysia's partnership with Singapore and the Philippines is strong when it comes to impact.** Also Malaysia-Thailand co-publications show an above average impact, particularly in biomedical research, clinical medicine and earth & environmental sciences. Malaysia-Indonesia co-publications, which make up the highest share of Malaysia's co-publications in the ASEAN region, are stronger than the average in built environment & design field, but weaker in the others. Please refer to the table below for exact numbers and details.

	MY co-publication	MY-ID co-pubs	MY-SG co-pubs	MY-PH co-pubs	MY-TH co-pubs	MY-VN co-pubs	MY-BR co-pubs	MY-KH co-pubs	MY-MM co-pubs	MY-LA co-pubs
Agriculture, Fisheries & Forestry	5.09	3.73	10.90	5.86	5.42	6.57	-	-	-	-
Biology	5.95	6.90	10.33	9.69	9.75	11.10	-	-	-	-
Biomedical Research	7.93	11.25	14.22	15.49	15.26	29.49	-	16.12	-	-
Built Environment & Design	3.92	8.16	-	-	-	-	-	-	-	-
Chemistry	4.49	4.90	6.76	11.66	3.71	-	-	-	-	-
Clinical Medicine	7.02	10.95	13.57	25.81	17.67	2.90	8.19	14.09	8.31	-
Communication & Textual Studies	1.05	-	-	-	-	13.96	-	-	-	-
Earth & Environmental Sciences	5.95	6.27	7.04	8.87	11.57	13.97	-	-	-	-
Economics & Business	3.31	0.99	4.26	1.30	2.97	-	-	-	-	-
Enabling & Strategic Technologies	5.03	5.08	9.73	6.45	3.26	3.87	1.62	-	-	-
Engineering	3.73	2.04	6.38	12.79	3.22	2.30	-	-	-	-
General Arts, Humanities & Social Sciences	0.73	1.74	-	-	-	-	-	-	-	-
General Science & Technology	3.48	6.81	12.41	13.71	14.55	-	-	-	-	-
Historical Studies	5.13	-	-	-	-	-	-	-	-	-
Information & Communication Technologies	2.10	1.46	3.40	-	2.08	-	-	-	-	-
Mathematics & Statistics	3.04	1.36	5.25	-	-	-	-	-	-	-
Philosophy & Theology	1.94	-	-	-	-	-	-	-	-	-
Physics & Astronomy	3.94	2.00	7.82	-	2.40	-	-	-	-	-
Psychology & Cognitive Sciences	6.48	-	9.37	-	-	-	-	-	-	-
Public Health & Health Services	3.54	-	3.34	16.69	5.30	-	-	-	-	-
Social Sciences	1.65	0.56	4.37	1.02	-	-	-	-	-	-
Visual & Performing Arts	0.85	-	-	-	-	-	-	-	-	-

Table 5: Impact of Malaysia's co-publications per SM research field with Singapore, Malaysia, Thailand, Indonesia, the Philippines, Vietnam, Brunei, Myanmar, Cambodia, 2004-2014 (Threshold: only SM fields with over 20 co-publications are considered)

*Impact of SM research fields of Malaysia's co-publications with top 5 partner countries from EU28/AC countries*

Table 6 depicts Malaysia's co-publications with its five most relevant partner countries within EU28/AC – namely Great Britain, Germany, France, the Netherlands and Italy. The data on average citations per article show that co-publications with European partners are in most cases above the field-average in Malaysia's co-publications overall. The difference in impact is particularly pronounced in agriculture, fisheries & forestry, biomedical research, and clinical medicine where the average number of citations is about twice that of the Malaysian co-publications. Interestingly, in enabling & strategic technologies, only the co-publications with France are above the average of Malaysia's co-publications.

	MY co-publications	MY-GB co-pubs	MY-DE co-pubs	MY-FR co-pubs	MY-NL co-pubs	MY-IT co-pubs
Agriculture, Fisheries & Forestry	5.09	10.1	11.57	5.66	5.12	22.49
Biology	5.95	9.93	10.62	14.02	11.47	8.46
Biomedical Research	7.93	14.64	23.57	18.77	21.38	24.82
Built Environment & Design	3.92	3.51	-	-	-	-
Chemistry	4.49	5.96	16.24	5.27	-	10.68
Clinical Medicine	7.02	13.44	22.6	24.46	33.5	27.53
Communication & Textual Studies	1.05	-	-	-	-	-
Earth & Environmental Sciences	5.95	7.76	10.13	9.01	10.53	31.74
Economics & Business	3.31	4.92	3.38	3.14	6.15	-
Enabling & Strategic Technologies	5.03	4.71	4.9	7.21	4.36	4.15
Engineering	3.73	4.48	4.5	3.58	3.79	3.57
General Arts, Humanities & Social Sciences	0.73	-	-	-	-	-
General Science & Technology	3.48	8.76	15.2	15.41	11.46	25.34
Historical Studies	5.13	12.58	-	-	-	-
Information & Communication Technologies	2.1	2.41	2.93	1.91	1.51	3.52
Mathematics & Statistics	3.04	3.54	-	3.5	-	-
Philosophy & Theology	1.94	-	-	-	-	-
Physics & Astronomy	3.94	4.83	6.13	3.97	8.05	5.94
Psychology & Cognitive Sciences	6.48	7.29	21.28	-	-	-
Public Health & Health Services	3.54	4.36	7.1	-	-	-
Social Sciences	1.65	2.26	2.61	-	-	-
Visual & Performing Arts	0.85	-	-	-	-	-

Table 6: Impact of Malaysia's co-publications per SM research field with top 5 partner countries from EU28/AC (Great Britain, Germany, France, the Netherlands and Italy), 2004-2014 (Threshold: only SM fields with over 20 co-publications are considered)

### 6.3 Singapore

#### Output over time

In the period 2004-2014, authors affiliated in Singapore have published overall 188,291 scientific publications (indexed in either Scopus or Web of Science). An average Singaporean publication involves 4.45 authors from 1.69 different countries and is cited 9.28 times. Out of these 188,291 publications, 83,528 publications are (international) co-publications, that is, they include at least two authors – one affiliated at an institution in Singapore and one affiliated at an institution from another country. Around 44% of Singapore’s scientific publications from 2004 to 2014 were international co-publications. 4,664 of these 83,528 co-publications include at least one author from Singapore and one from another ASEAN country, 24,682 of these include at least one author from Singapore and one from an EU28 (or affiliated) country.

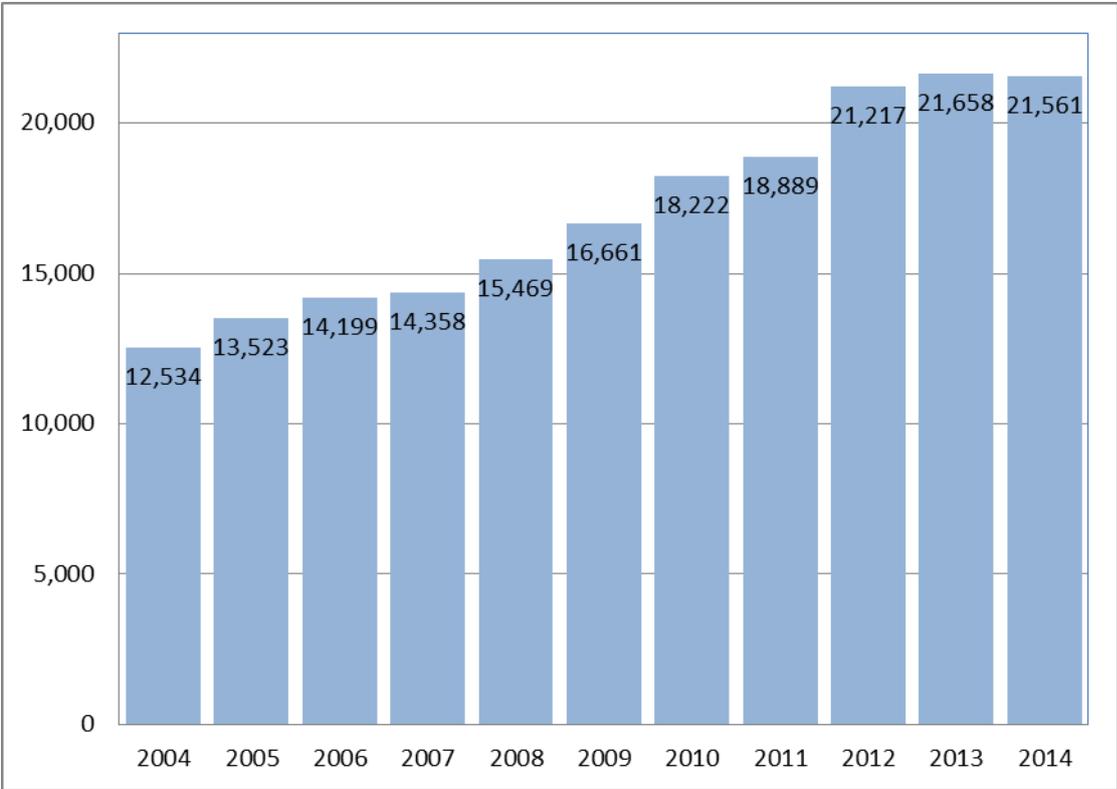


Figure 37: Singapore’s publication output, 2004-2014

Figure 37 shows the development of Singapore’s annual publication output from 2004 to 2014. Compared to the development of Singapore’s annual co-publication output in the same time frame (see Figure 38), the annual publication output growth is slightly slower and especially in the last years (2012 to 2014), the overall annual publication output of Singapore rather stagnates whereas Singaporean co-publications grow stronger compared to the years before. The annual Singaporean publication as well as the co-publication output steadily increases (with two minor exceptions – the co-publication output is lesser in 2010 than in 2009, and the publication output in 2014 is smaller than in 2013) within the period 2004-2014. But whereas the annual Singaporean publication output not even doubles from 2004, 12,534 publications, to 2014, 21,561 publications, the annual

Singaporean co-publication output more than triples from 2004, 3,889 co-publications, to 2014, 12,332 co-publications.

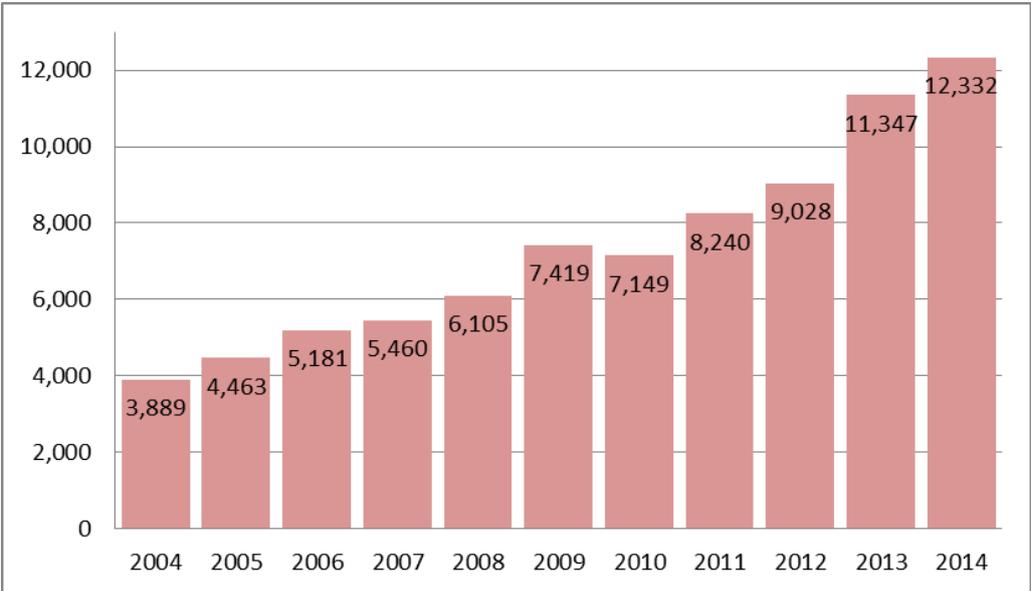


Figure 38: Singapore’s co-publication output, 2004-2014

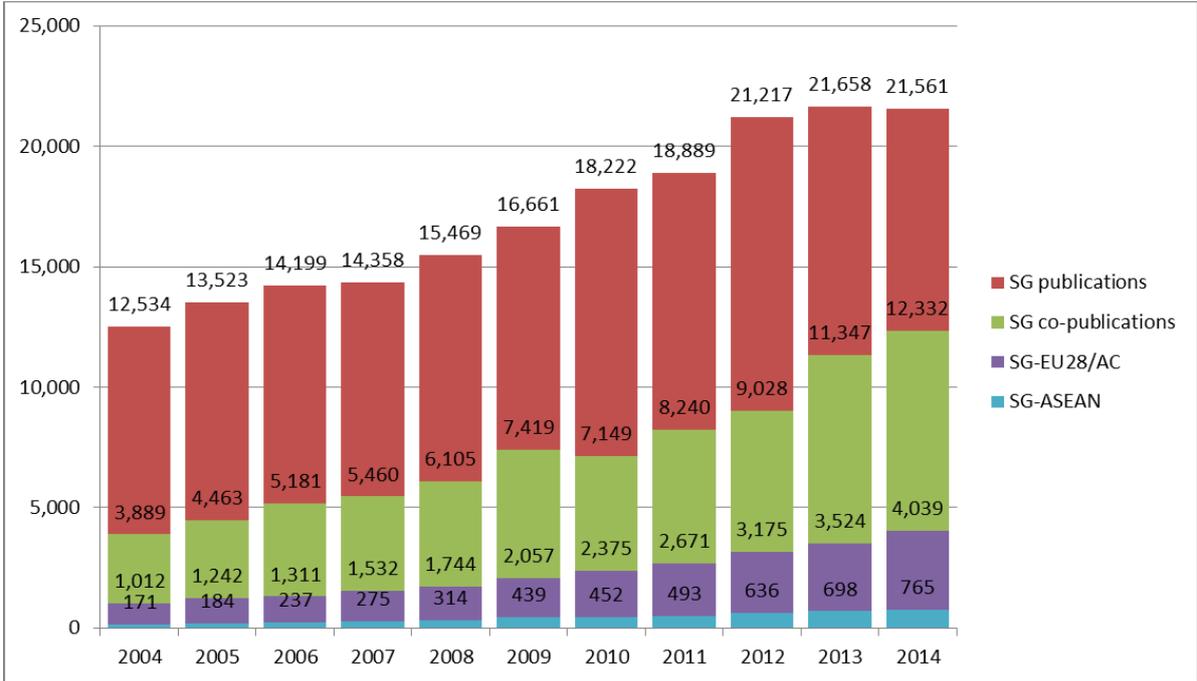


Figure 39: Overview of the annual Singaporean (co-)publication output 2004-2014, – overlay view, i.e. the bars are not stacked but placed “behind” each other (all start from 0)

Since Figure 39 compares the annual output of Singapore’s overall publications, co-publications, co-publications with the EU28/AC and co-publications with other ASEAN countries in absolute numbers, it is difficult to see, for example, if the annual output of co-publications with ASEAN countries is growing faster or slower than the Singaporean overall publications. To show this data, Figure 40 shows the annual growth (always compared to the numbers of the year 2004 which are set to 100%)

of Singapore’s overall publications, co-publications, co-publications with the EU28/AC and co-publications with other ASEAN countries. It is visible that the Singaporean co-publications with ASEAN countries are growing much faster than the overall Singaporean publications.

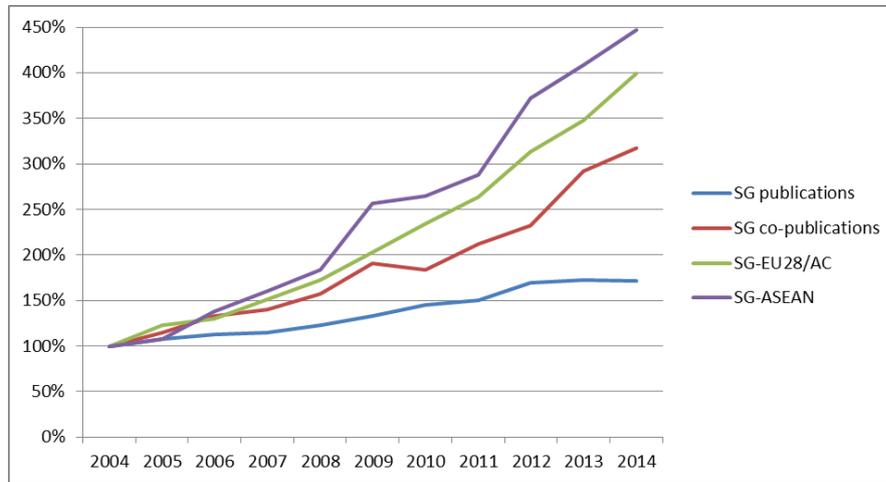


Figure 40: Overview of the growth of annual Singaporean (co-)publication output, 2004-2014

### Analysis of research topics in Singaporean research output

Figure 41 shows the absolute numbers and the percentage of the research area distribution of Singaporean publications from 2004 to 2014. Similar to Malaysia, nearly half of the Singaporean publications (45%) are published in the research area of “Applied Sciences”. 24% of all Singaporean publications are related to “Health Sciences”, and 20% are related to “Natural Sciences”.

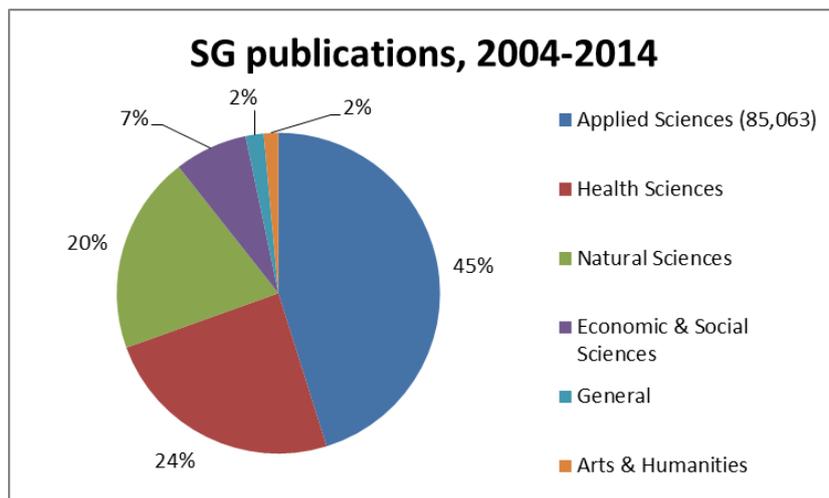


Figure 41: Research areas of Singapore's publications, 2004-2014

On a more detailed level, the level of Science-Metrix fields (Figure 422), 18%, or 33,033 publications, of all Singaporean scientific publications from 2004 to 2014 are published in the field “Information & Communication Technologies”, followed by 17% (31,292 publications) published in the field “Clinical Medicine” and 14% (26,761 publications) in the field “Engineering”. Other research fields with comparatively strong publication output are (in descending order) “Enabling & Strategic

Technologies” (12% or 22,400 publications), “Physics & Astronomy” (10% or 19,596 publications), “Biomedical Research” (5% or 10,046 publications), “Chemistry” (5% or 9,821 publications), “Social Sciences” (4% or 7,448 publications), “Economics & Business” (3% or 6,324 publications) and “Mathematics & Statistics” (2% or 3,224 publications).

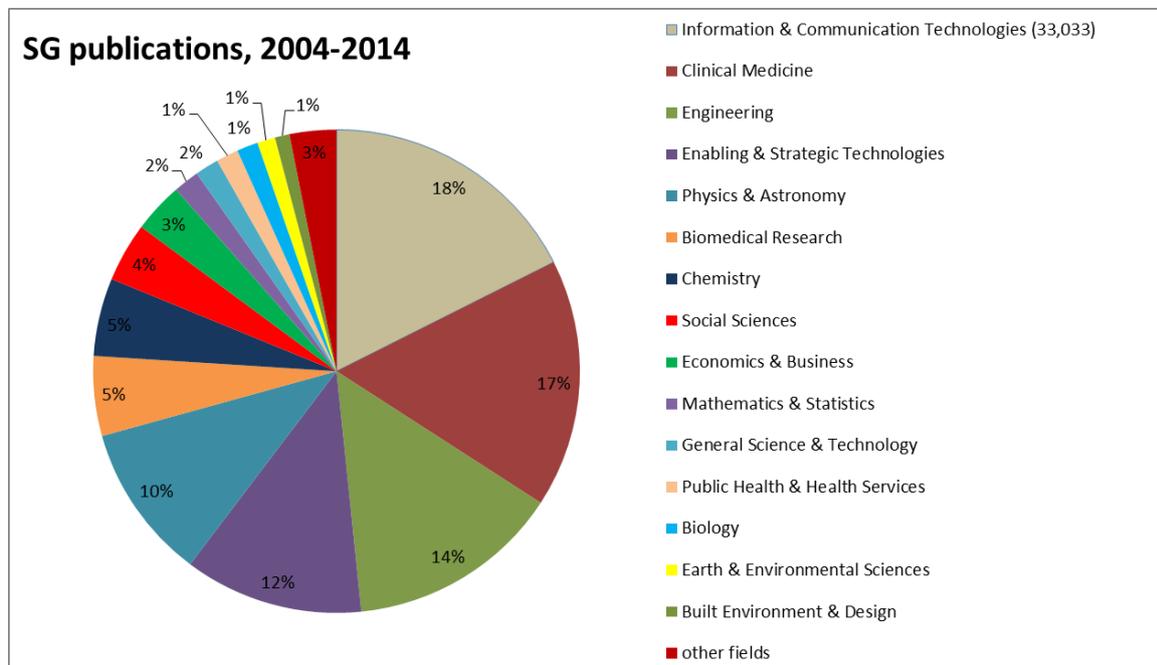


Figure 42: SM research fields of Singaporean publications, 2004-2014

Looking at the annual distribution of Singaporean publications (Figure 43) in the ten research fields with the most publications it is visible that “Clinical Medicine” is growing stronger than “Information & Communication Technologies” and has, since 2012, even more annual publications. Similarly, “Enabling & Strategic Technologies” is growing fast – whereas in 2004 it was the research field with the fifth highest annual publication output in 2014, it has slightly more publications than “Engineering” and therefore is the research field with the third highest annual publication output. The annual publication output in the research fields “Physics & Astronomy”, “Information & Communication Technologies” as well as in the “Social Sciences” is decreasing since 2012. It remains to be seen whether the decrease is an artefact (e.g. due to a delay in journal data coverage in the source databases) or indicates that a threshold has been reached. The idea that Singapore’s publication output has reached a certain threshold, indicating a mature research system, is also sustained by the fact that Singaporean publication output growth in recent years has been smaller than Malaysia’s. Malaysia’s annual publication output is now beyond Singapore’s.

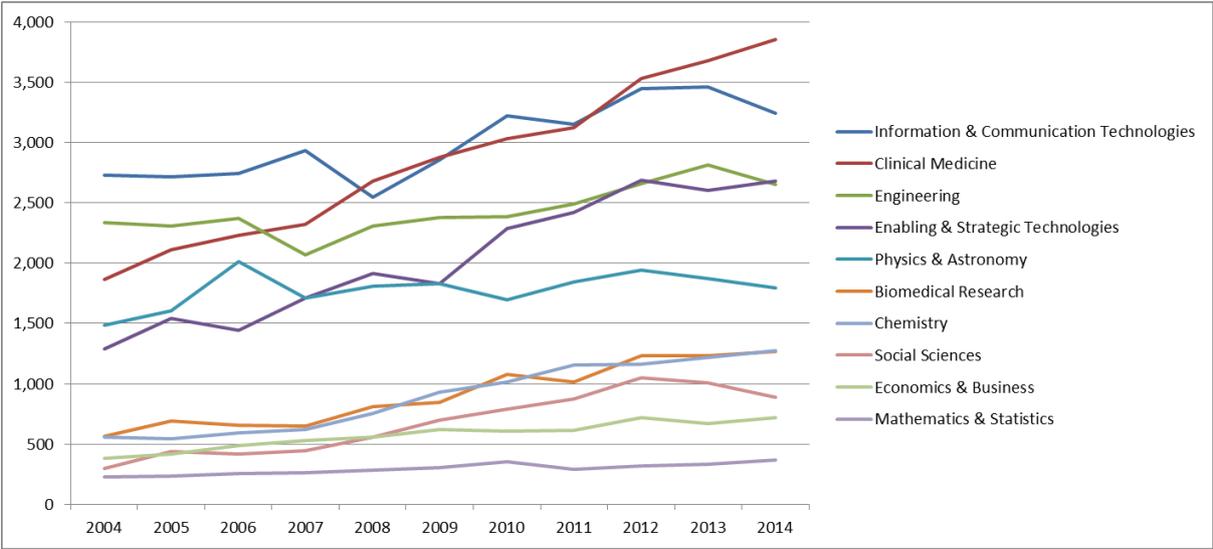


Figure 43: Annual development of the top 10 SM fields of Singaporean publications, 2004-2014

Compared to the overall Singaporean publications, the thematic distribution of Singaporean co-publications is not that different (Figure 44) – “Clinical Medicine” is the research field published most in: 17% or 13,904 co-publications. Nearly 45% of all Singaporean “Clinical Medicine” publications involve at least one author from another country. “Information & Communication Technologies” is the research field with the second biggest co-publication output: 16% of all Singaporean co-publications or 13,089 co-publications in total, which is nearly 40% of all Singaporean “Information & Communication Technologies” publications overall. These two research fields are followed, as in the overall Singaporean publications, by “Engineering” (12% or 10,057 co-publications, which is around 38% of the overall “Engineering” publications of Singapore), “Enabling & Strategic Technologies” (11% or 9,400 co-publications, which is around 42% of the overall “Enabling & Strategic Technologies” publications of Singapore) and “Physics & Astronomy” (11% or 9,138 co-publications, which is around 46% of the overall “Physics & Astronomy” publications of Singapore).

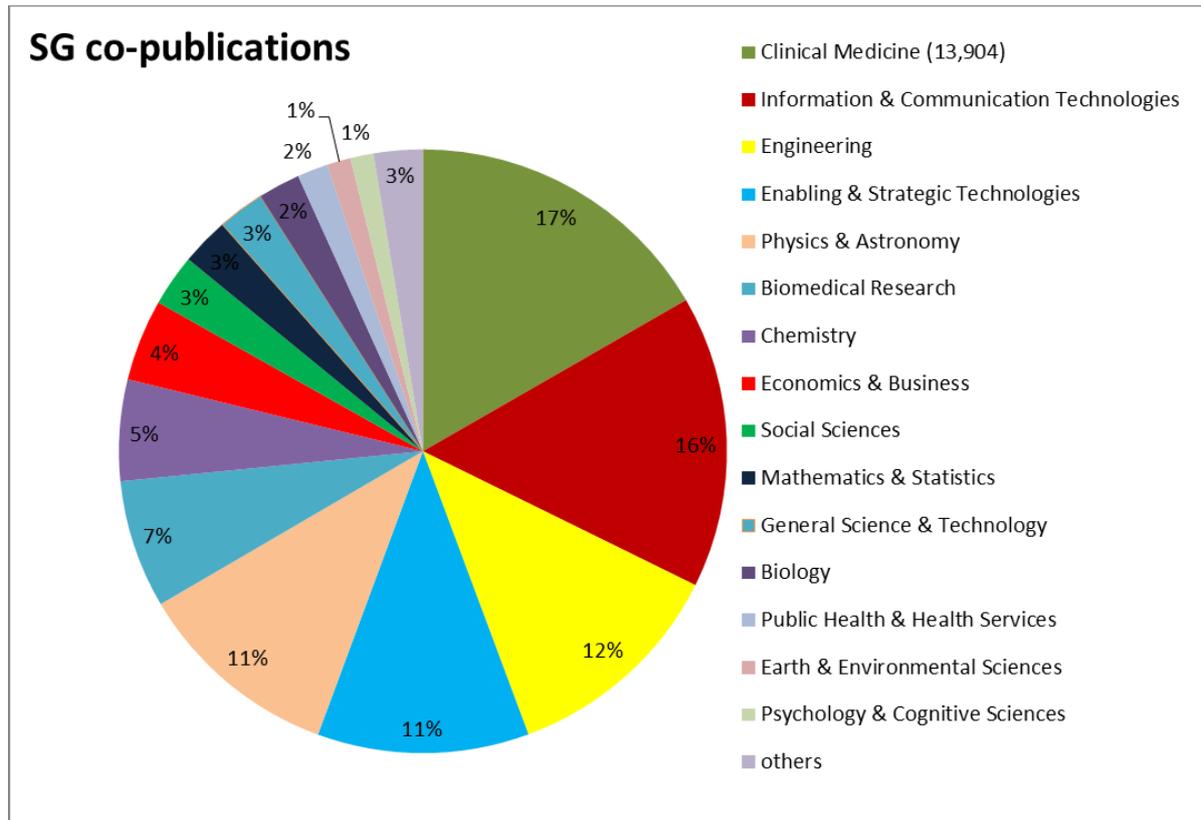


Figure 44: SM research fields of Singaporean co-publications, 2004-2014

Looking at the annual distribution of Singaporean co-publications (Figure 45) in the ten research fields with the highest publication output it is visible that “Clinical Medicine” is growing stronger than “Information & Communication Technologies” and has, since 2007, even more annual co-publications. Similarly, “Engineering” and “Enabling & Strategic Technologies” are growing faster than e.g. “Physics & Astronomy”.

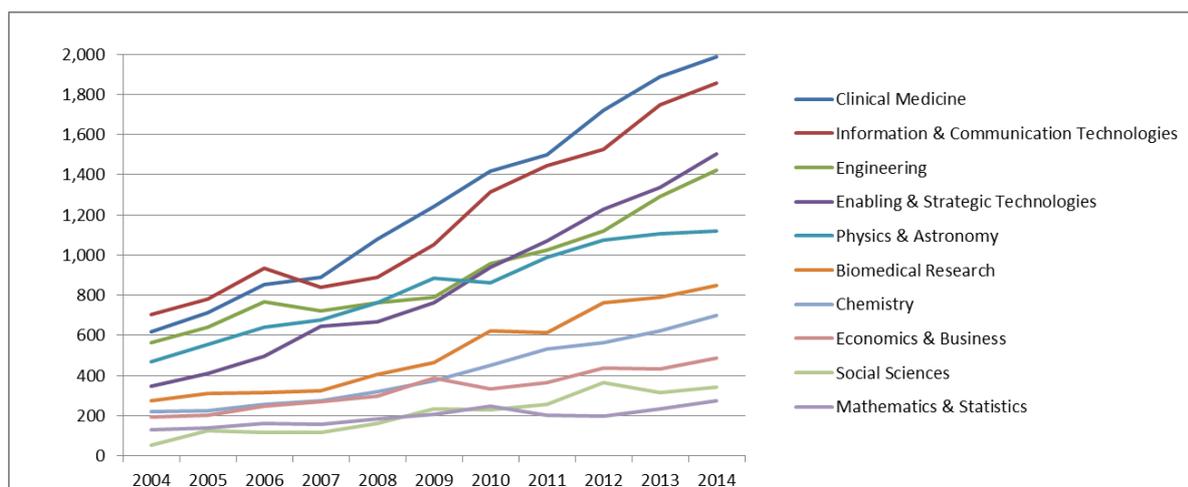


Figure 45: Annual development of the top 10 SM fields of Singaporean co-publications, 2004-2014

For the co-publications of Singapore involving at least one additional author from another ASEAN country, “Clinical Medicine” is by far the research field published most in: 33% or 1,559 co-

publications. This is 11% of all Singaporean “Clinical Medicine” co-publications or just under 5% of all Singaporean “Clinical Medicine” publications. “Engineering” is the research field with the second most Singapore-ASEAN co-publications: 10% of all Singapore-ASEAN co-publications or 448 co-publications in total. This is nearly 4.5% of all Singaporean “Engineering” co-publications or 1.6% of all Singaporean “Engineering” publications overall. These two research fields are followed by “Biology” (8% or 391 co-publications, which is around 20.9% of the “Biology” co-publications of Singapore or 14.8% of the overall “Biology” publications of Singapore), “Biomedical Research” (8% or 379 co-publications, which is around 6.6% of the “Biomedical Research” co-publications or 3.8% of the overall “Biomedical Research” publications of Singapore) and “Information & Communication Technologies” (7% or 333 co-publications, which is around 2.5% of the “Information & Communication Technologies” co-publications or 1% of the overall “Information & Communication Technologies” publications of Singapore, see Figure 46).

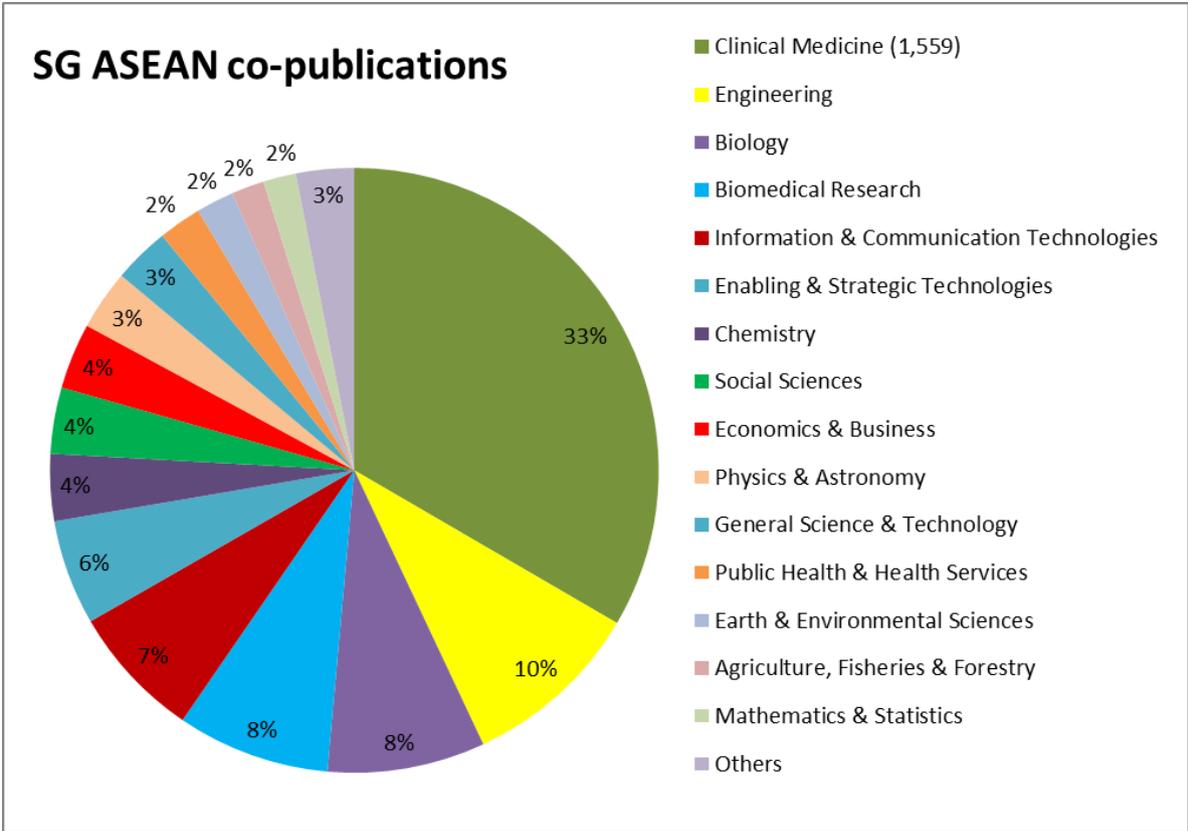


Figure 46: SM research fields of Singaporean co-publications with ASEAN countries, 2004-2014

With 22% (or 5,440 co-publications) of all Singaporean co-publications involving at least one author from an EU28/AC country, “Clinical Medicine” is the research field published most in. In 39% of all Singaporean “Clinical Medicine” co-publications or 16.5% of the overall Singaporean “Clinical Medicine” publications is at least one author from an EU28/AC country involved. The research field with the second most Singapore-EU28/AC co-publications in the time frame 2004 to 2014 is “Information & Communication Technologies” with 13% of all Singaporean co-publications with the EU28/AC or 3,219 co-publications, which are 24.5% of all Singaporean co-publications or 9.7% of the overall Singaporean publications in “Information & Communication Technologies”. These two research fields are followed by “Physics & Astronomy” (11% or 2,758 co-publications, which are

around 30.2% of the “Physics & Astronomy” co-publications of Singapore or 14% of the overall “Physics & Astronomy” publications of Singapore), “Biomedical Research” (10% or 2,474 co-publications, which are around 43.2% of the “Biomedical Research” co-publications or 24.6% of the overall “Biomedical Research” publications of Singapore) and “Engineering” (9% or 2,239 co-publications, which is around 22% of the “Engineering” co-publications or 8.4% of the overall “Engineering” publications of Singapore, see Figure 47).

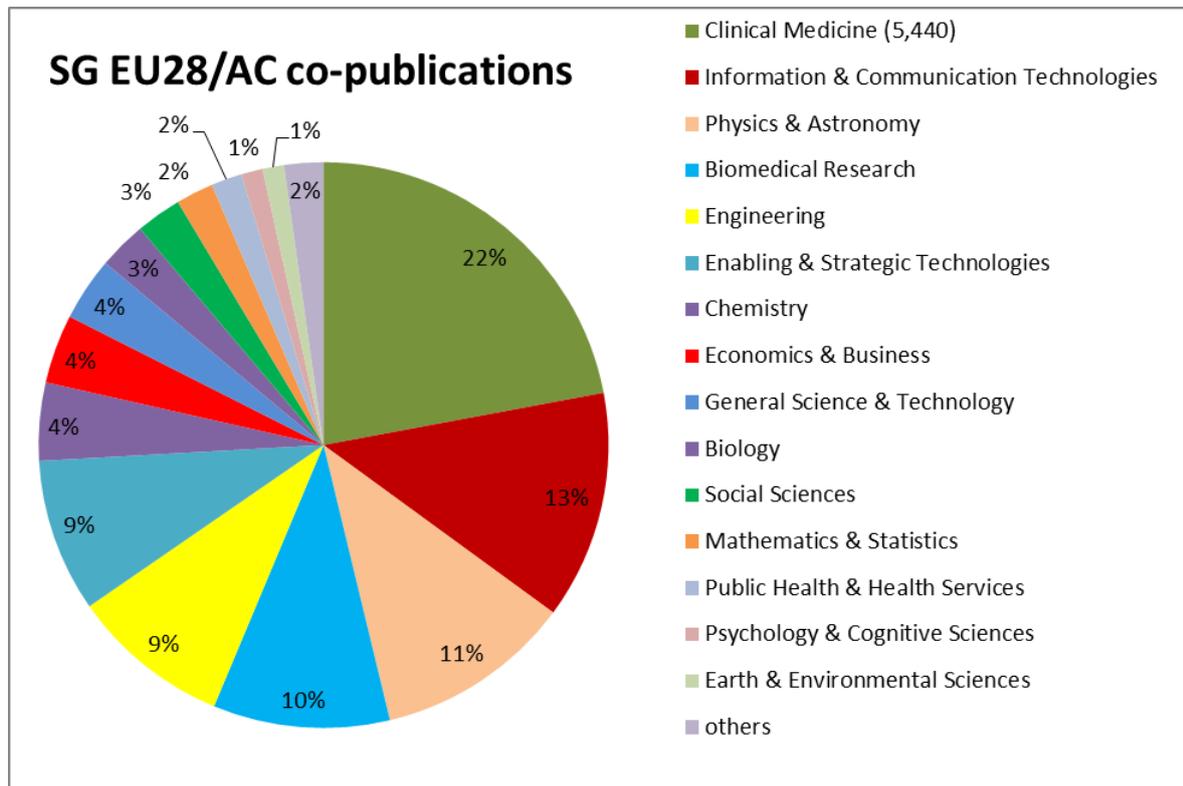


Figure 47: SM research fields of Singaporean co-publications with EU28/AC countries, 2004-2014

### Strongest collaboration linkages – within the ASEAN region and the EU

Regarding Singapore’s scientific collaboration with other ASEAN countries as well as with the EU28/AC, the most important co-publication partner countries for Singapore are – in descending order – Great Britain, Germany, France, Malaysia, the Netherlands, Italy, Switzerland, Sweden, Spain and Thailand. Table 7 gives a detailed overview of the top 20 collaboration countries of Singapore in regards to its collaboration with the two regions of ASEAN and EU28/AC. Highlighted in bold are top values of each category<sup>10</sup>.

<sup>10</sup> Over 33 citations per average co-publication; over 7 involved countries; over 25 involved authors.

	Co-publications	mean citations	mean country count	mean author count
GB	9,334	18.22	3.78	10.43
DE	4,585	22.77	4.69	14.79
FR	3,460	21.01	4.98	16.16
MY	2,321	9.91	4.53	10.26
NL	2,258	24.66	5.38	19.77
IT	2,014	28.04	6.3	22.11
CH	1,902	28.22	5.11	17.12
SE	1,570	36.31	5.88	24.64
ES	1,426	33.43	7.05	27.56
TH	1,259	22.84	6.52	17.61
DK	1,025	33.95	6.59	27.6
BE	858	30.47	7.26	27.94
IS	846	32.36	5.44	18.72
AT	746	27.26	6.59	25.05
PL	711	34.87	7.13	25.93
ID	699	9.39	5.84	14.2
PH	680	22.85	7.39	18.9
FI	658	38.75	8.2	39.51
NO	647	40.1	7.85	36
VN	589	11.73	5.53	12.23

Table 7: Singapore's top 20 collaboration countries within ASEAN and with the EU (Source: WoS+Scopus)

Singapore's co-publications involving at least one author affiliated in Norway are cited the most on average (40.1) when looking at Singapore's 20 most involved co-publication partner countries in the ASEAN region and within the EU28/AC. Co-publications with Finland (cited 38.75 times on average), Sweden (cited 36.31 times on average), Poland (cited 34.87 times on average), Denmark (cited 33.95 times on average) and Spain (cited 33.43 times on average) are cited comparatively frequently as well. Co-publications with Spain, Denmark, Belgium, Finland, Poland and Norway include a rather high average number of different authors on (all involve more than 25 authors on average, Finland being the leader with 39.51 authors). Scrutinising the average number of participating countries, Finland is again on top of the list with 8.2 countries, followed by Norway, the Philippines, Belgium and Poland all with more than seven participating countries.

### Collaboration linkages – within the ASEAN region in detail

In total, Singapore has 4,664 co-publications which involve at least one author affiliated in another ASEAN country. Figure 48 shows the involvement of the different ASEAN countries in co-publications with Singapore from 2004-2014. The strongest collaboration partner for Singapore in the ASEAN region is Malaysia with 2,321 joint co-publications. Second strongest partner is Thailand with 1,259 and third strongest partner is Indonesia with 699 joint co-publications, followed closely by the Philippines with 680 co-publications.

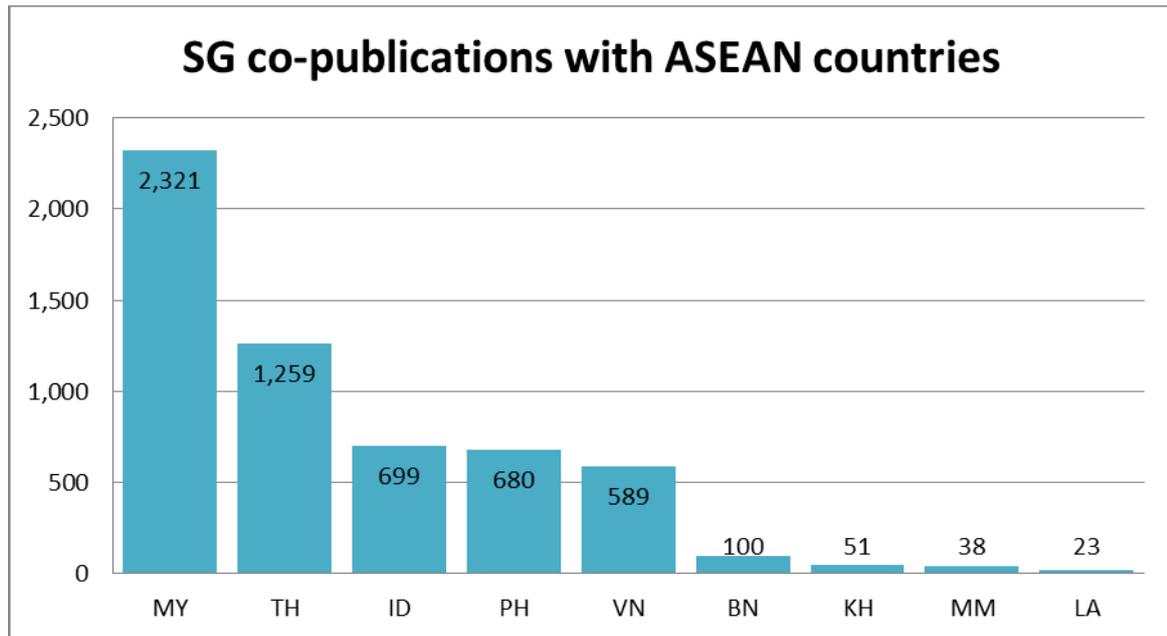


Figure 48: Singapore's co-publications with ASEAN countries, 2004-2014

Looking at the development over time of Singapore’s co-publications with its five strongest collaboration partners from the ASEAN region (Figure 49), it is visible that the co-publications involving Malaysian authors are growing rather fast. Singapore’s annual co-publication output with Thailand grew rather steadily from 2004 to 2009, starting just below 50 co-publications in 2004 to over 100 co-publications in 2009, from 2009 to 2010 there was a small decline and afterwards, from 2010 to 2012 a fast growth, but from 2012 onwards the annual co-publication output of Singapore-Thai co-publications rather stagnated. A similar development pattern is visible for the co-publications with the Philippines.

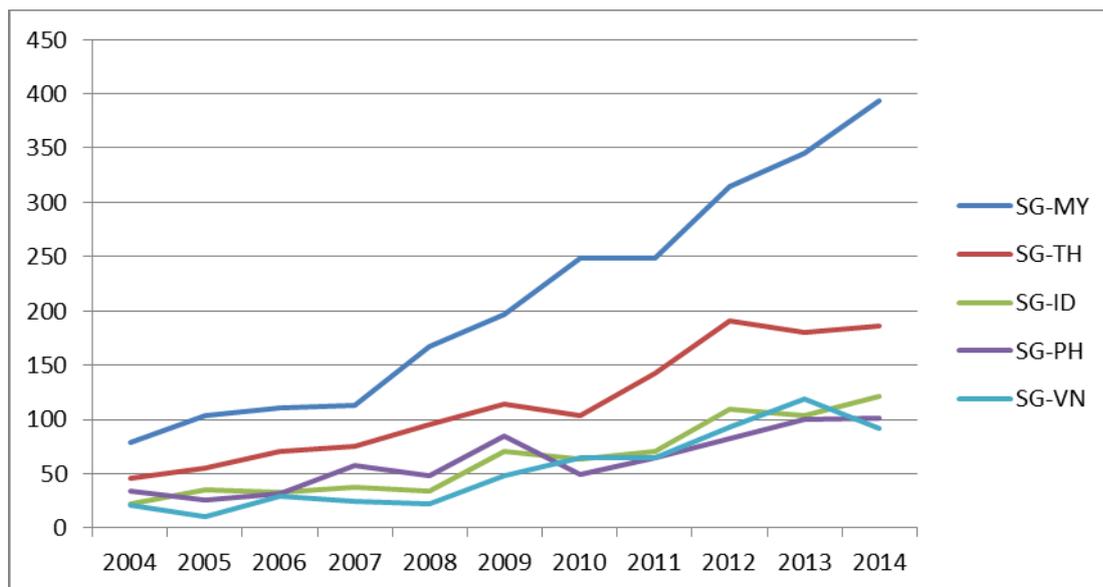


Figure 49: Singapore's co-publications with the five strongest ASEAN collaboration countries and their development over time, 2004-2014

The three SM research fields with the highest co-publication output for Singapore and Malaysia are “Clinical Medicine” (833 co-publications), “Engineering” (279 co-publications) and “Information & Communication Technologies” (184 co-publications), for Singapore and Thailand “Clinical Medicine” (552 co-publications), “Biomedical Research” (186 co-publications) and “Engineering” (65 co-publications), for Singapore and Indonesia “Clinical Medicine” (246 co-publications), “Biology” (121 co-publications) and “Biomedical Research” (63 co-publications), for Singapore and the Philippines “Clinical Medicine” (303 co-publications), “Biology” (121 co-publications) and “Biomedical Research” (63 co-publications) as well and for Singapore and Vietnam “Clinical Medicine” (230 co-publications), “Information & Communication Technologies” (59 co-publications) and “Biomedical Research” (52 co-publications).

“Clinical Medicine” is the SM research field with the most co-publications in all five cases, the other SM research fields also do not vary that much – only five different research fields are in the top 4 research fields of each co-publication partnership: “Engineering”, “Information & Communication Technologies”, “Biomedical Research” and “Biology”.

Figure 50, Figure 51 and Figure 52 show the overall distribution of SM research fields for Singapore’s co-publications with Malaysia, Thailand and Indonesia in detail.

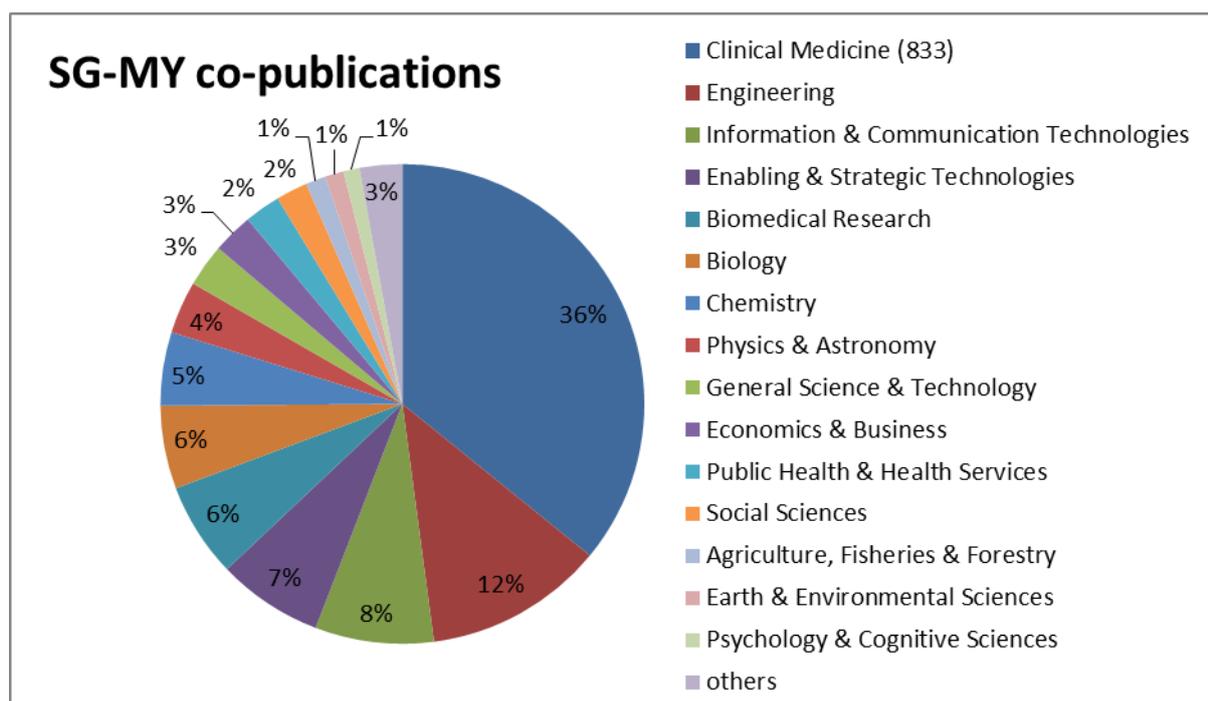


Figure 50: SM research fields of Singapore-Indonesia co-publications; 2004-2014

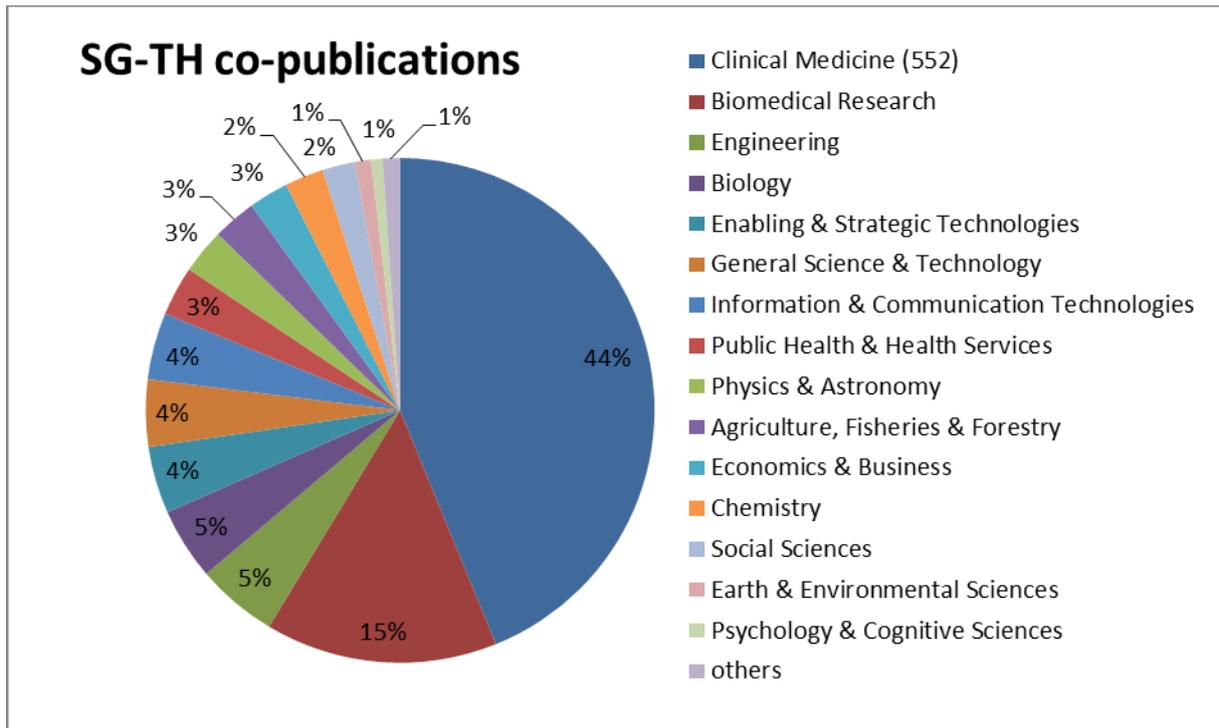


Figure 51: SM research fields of Singapore-Thailand co-publications; 2004-2014

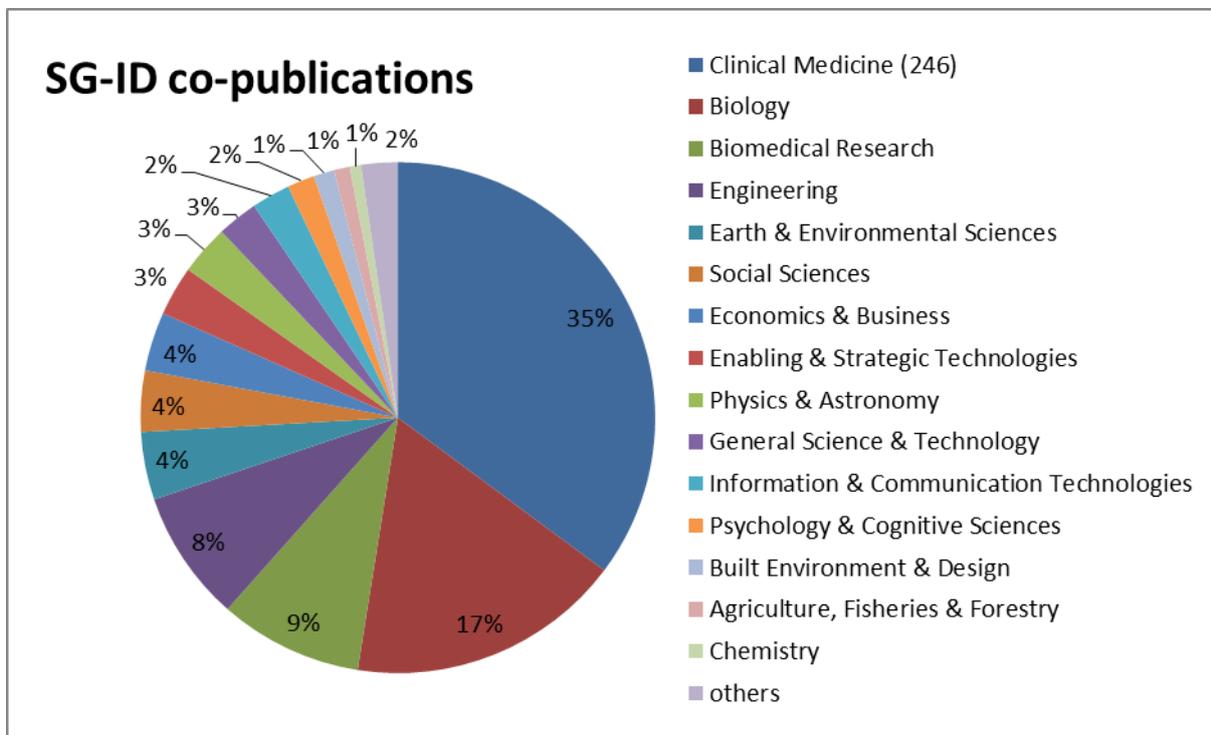


Figure 52: SM research fields of Singapore-Indonesia co-publications; 2004-2014

**Collaboration linkages – with the EU28/AC countries in detail**

In total, Singapore has 24,682 co-publications which involve at least one author affiliated in one of the EU28/AC. Figure 53 shows the involvement of the 15 EU28/AC countries which are involved most in co-publications with Singapore from 2004-2014. The strongest collaboration partner for Singapore in the EU28/AC region is Great Britain with 9,334 joint co-publications. The second strongest partner is Germany with 4,585 and third strongest partner is France with 3,460 joint co-publications, followed the Netherlands with 2,258 co-publications.

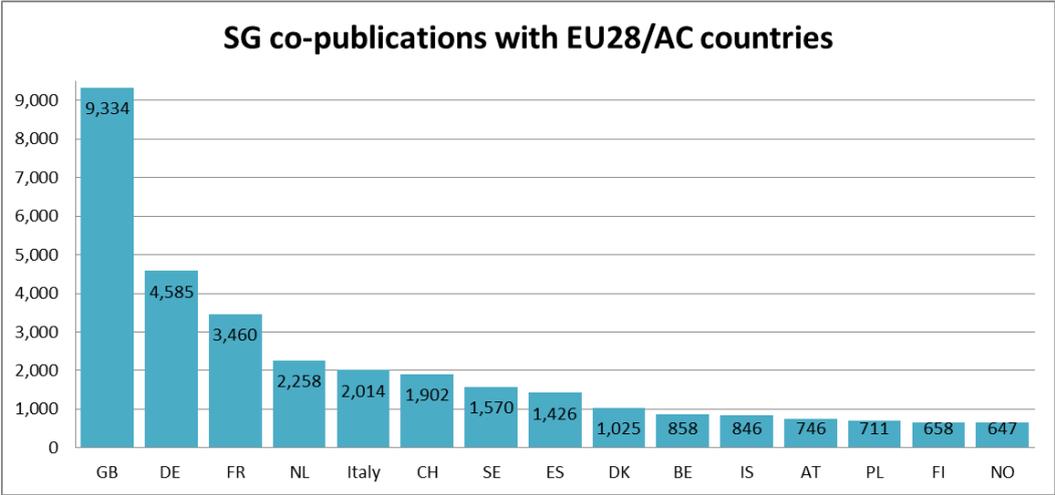


Figure 53: Singapore's co-publications with EU28/AC countries, 2004-2014

Looking at the development over time of Singapore’s co-publications with its five strongest collaboration partners from the EU28/AC region (Figure 54), it is visible that the co-publications involving authors affiliated in Great Britain are growing somewhat faster than with Germany, France, the Netherlands and Italy, especially since 2011. Co-publications with Germany and France have a rather similar, steady increase in their annual co-publication output with Singapore and Singapore’s annual co-publication output with The Netherlands is slowing down since 2012.

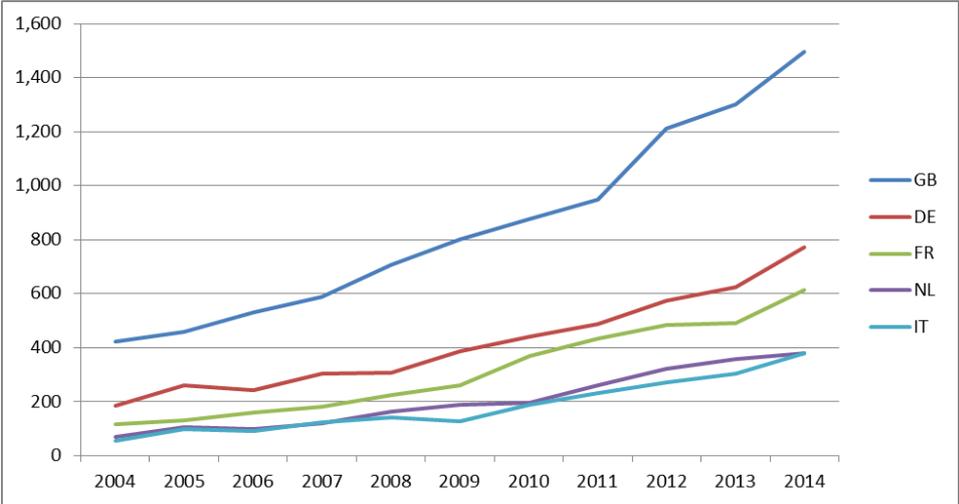


Figure 54: Singapore's co-publications with the five strongest EU28/AC collaboration partner countries and their development over time, 2004-2014

The three SM research fields with the most co-publication output for Singapore and Great Britain are “Clinical Medicine” (2,407 co-publications), “Biomedical Research” (914 co-publications) and “Information & Communication Technologies” (898 co-publications), for Singapore and Germany “Clinical Medicine” (1,167 co-publications), “Physics & Astronomy” (600 co-publications) and “Biomedical Research” (513 co-publications), for Singapore and France “Clinical Medicine” (781 co-publications), “Information & Communication Technologies” (592 co-publications) and “Biomedical Research” (440 co-publications), for Singapore and the Netherlands “Clinical Medicine” (644 co-publications), “Biomedical Research” (278 co-publications) and “Information & Communication Technologies” (255 co-publications) and for Singapore and Italy “Clinical Medicine” (696 co-publications), “Physics & Astronomy” (292 co-publications) and “Information & Communication Technologies” (229 co-publications).

“Clinical Medicine” is the SM research field with the most co-publications in all five cases, the other SM research fields do not vary that much – only four different research fields are in the top 4 research fields of each co-publication partnership: “Physics & Astronomy”, “Information & Communication Technologies” and “Biomedical Research”.

Figure 55, Figure 56 and Figure 57 show the overall distribution of SM research fields for Singapore’s co-publications with Great Britain, Germany and France in detail.

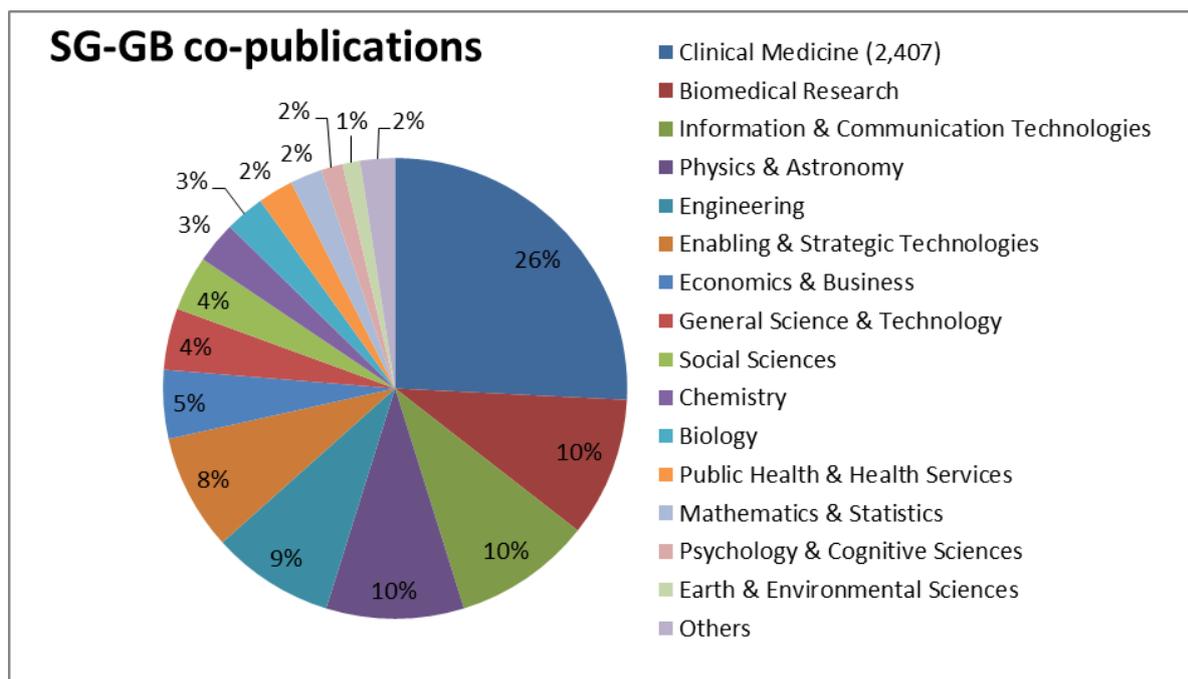


Figure 55: SM research fields of Singapore-Great Britain co-publications, 2004-2014

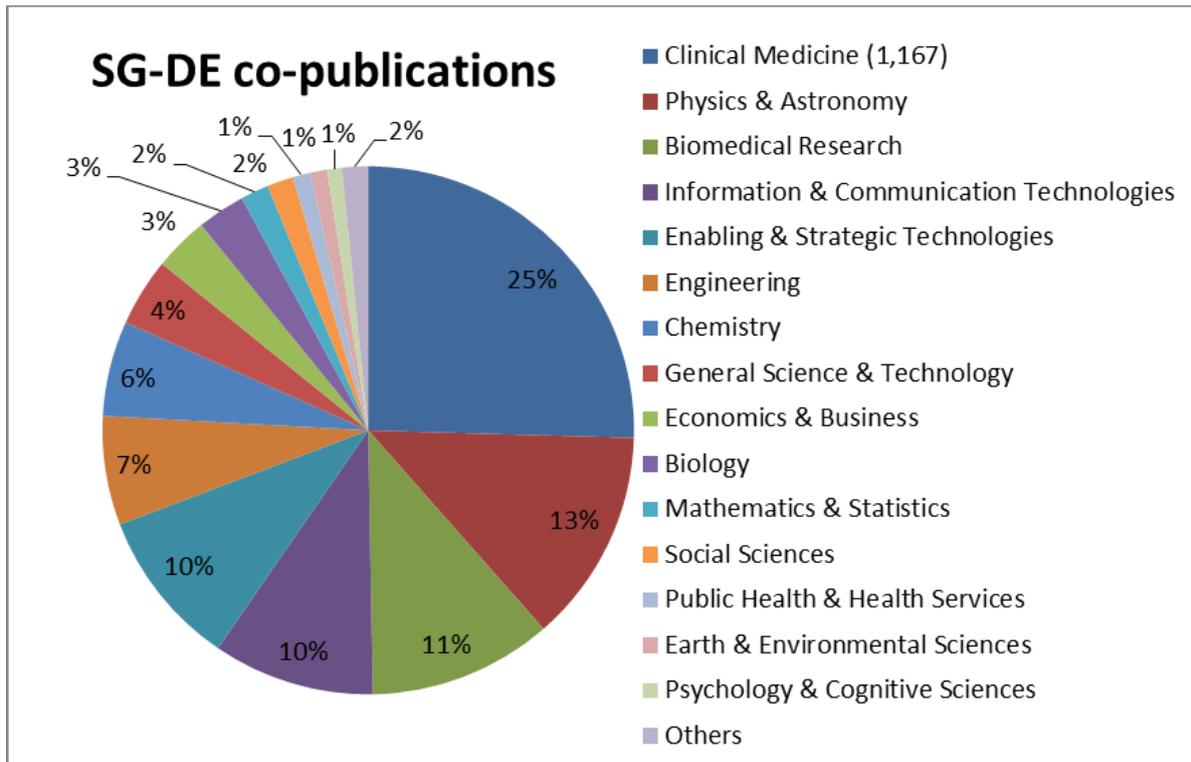


Figure 56: SM research fields of Singapore-Germany co-publications, 2004-2014

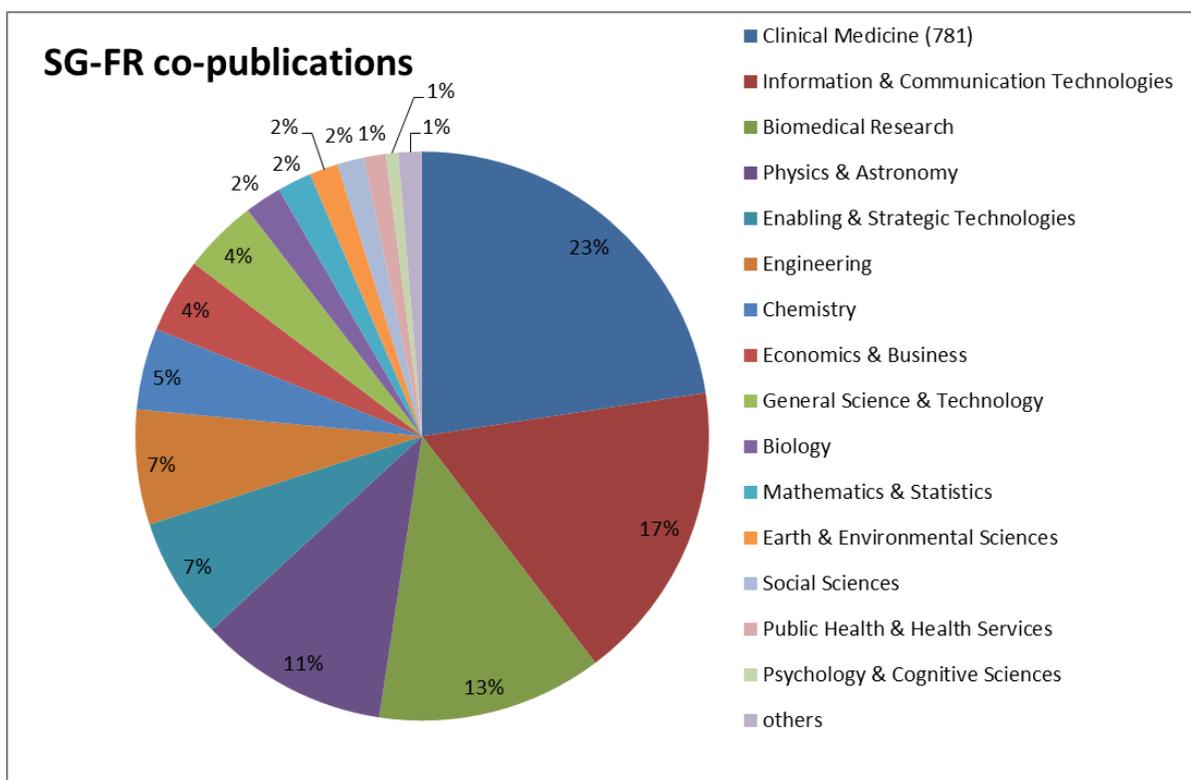


Figure 57: SM research fields of Singapore-France co-publications, 2004-2014

### Impact Analysis

Within the analysed time span of 2004 to 2014, the average citation of a publication involving at least one author from Singapore amounts to 9.28, i.e. each publication has been cited on average 9.28 times. Works co-authored with at least one author from a foreign country are cited more often: 11.6 is the number of average citations for internationally co-authored works. Works co-authored with at least one author from EU28/AC are cited 14.53 times on average and co-publications with at least one author from an ASEAN country are cited 12.6 times on average.

Table 8 gives an overview of the average citations of the different Science Metrix fields of Singaporean overall publications, Singaporean co-publications as well as Singapore-ASEAN and Singapore-EU28/AC co-publications. Figures in bold mark the comparatively highest average citation count.

#### *Overview of average citations per SM research field: Comparison of Singapore's publications, co-publications, co-publications with ASEAN and with EU28/AC*

Singapore's co-publications with ASEAN countries have a comparatively high impact in "Built Environment & Design", "Historical Studies", "Philosophy & Theology" - fields with rather low (co-)publication output – and "Mathematics & Statistics". Co-publications with EU28/AC countries have a comparatively high impact in most of the fields with many (co-)publications: "Biology", "Biomedical Research", "Clinical Medicine", "Earth & Environmental Sciences", "General Science & Technology", "Information & Communication Technologies", "Physics & Astronomy" and some smaller research fields like "Social Sciences" and "Psychology & Cognitive Sciences".

	SG publications	SG co-publications	SG-ASEAN copubs	SG-EU28/AC copubs
Agriculture, Fisheries & Forestry	11.39	<b>11.4</b>	9.72	6.69
Biology	9.78	10.4	8.25	<b>11.94</b>
Biomedical Research	17.85	20.54	17.9	<b>24.37</b>
Built Environment & Design	6.16	5.93	<b>8.57</b>	6.21
Chemistry	<b>18.9</b>	16.87	7.56	16.26
Clinical Medicine	10.76	15.68	19.97	<b>21.98</b>
Communication & Textual Studies	2.49	<b>3.11</b>	1.05	2.06
Earth & Environmental Sciences	5.41	5.89	6.13	<b>7.59</b>
Economics & Business	7.33	<b>9.56</b>	4.06	7.06
Enabling & Strategic Technologies	11.2	<b>12.65</b>	8.69	11.62
Engineering	7.19	<b>8.46</b>	6.22	7.6
General Arts, Humanities & Social Sciences	1.11	<b>1.76</b>	0	1.24
General Science & Technology	19.33	25.02	32.22	<b>35.36</b>
Historical Studies	1.9	4.05	<b>12.52</b>	7.29
Information & Communication Technologies	5.32	6.86	3.43	<b>7.46</b>
Mathematics & Statistics	7.51	7.54	<b>9.19</b>	5.84
Philosophy & Theology	1.62	2.44	<b>2.8</b>	<b>2.8</b>
Physics & Astronomy	9.46	10.28	5.97	<b>11.39</b>
Psychology & Cognitive Sciences	6.53	8.04	7.78	<b>8.32</b>
Public Health & Health Services	4.47	6.35	4.28	<b>7.53</b>
Social Sciences	3.05	3.97	2.62	<b>4.17</b>

Visual & Performing Arts 0.76 0.83 0 0.56

**Table 8: Overview of average citations of different SM research fields: Singaporean publications, co-publications, ASEAN co-publications and EU28/AC co-publications**

**Impact of SM research fields of Singapore’s co-publications with ASEAN countries**

Table 9 shows the impact of Singapore's co-publications per Science-Metrix research field with Malaysia, Thailand, Indonesia, the Philippines, Vietnam and Brunei. Values marked with red are below 50% of the average citation count the overall Singaporean co-publications in the respective research field received, values marked in green are more than 50% higher than the average value of citations of the Singaporean co-publications. I.e. co-publications with the Philippines and Thailand have a high impact in “Clinical Medicine”, co-publications with Malaysia in “Historical Studies”. Also, co-publications with Indonesia have a considerable impact in “General Science & Technologies” as well as Singapore-Vietnam co-publications in “Mathematics & Statistics”.

	SG co-publications	SG-ID co-publications	SG-MY co-publications	SG-PH co-publications	SG-TH co-publications	SG-VN co-publications	SG-BN co-publications
Agriculture, Fisheries & Forestry	11.4	--	10.9	--	9.6	--	--
Biology	10.4	7.81	10.33	9.96	5.33	3.33	--
Biomedical Research	20.54	10.93	14.22	23.29	24.16	28.13	--
Built Environment & Design	5.93	--	6.43	--	--	--	--
Chemistry	16.87	--	6.76	--	9.55	--	--
Clinical Medicine	15.68	13.51	13.57	34.32	33.93	13.72	8.73
Earth & Environmental Sciences	5.89	6.84	7.04	--	--	--	--
Economics & Business	9.56	1.46	4.26	1.07	5.09	--	--
Enabling & Strategic Technologies	12.65	2.77	9.73	0.26	9.67	--	--
Engineering	8.46	2.4	6.38	1.43	11.35	6.47	--
General Science & Technology	25.02	38.67	12.41	--	41.75	--	--
Historical Studies	4.05	--	18.08	--	--	--	--
Information & Communication Technologies	6.86	--	3.4	3.03	2.93	4.75	--
Mathematics & Statistics	7.54	--	--	--	--	13.2	--
Physics & Astronomy	10.28	3.77	7.82	--	4.06	--	--
Psychology & Cognitive Sciences	8.04	--	9.37	--	--	--	--
Public Health & Health Services	6.35	--	3.34	--	8.9	--	--
Social Sciences	3.97	0.85	4.37	1.92	1.43	--	--

**Table 9: Impact of Singapore's co-publications per SM research field with Malaysia, Thailand, Indonesia, the Philippines, Vietnam and Brunei 2004-2014 (Threshold: only SM fields with over 20 co-publications in the time frame 2004-2014 are considered). Values marked with red are below 50% of the average citation count the overall Singaporean co-publications in the respective research field received, values marked in green are more than 50% higher than the average citation count.**

**Impact of SM research fields of Singapore’s co-publications with EU28/AC countries**

Table 10 shows the average number of citations per SM research field with Great Britain, Germany, France, the Netherlands and Italy. Values marked with red are below 50% of the average citation the overall Singaporean co-publications in the respective research field received in the same time frame, values marked in green are more than 50% higher than the average value of citations of the Singaporean co-publications. I.e. co-publications with Great Britain have an above-average impact in the fields “General Science & Technology” and “Historical Studies”, co-publications with Germany, France, the Netherlands and Italy have an outstanding impact in “Clinical Medicine” and “General Science & Technology”, co-publications with the Netherlands in “Biology”, “Biomedical Research” and co-publications with Italy in “Biomedical Research”.

	SG co-publications	SG-GB co-publications	SG-DE co-publications	SG-FR co-publications	SG-NL co-publications	SG-IT co-publications
Agriculture, Fisheries & Forestry	11.4	6.75	--	--	--	--
Biology	10.4	16.48	13.99	13	22.67	7.38
Biomedical Research	20.54	30.69	35.71	34.19	48.92	52.08
Built Environment & Design	5.93	7.35	2.05	--	5.6	--
Chemistry	16.87	19.34	14.29	11.56	18.31	9.48
Clinical Medicine	15.68	26.27	35.08	42.67	37.24	41.29
Communication & Textual Studies	3.11	2.53	--	--	--	--
Earth & Environmental Sciences	5.89	11.09	3.04	7.95	3.06	--
Economics & Business	9.56	6.55	4.91	8.64	9.88	9.07
Enabling & Strategic Technologies	12.65	14.47	15.85	12.03	7.4	7.5
Engineering	8.46	7.58	6.84	5.95	9.72	8.23
General Science & Technology	25.02	50.1	73.3	53.78	67.99	68.81
Historical Studies	4.05	9.99	3.46	--	--	--
Information & Communication Technologies	6.86	9.09	9.53	5.7	5.02	7.83
Mathematics & Statistics	7.54	5.01	9.13	8.49	--	2.65
Philosophy & Theology	2.44	2.96	--	--	--	--
Physics & Astronomy	10.28	14.04	15.39	7.83	10.2	18.89
Psychology & Cognitive Sciences	8.04	7.66	10.13	13.31	13.68	--
Public Health & Health Services	6.35	7.18	9.35	7.92	5.52	--
Social Sciences	3.97	5.66	2.1	1.41	3.34	--

Table 10: Impact of Singapore's co-publications per SM research field with Great Britain, Germany, France, the Netherlands and Italy, 2004-2014 (Threshold: only SM fields with over 20 co-publications in the time frame 2004-2014 are considered). Values marked with red are below 50% of the average citation count the overall Singaporean co-publications in the respective research field received, values marked in green are more than 50% higher than the average citation count.

## 6.4 Thailand

### Output over time

Between 2004 and 2014, authors affiliated in an organisation in Thailand have published<sup>11</sup> ~118k (thousand) scientific publications overall. On average, each publication involves roughly 8 authors from slightly above 2 different countries and is cited nearly 6 times. Out of the overall publications, ~44.7k (or roughly 38%) are (international) co-publications, i.e. they have been co-authored by at least two authors – one affiliated at an organisation in Thailand and one affiliated at an institution abroad. About 5,400 of those co-publications were produced in collaboration with another ASEAN country and about 15k with an EU27/AC country.

<sup>11</sup>

indexed in *Scopus* or/and *Web of Science*

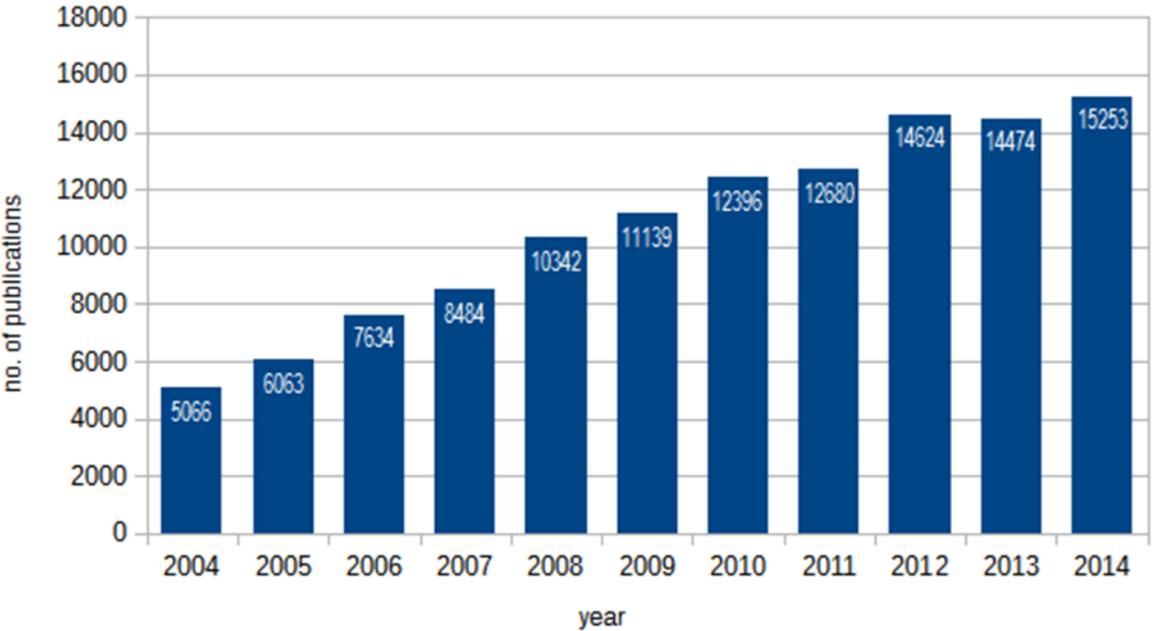


Figure 58: Thailand’s publication output, 2004-2014

Figure 58 shows the development of Thailand’s annual publication output from 2004 to 2014. In comparison, the co-publication output is growing slower – its share of overall publication was ~44% in 2004 and at ~39% in 2014. Nevertheless, after a boost<sup>12</sup> in 2012, the annual publication output seems to be increasing at a slower pace. The number of publications in 2014 was about three times higher than in 2004 (~15k vs. ~5.1k). The number of (international) co-publications increased from ~ 2,200 in 2004 to ~ 5,900 in 2014 (see Figure 59), which means they increased by a factor of roughly 2.7.

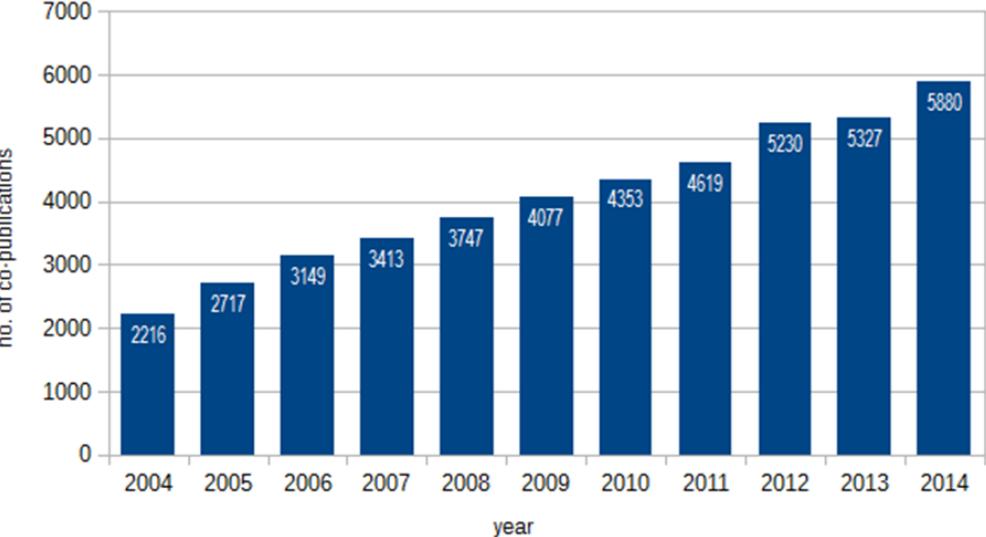


Figure 59: Thailand’s co-publication output, 2004-2014

<sup>12</sup> which may partly have been “caused” by a better coverage by the used citation databases

Of the observed co-publications between 2004 and 2014, about 5.4k were intra-ASEAN, i.e. they involved at least one author affiliated with an organisation in an ASEAN country (other than TH). In the same period, co-publications with the EU (incl. countries associated to the EU Framework Programme for Research and Technological Development) amounted to ~15.1k, which is almost triple that of the intra-ASEAN ones (see Figure 60).

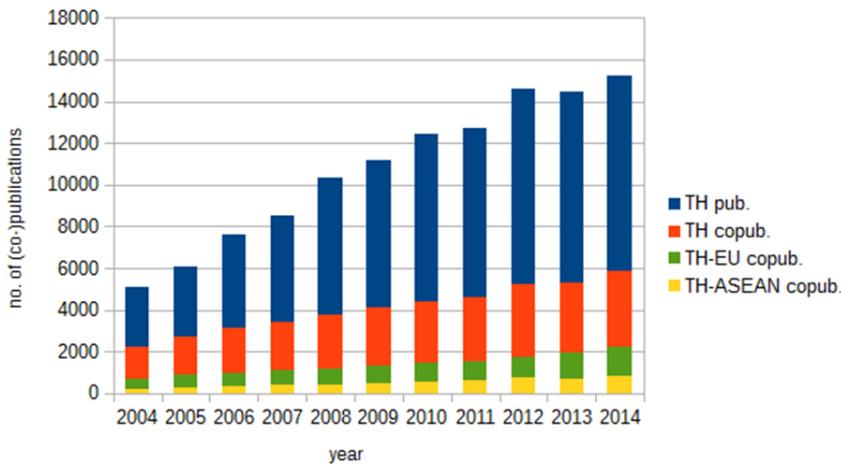


Figure 60: Overview of the Thai (co-)publication output, 2004-2014– overlay view, i.e. the bars are not stacked but placed “behind” each other (all start from 0)

Whereas Figure 60 compares the absolute numbers, Figure 61 compares the growth of the output – the development is rendered relative to the base year 2004 (= 100 %). The TH-ASEAN co-publications grew most, i.e. their number in 2014 is about five times the amount in 2004. The number of (international) co-publications did not grow as much. As was mentioned above, it did not even grow as steady as the overall publication output, which is a rare observation in today’s internationalisation efforts. Thailand’s co-publications with the EU28/AC did show an above-average growth compared to the overall co-publications, i.e. in 2004, the former’s share of the latter was about 32%; in 2014, that share was 37 %.

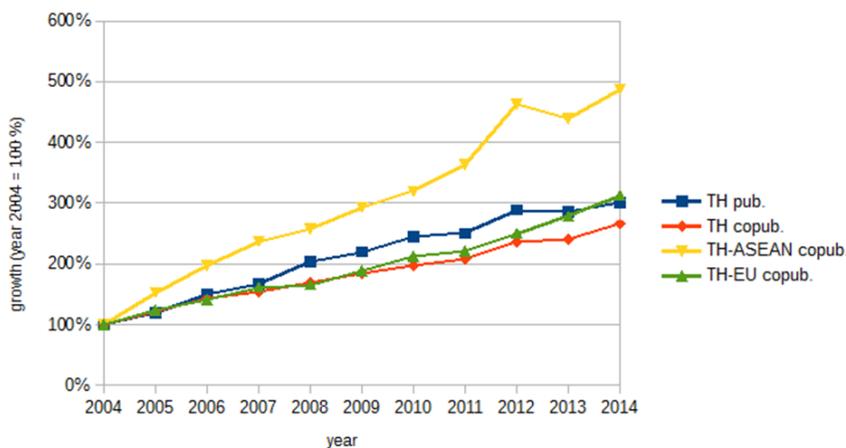


Figure 61: Overview of the growth of annual Thai (co-)publication output, 2004-2014

### Analysis of research topics in Thai research output

Figure 62 shows the percentage of the research area distribution of Thai publications from 2004 to 2014. Three research areas make up about 90% of Thai publications: Applied Sciences (37%), Health Sciences (34%), and Natural Sciences (21%).

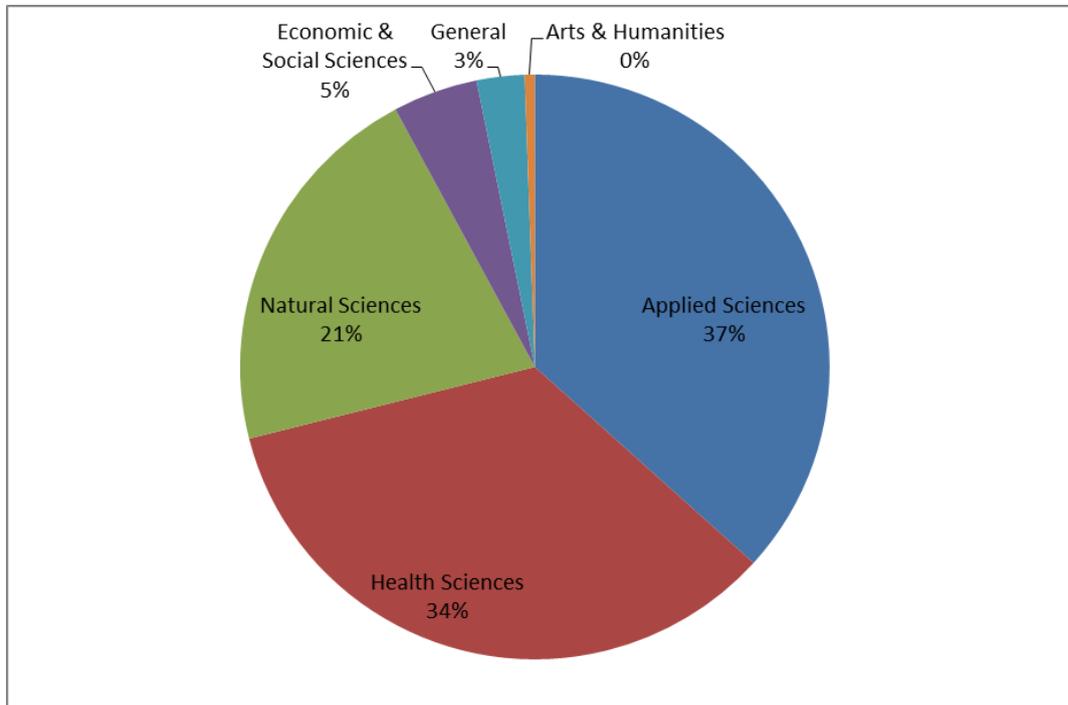


Figure 62: Research topics of Thailand's publications, 2004-2014

On a more detailed level, i.e. the level of Science-Metrix fields, 23% of all Thai scientific publications from 2004 to 2014 are published in the field Clinical Medicine, 11% in Engineering, 10% in Enabling & Strategic Technologies, 9% in Biomedical Research, 8% in ICT, 7% in Biology, 6% in Agriculture, Fisheries & Forestry, 6% in Chemistry, and 4% in Physics & Astronomy (see Figure 63).

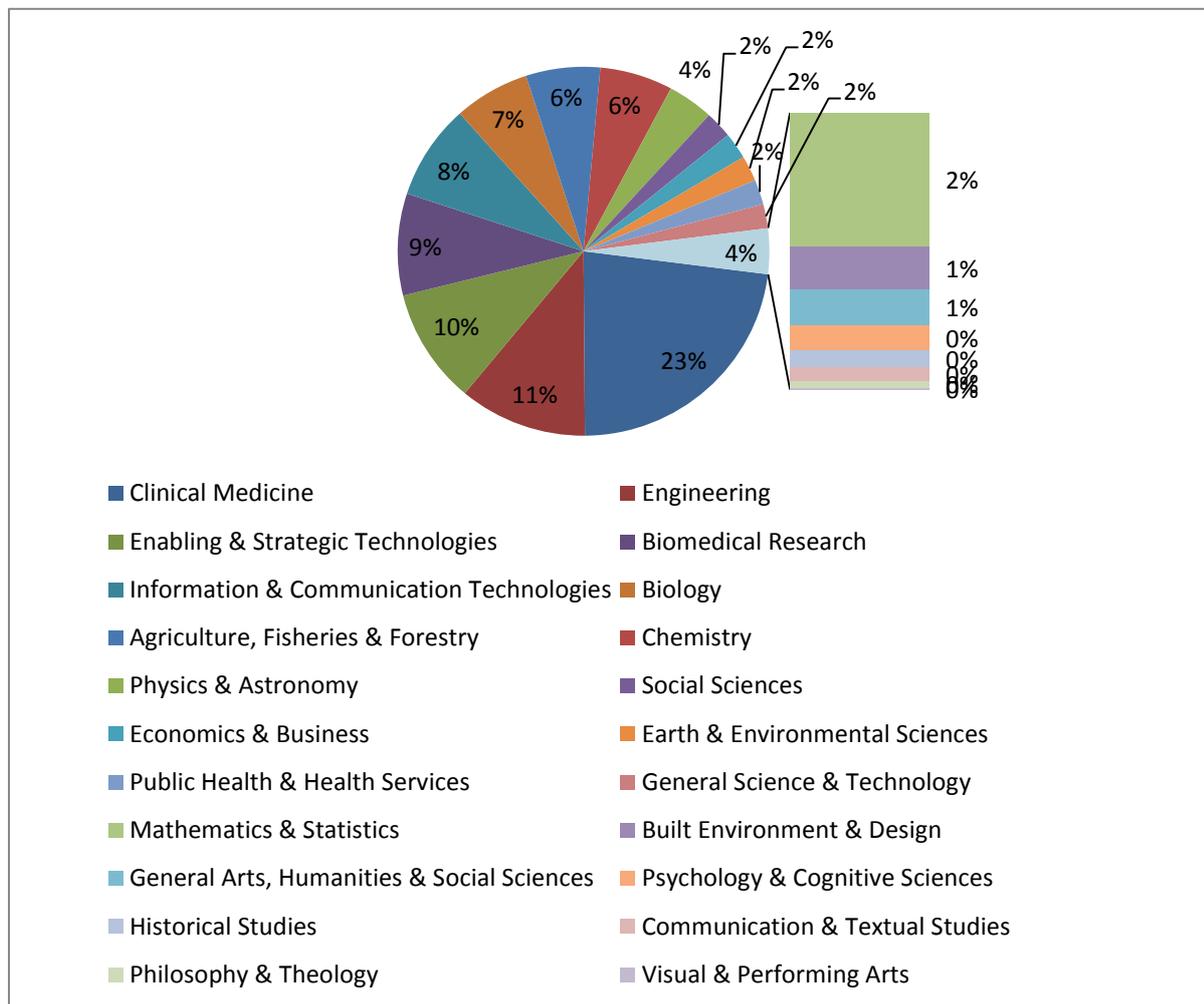


Figure 63: SM research fields of Thai publications, 2004-2014

Looking at the annual distribution of Thai top ten research fields in terms of number of publications it becomes apparent that Clinical Medicine has started fairly high and is still growing stronger than other fields (see Figure 64). Enabling & Strategic Technologies are growing stronger than Engineering, especially since 2009. Figure 65 offers a closer look at the development of the other research fields (Clinical Medicine has been left out): they seem to be stagnating (Chemistry or Agriculture, Fisheries & Forestry) or even declining (ICT or Biomedical Research); it remains to be seen whether the development of the latter becomes a trend; a more positive development can be noted for Biology and Social Sciences.

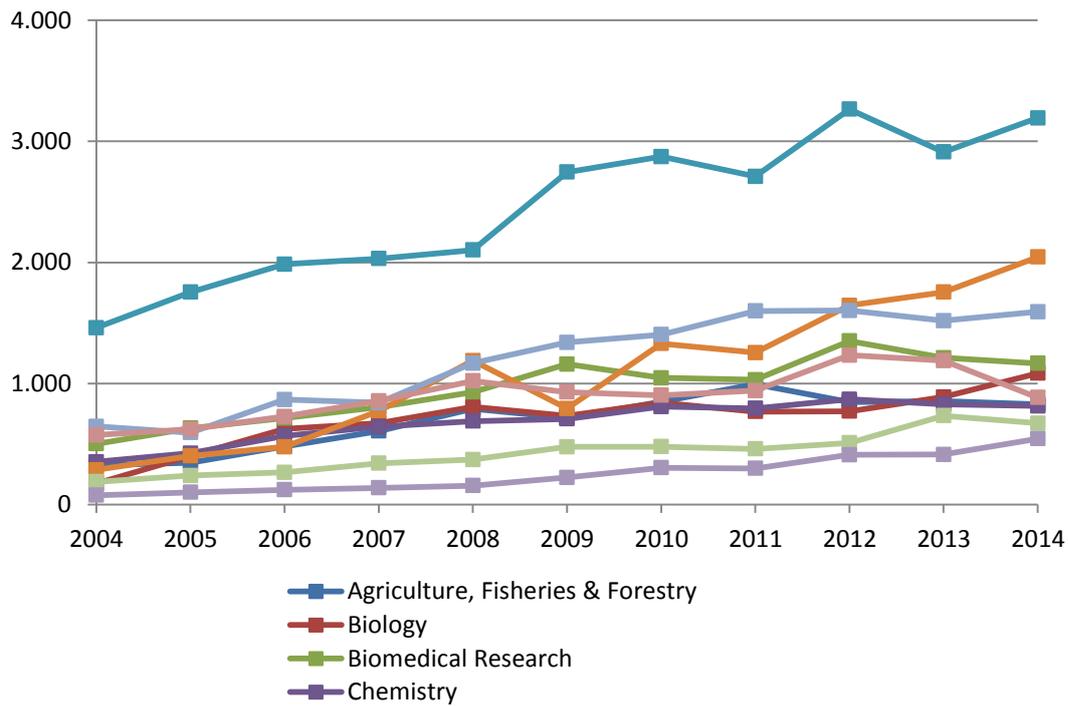


Figure 64: Annual development of the top 10 SM fields of Thai publications, 2004-2014

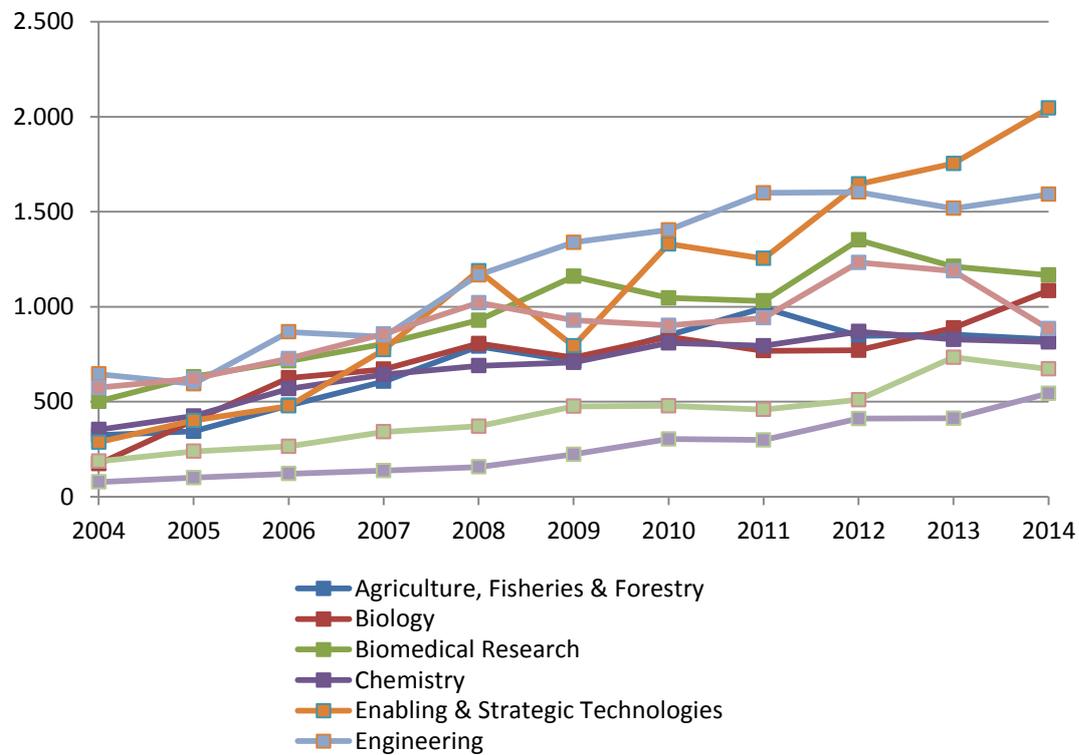


Figure 65: Annual development of the top 10 SM fields - without Clinical Medicine - of Thai publications, 2004-2014

Compared to the overall Thai publications, the thematic distribution of Thai co-publications (see Figure 66) is not much different: Clinical Medicine is still the output-strongest research field; Biomedical Research is more prominent (15% share vs. 9% of overall publications); Engineering remains among the top three (with a slightly lower share, though, i.e. 7% vs. 11%). Enabling & Strategic Sciences is slightly less (7% vs. 10%). However, ICT seems less important (4% vs. 8%) too.

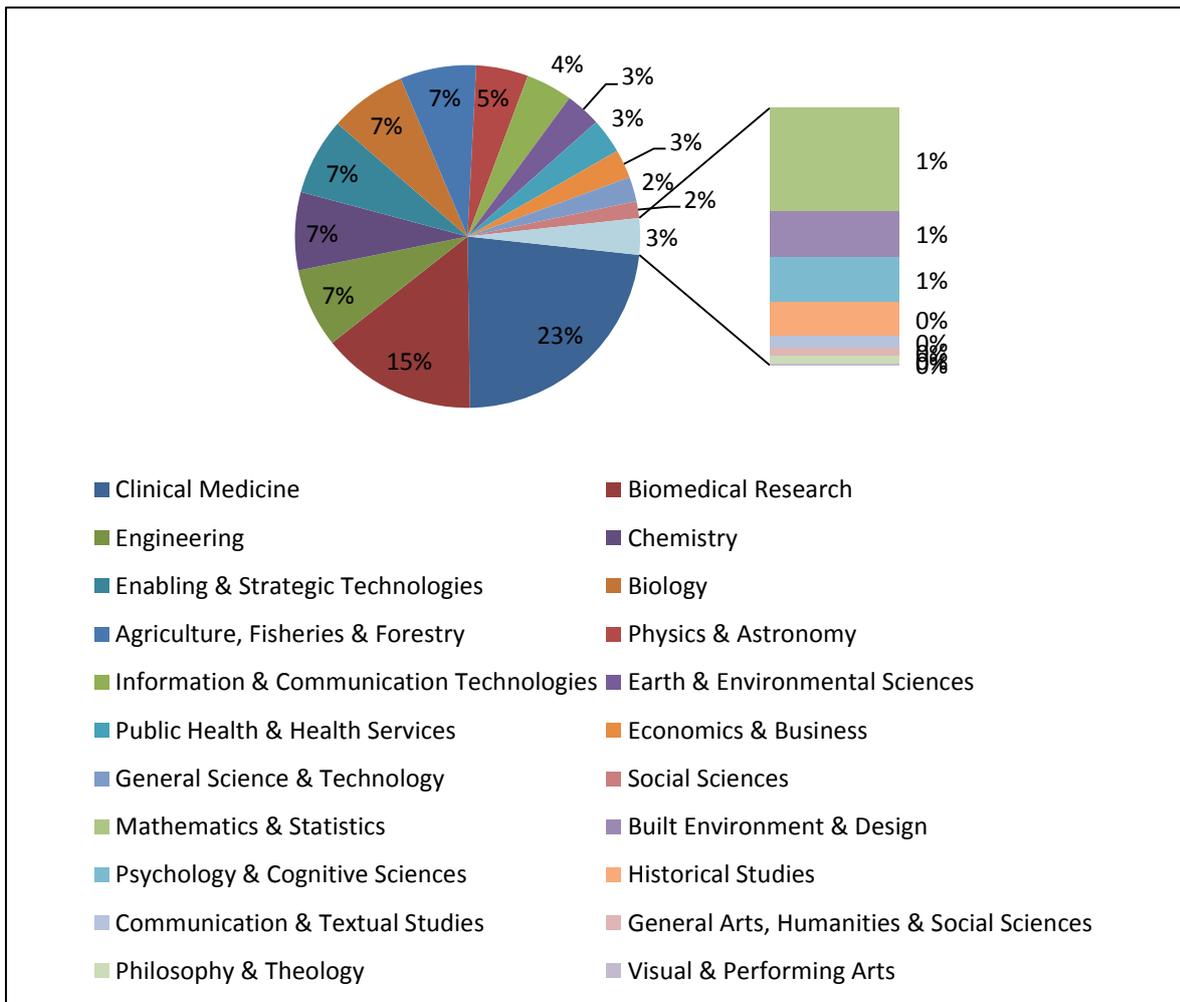


Figure 66: SM research fields of Thai co-publications, 2004-2014

Looking at the annual distribution of Thai co-publications top ten in terms of the annual growth in the number of co-publications (see Figure 67), Clinical Medicine is growing stronger than the field with the second highest output (Biomedical Research). Eliminating the strongest field from the figure allows a better look at the other fields (see Figure 68) Biology, Enabling & Strategic Technologies, and – to a lesser degree Earth & Environmental Science have experienced a boost from 2013 to 2014. ICT and Engineering seem to stagnate, whereas Physics & Astronomy seems to pick up more speed compared to 2012 and before.

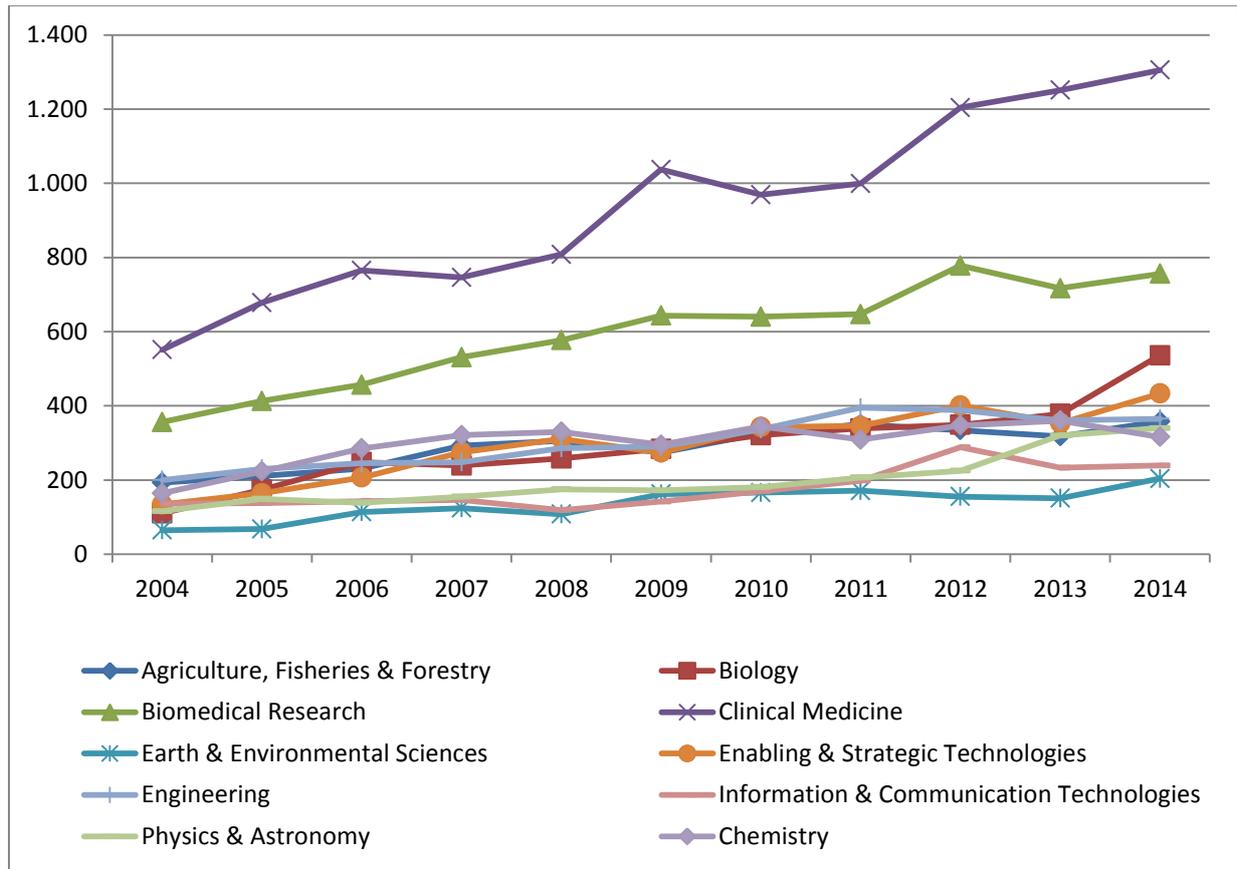


Figure 67: Annual development of the top 10 SM fields of Thai co-publications, 2004-2014

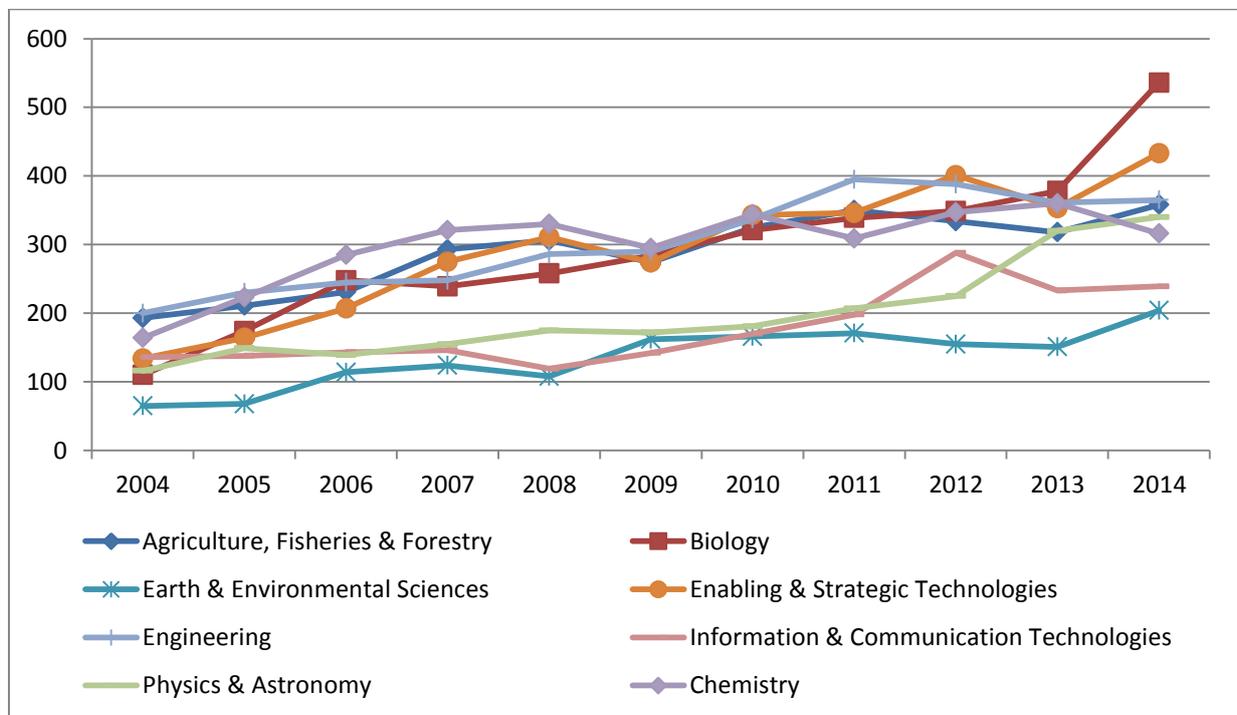


Figure 68: Annual development of the top 10 SM fields - without Clinical Medicine and Biomedical Research - of Thai co-publications, 2004-2014

Examining the Thai co-publications with other ASEAN countries reveals, that Clinical Medicine is even stronger (30% share vs. 23% share of all co-publications) Biomedical Research remains second; however, Chemistry is more prominent (10% vs. 7%), while Engineering is less pronounced (5% vs. 7%). The other fields remain more or less the same (see Figure 69)

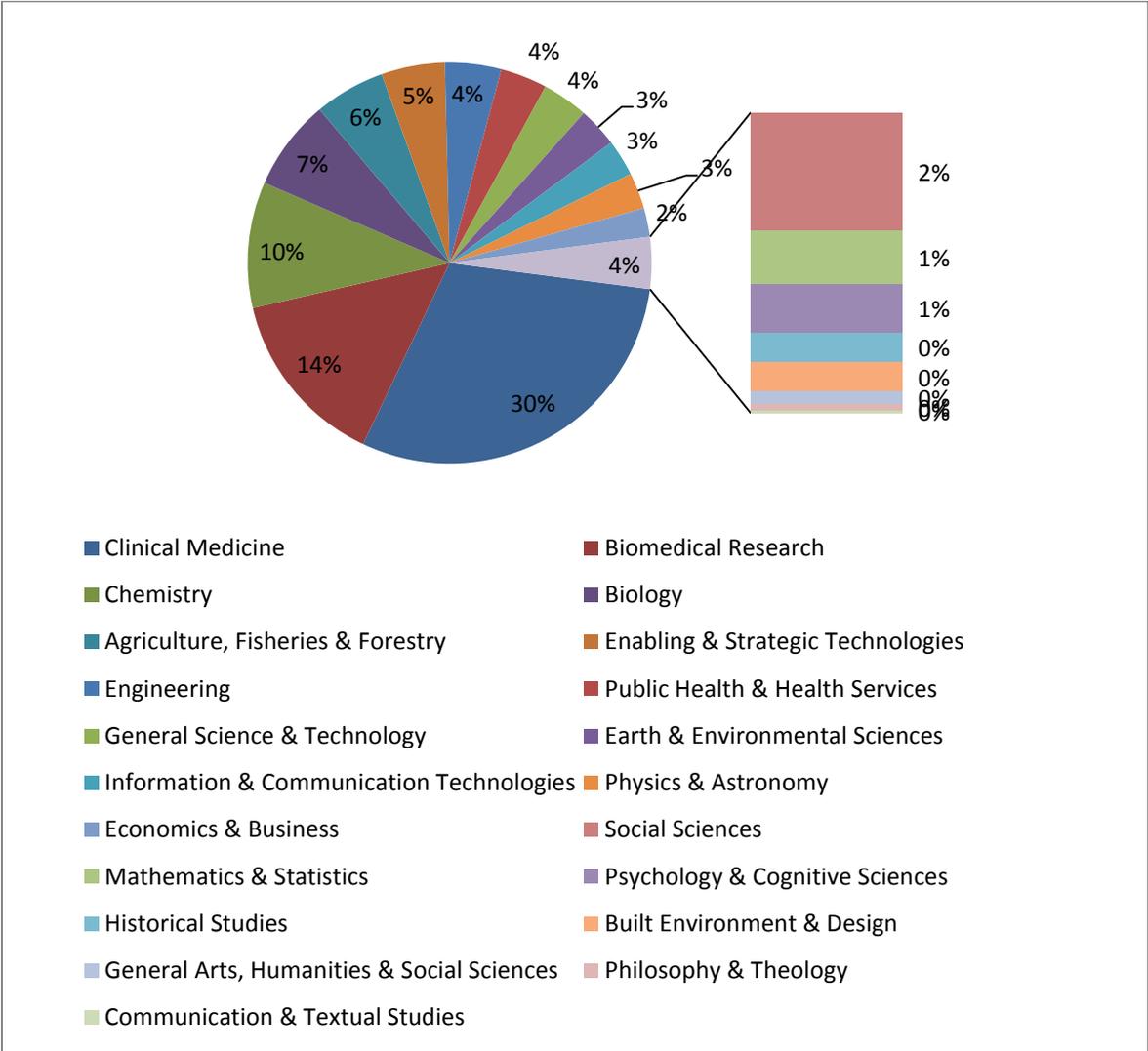


Figure 69: SM research fields of Thai co-publications with ASEAN countries, 2004-2014

Figure 70 shows the shares of the Thai co-publication with the EU member states (incl. countries associated to the EU Framework Programmes). They mirror the Thailand-ASEAN shares in most regards; the difference is that Biomedical Research and Physics & Astronomy is a bit more, Chemistry and Clinical Medicine a bit less prominent. Clinical Medicine and Biomedical Research still remain at the top in terms of shares.

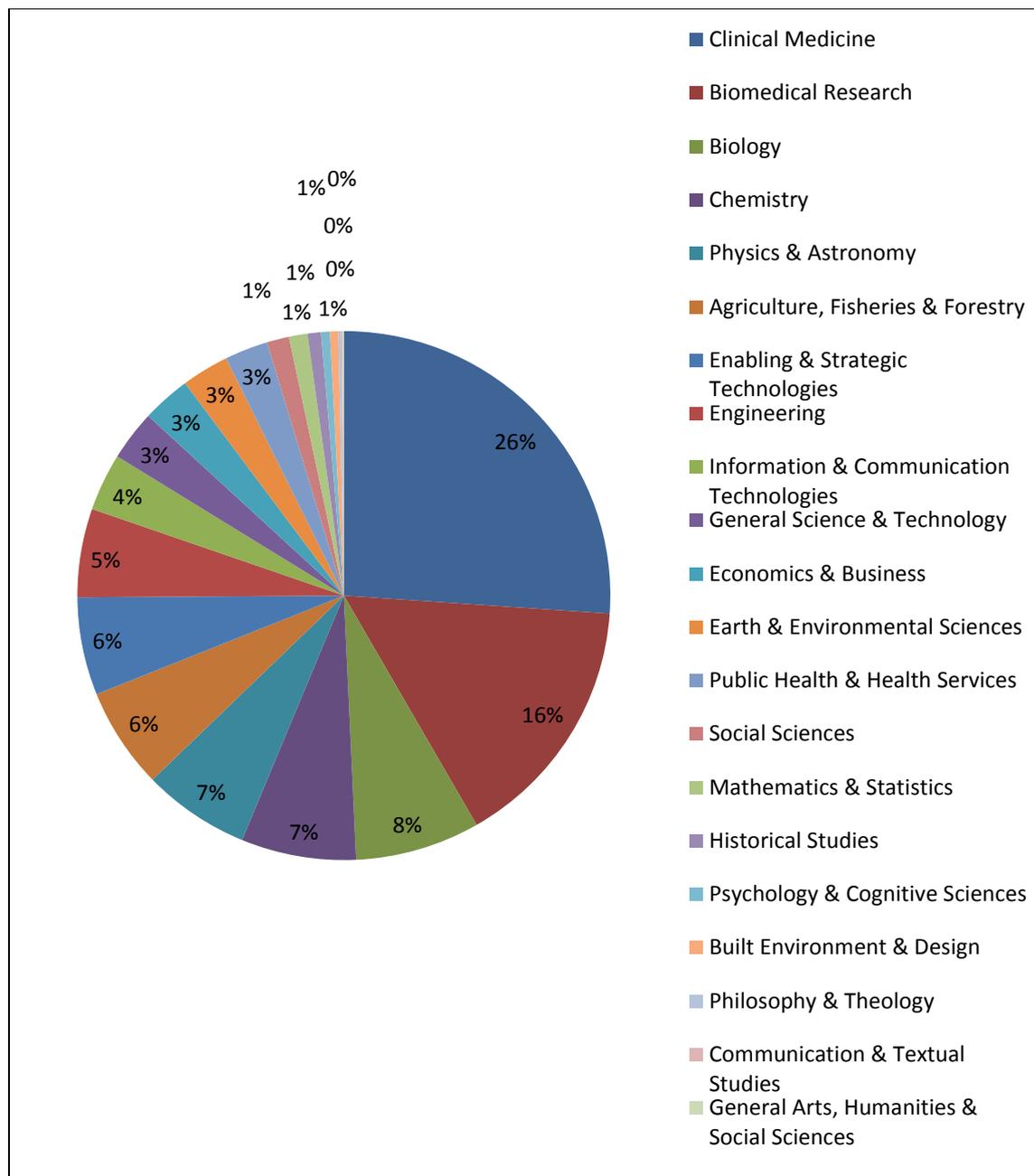


Figure 70: SM research fields of Thai co-publications with EU28/AC countries, 2004-2014

### Strongest collaboration linkages – within the ASEAN region and the EU

Regarding Thailand’s scientific collaboration with other ASEAN countries as well as with the EU28/AC, the most important co-publication partner countries for Thailand are – in descending order – Great Britain, France, Germany, Malaysia, the Netherlands, Switzerland, Singapore, Italy, Vietnam, and Indonesia. **Table 11** gives a detailed overview of the top 20 collaboration countries of Thailand in regards to its collaboration with the two regions of ASEAN and EU28/AC. Highlighted in bold are the top values of each category. A higher number of mean authors usually indicates that big science is relatively prominent in the collaboration with the respective country.

country	Co-pub	mean citations	mean no. of countries	mean no. of authors
GB	<b>5,779</b>	19.01	5.43	80.3
FR	<b>2,875</b>	16.85	7.64	154.61
DE	<b>2,856</b>	14.32	7.36	154.44
<b>MY</b>	<b>1,914</b>	9.23	6.27	71.79
NL	<b>1,479</b>	<b>21.78</b>	6.22	41
CH	1,360	<b>22.86</b>	<b>12.02</b>	<b>313.25</b>
<b>SG</b>	1,259	<b>22.84</b>	6.52	17.61
IT	1,245	<b>22</b>	<b>12.91</b>	<b>345.33</b>
<b>VN</b>	1003	16.69	5.54	11.76
<b>ID</b>	990	14.62	5.81	12.98
SE	957	18.78	6.84	56.39
AT	918	12.09	<b>12.03</b>	<b>425.89</b>
ES	873	<b>22.74</b>	<b>16.43</b>	<b>489.1</b>
BE	868	20.32	<b>13.9</b>	<b>444.67</b>
<b>PH</b>	841	20.68	7.32	15.56
<b>KH</b>	411	19.61	5.69	13.6
<b>LA</b>	403	10.14	4.24	9.78
<b>MM</b>	188	15.74	5.27	10.92
<b>BN</b>	27	16.41	8.81	17.22

Table 11: Thailand's top 20 collaboration countries within ASEAN and with the EU28/AC (Source: WoS+Scopus)

Thailand's co-publications are cited most often with Switzerland, Singapore, Spain, Italy or the Netherlands being involved. The section on impact analysis (see p. 91) examines this more closely.

In term of the average number of countries or average number of authors involved, Spain, Belgium, Austria, Italy and Switzerland lead the top. This cannot be regarded as an indicator for quality but rather as a characteristic of the research collaboration.

### Collaboration linkages - within the ASEAN region in detail

In total, Thailand has about 5.4k co-publications (2004-2014) that involve at least one author affiliated with an organisation in another ASEAN country. Figure 71 shows the involvement of the different ASEAN countries in co-publications with Thailand. The strongest collaboration partner – in terms of the number of joint co-publications – in the ASEAN region is Malaysia with ~1.9k co-publications. The second strongest partner is Singapore with ~1.3k, and the third strongest partners are Vietnam and Indonesia, each with ~1k joint co-publications.

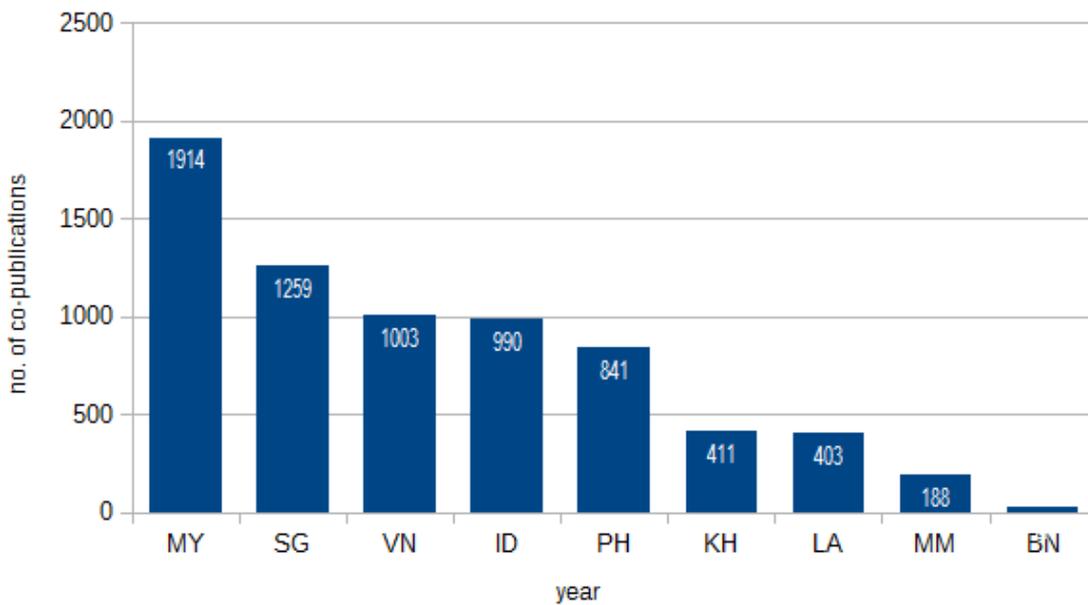


Figure 71: Thailand's co-publications with ASEAN countries, 2004-2014

Looking at the development over time of Thailand's co-publications with its five strongest collaboration partners from the ASEAN region (see Figure 72) it is visible that the co-publications all started at a similar point (around 40 co-publications). The ones involving Malaysian authors are growing particularly fast (~330 in 2014 vs. 35 in 2004). Thailand's annual co-publication output with Singapore grew rather steadily from 2004 to 2010, and then shows a boost until 2012 and stagnation after that. A similar development can be observed for the collaboration with Indonesia and the Philippines. Co-publications with Vietnam show somewhat more dynamic; it remains to be seen, whether the current patterns turn into a trend.

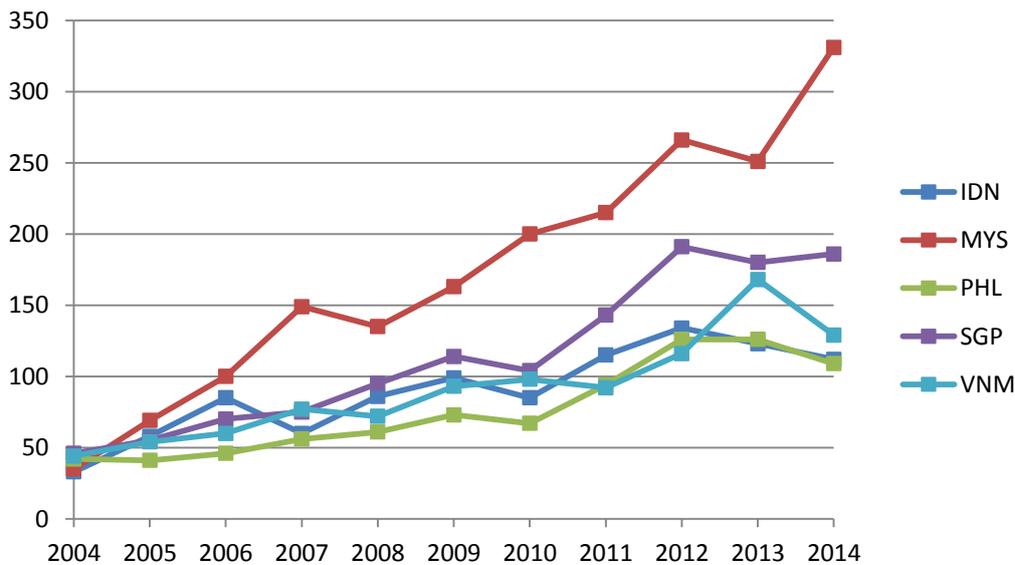


Figure 72: Thailand's co-publications with the five strongest ASEAN collaboration countries and their development over time, 2004-2014

The three SM research fields with the most co-publication output for Thailand and Malaysia are Clinical Medicine (~500), Chemistry (460), and Biomedical Research (~160), for Thailand and Singapore Clinical Medicine (~550), Biomedical Research (~190), and Engineering (65), for Thailand and Vietnam Clinical Medicine (~240), Biomedical Research (~210), and Biology (~80), for Thailand and Indonesia Clinical Medicine (~440), Biomedical Research (~160), Biology (~60), and for Thailand and the Philippines Clinical Medicine (~330), Biomedical Research (~140), Biology (70). The shares of those research fields with the three most prominent countries can be found in the figures below (Figure 73 - Figure 75).

Clinical Medicine is the SM research field with the most co-publications in all five cases, the other SM research fields do not vary much either – Biomedical Research is involved in all of them, Biology in three cases (Thailand-Vietnam, Thailand-Indonesia, Thailand-Philippines), and Chemistry and Engineering each in one case (Thailand-Malaysia and Thailand-Singapore, respectively).

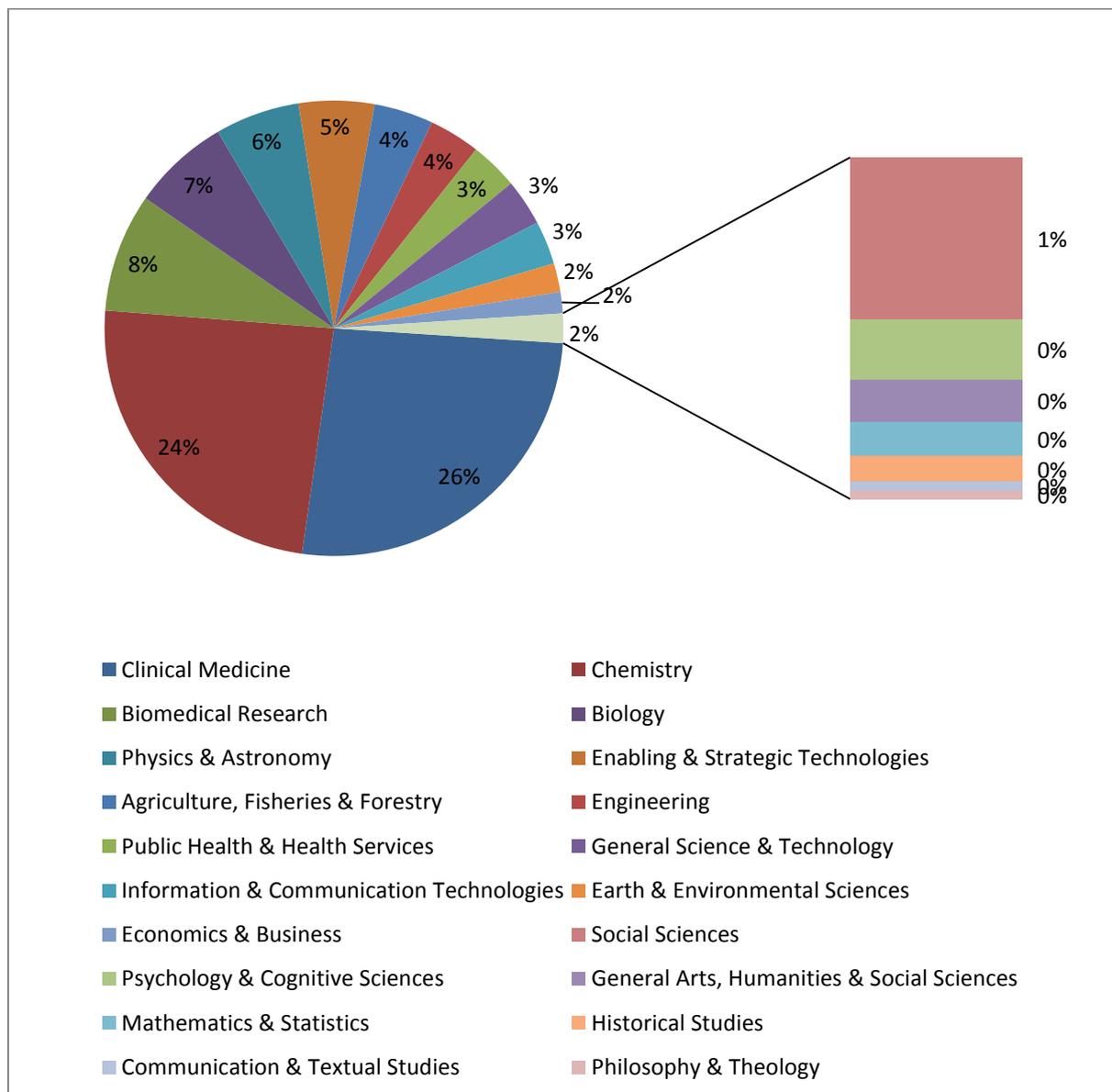


Figure 73: SM research fields of Thailand-Malaysia co-publications; 2004-2014

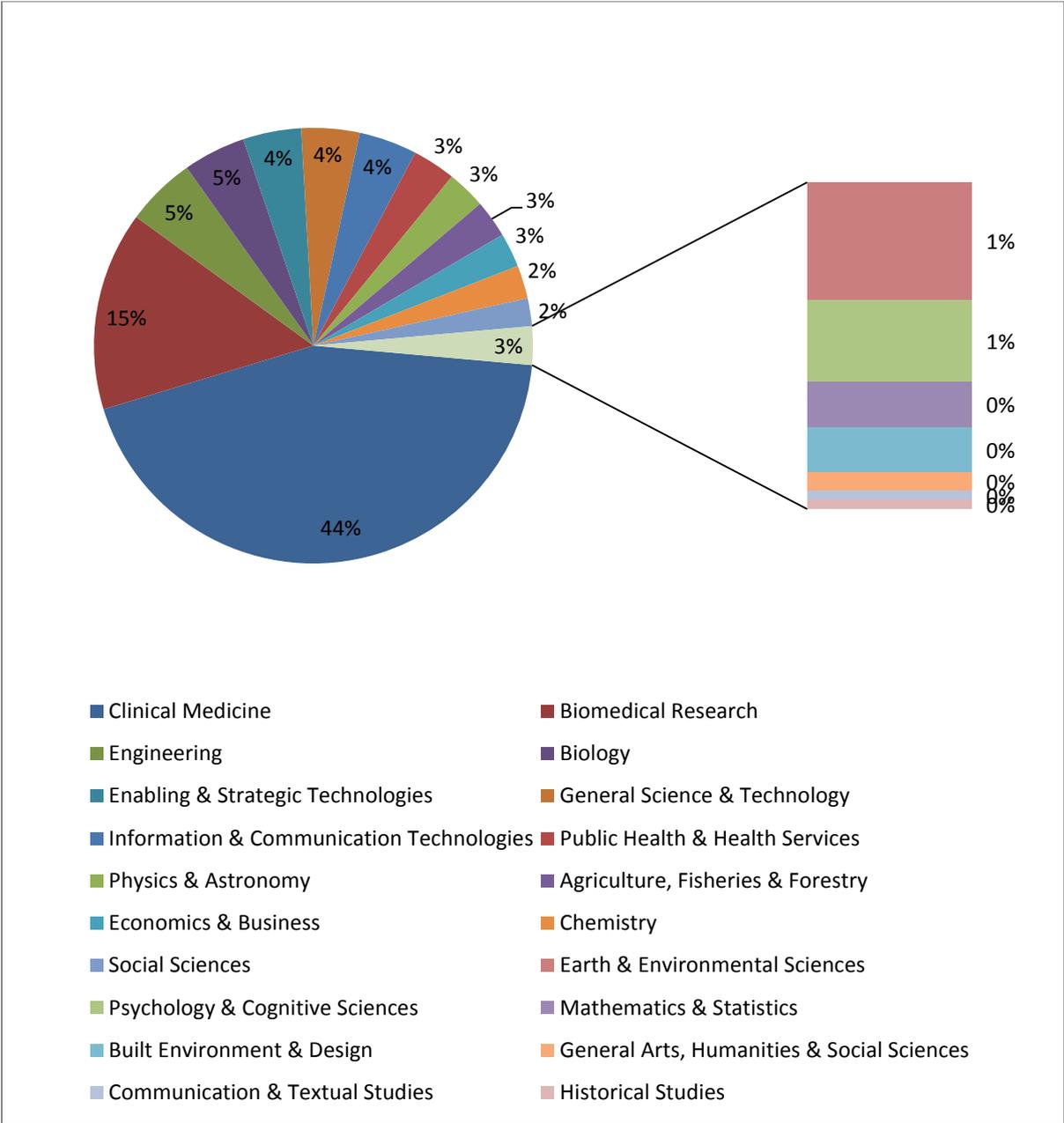


Figure 74: SM research fields of Thailand-Singapore co-publications; 2004-2014

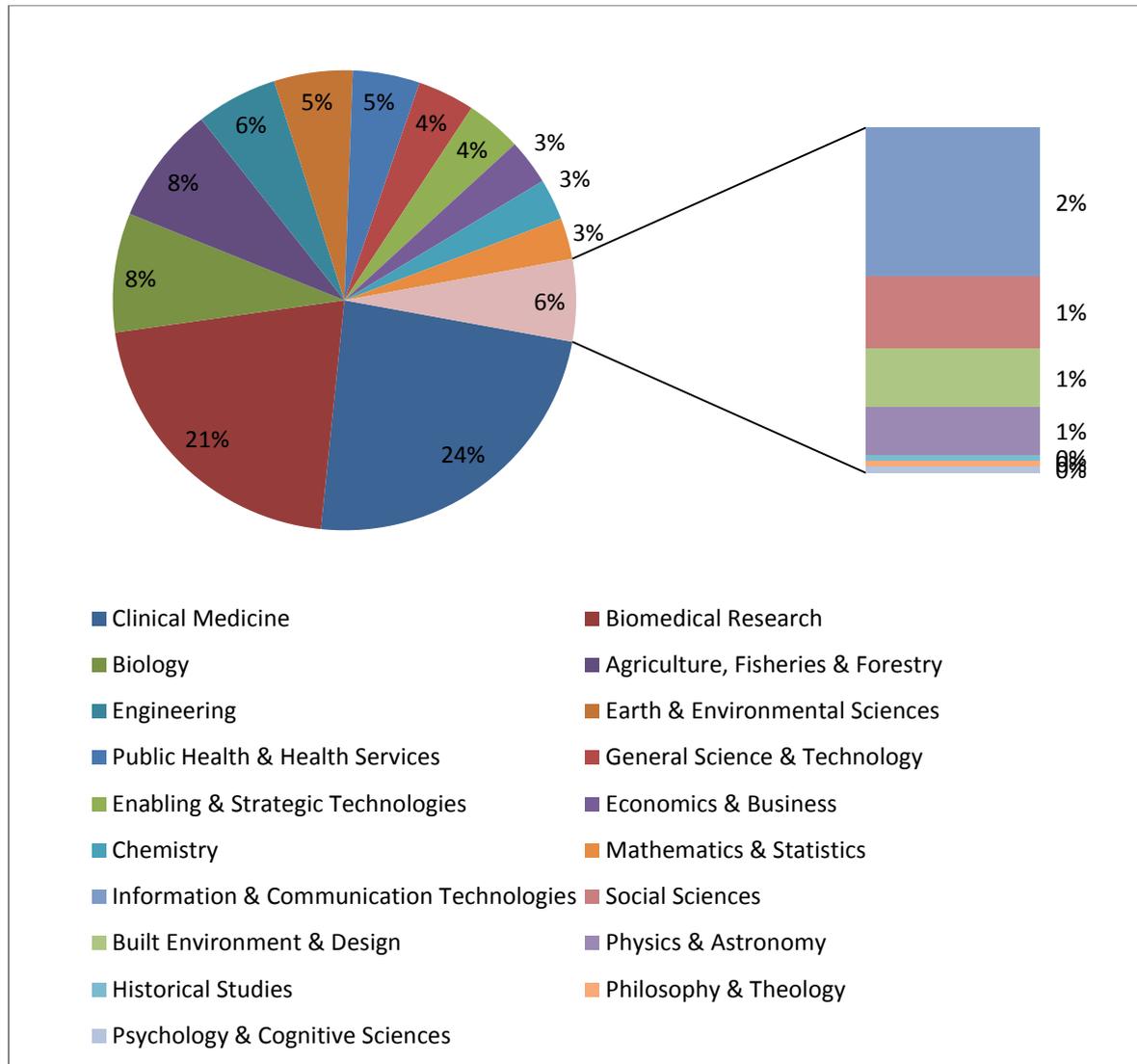


Figure 75: SM research fields of Thailand-Vietnam co-publications; 2004-2014

### Collaboration linkages – with the EU28/AC countries in detail

In total, Thailand has ~15k co-publications that involve at least one author affiliated in one of the EU member states (incl. countries associated to the EU Framework Programmes). Figure 76 shows the involvement of the top 10 EU countries in terms of their involvement in co-publications with Thailand. The strongest collaboration partner for Thailand in the EU region is Great Britain with ~5.8k joint co-publications, followed by France and Germany with ~2.9k each, the Netherlands (~1.5k), Switzerland (~1.4k), and Italy (~1.2k).

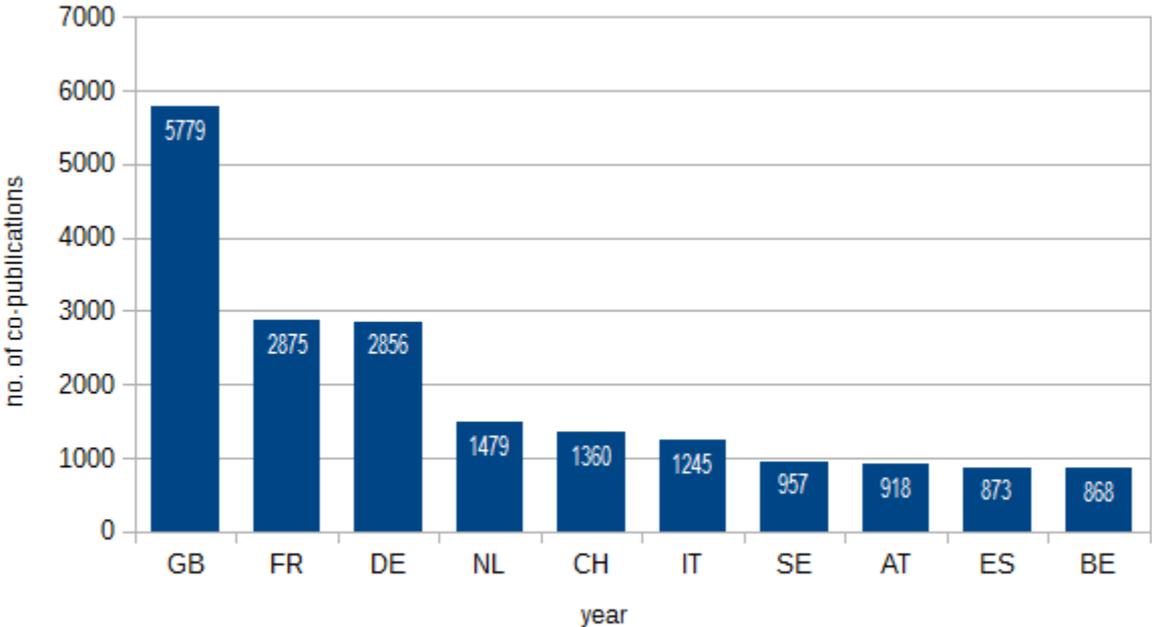


Figure 76: Thailand's co-publications with EU28/AC countries, 2004-2014

Examining more closely the development over time (see Figure 77 and Figure 78) of Thai co-publications with its ten strongest collaboration partners from the EU region reveals that the co-publications involving authors affiliated with organisations in Great Britain have started at a much higher level than the co-publications with the other EU countries. Even France and Germany have started at about a third of the TH-GB co-publications. Nevertheless, the Thailand-Great Britain co-publications seem to grow steadily – from 2004 to 2014, the amount of co-publication has nearly tripled. The amount of Thailand-France and Thailand-Germany co-publications have grown nearly four times (3.8 and 4.2 times, respectively), again, starting at a lower level. The development is harder to compare for the other EU countries as their starting level is yet lower (between ~30 to ~60 co-publications in 2004). Consequently, their potential for growth is higher: ES and IT each ~8 times, BE ~6 times, CH ~5 times, Austria, the Netherlands , and Sweden each about 4 times.

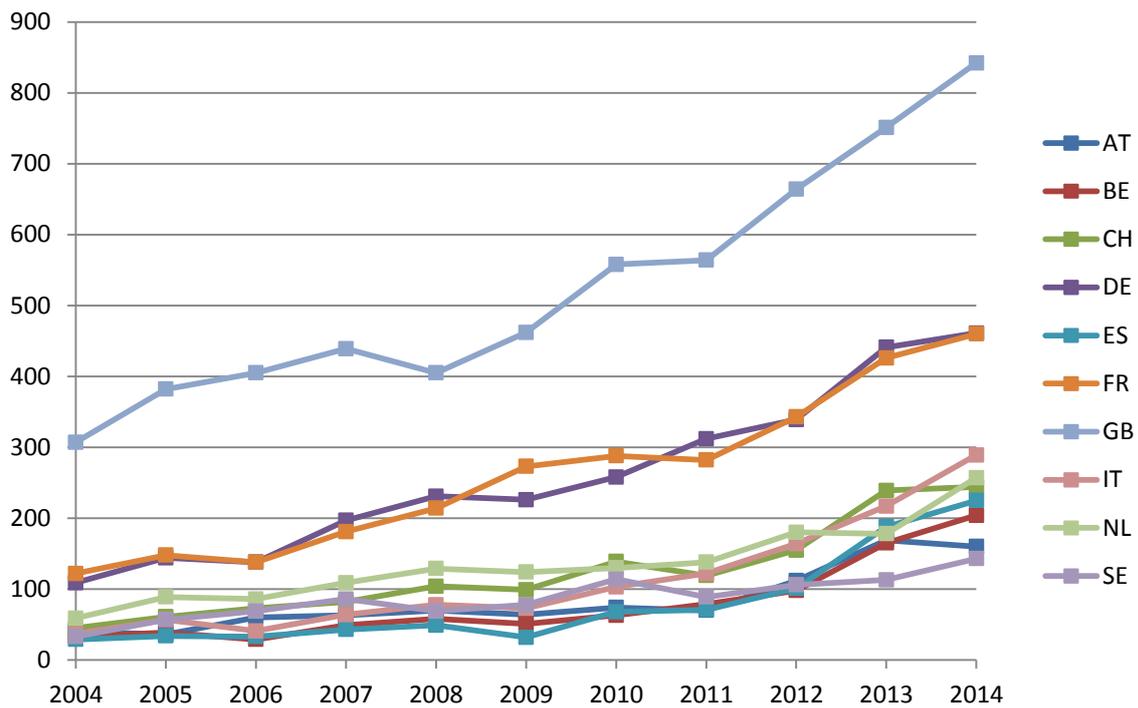


Figure 77: Thailand's co-publications with the ten strongest EU28/AC collaboration partner countries and their development over time, 2004-2014

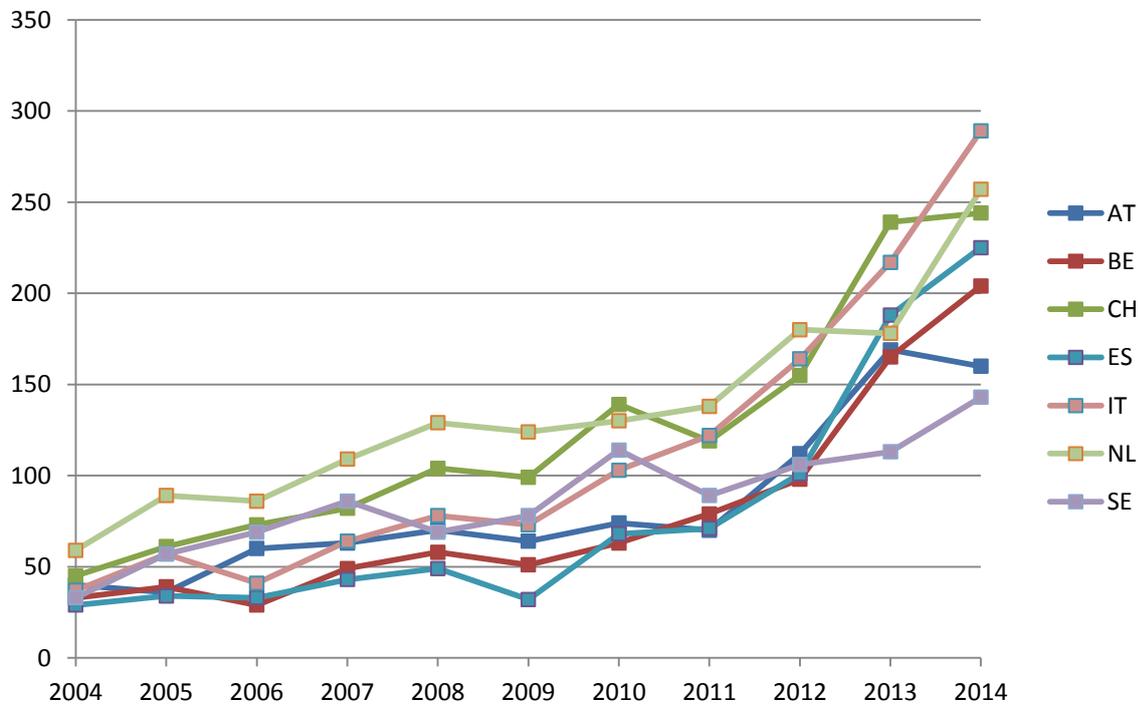


Figure 78: Thailand's co-publications with the ten strongest EU28/AC collaboration partner countries and their development over time, 2004-2014 – line chart without GB, FR, and DE to make visible the development of other EU partner countries

The three figures below (Figure 79, Figure 80, and Figure 81) show the overall distribution of SM research fields for Thailand’s co-publications with Great Britain, France, and Germany in detail. The top three fields for Thailand-Great Britain as well as Thailand-France are Clinical Medicine (30% and 25%, respectively), Biomedical Research (17%), and Physics & Astronomy (7% and 11%, respectively), for Thailand-Germany they are the same (Clinical Medicine at the top with a share of 26%) but Physics & Astronomy (15%) and Biomedical Research (12%) have their place reversed.

Clinical Medicine is the SM research field with the most co-publications in the top 10 EU collaboration countries, with the exception of Austria and Spain where the top field – in terms of number of co-publications – is Physics & Astronomy (Austria: ~250 vs. ~190 in Clinical Medicine; Spain: ~270 vs. ~220 in Clinical Medicine). Biomedical Research is typically among the top three fields as well (Switzerland, Italy, Sweden, Spain, Belgium), Physics & Astronomy in the case of Switzerland, Italy, Sweden, Austria, Spain, and Belgium, Agriculture, Fisheries & Forestry in only once instance (the Netherlands), as is Chemistry (Austria).

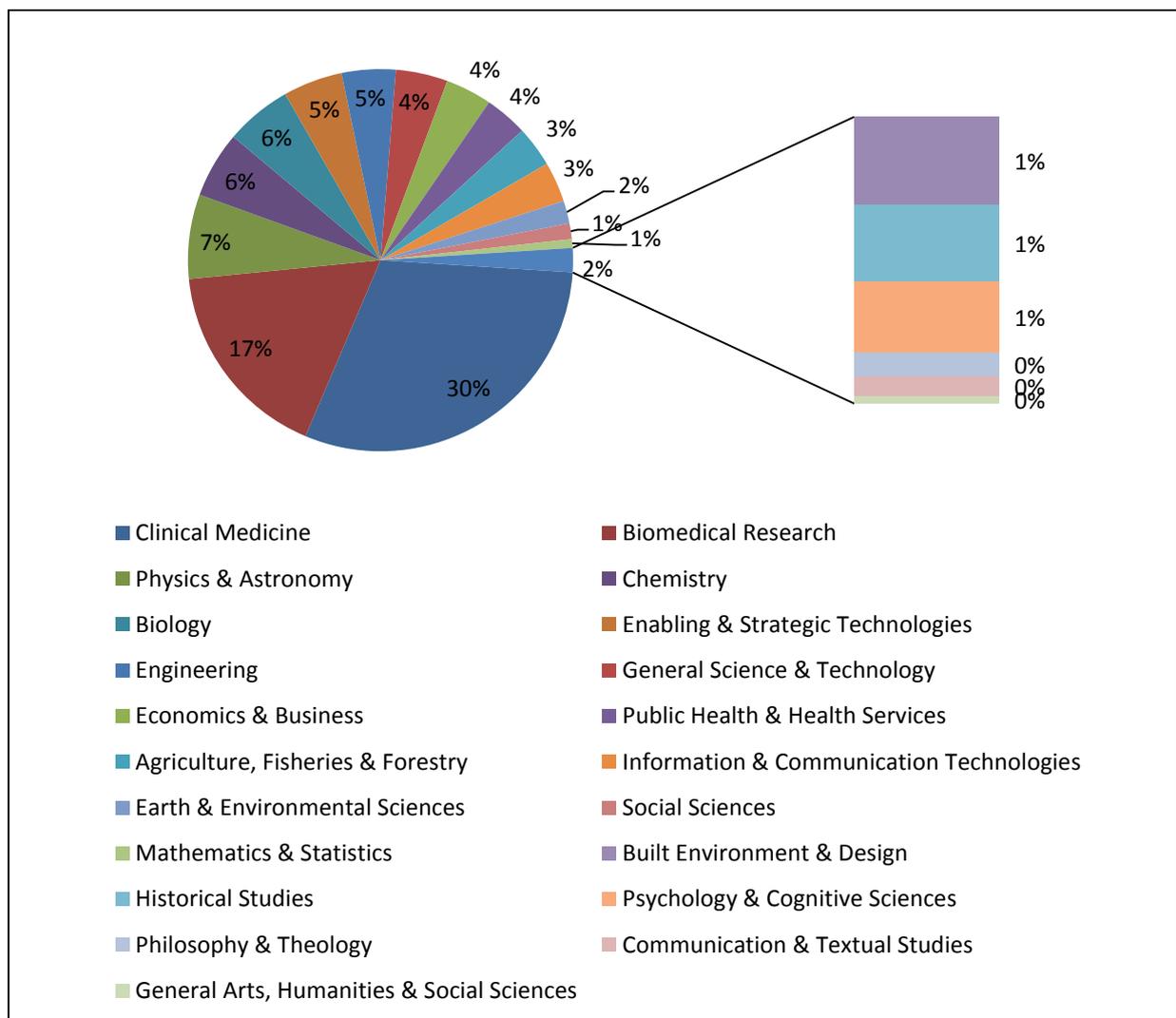


Figure 79: SM research fields of Thailand-Great Britain co-publications from 2004-2014

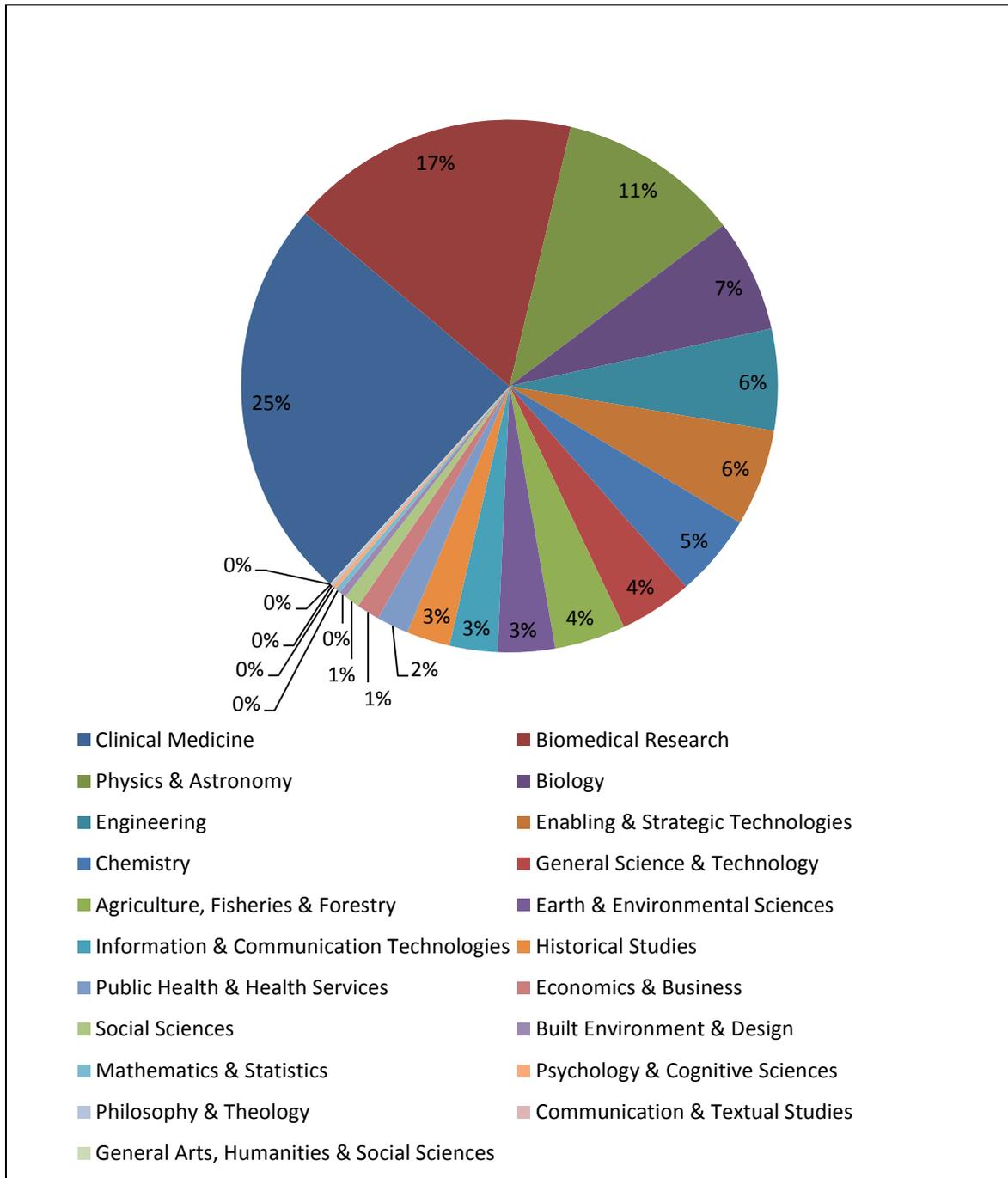


Figure 80: SM research fields of Thailand-France co-publications from 2004-2014

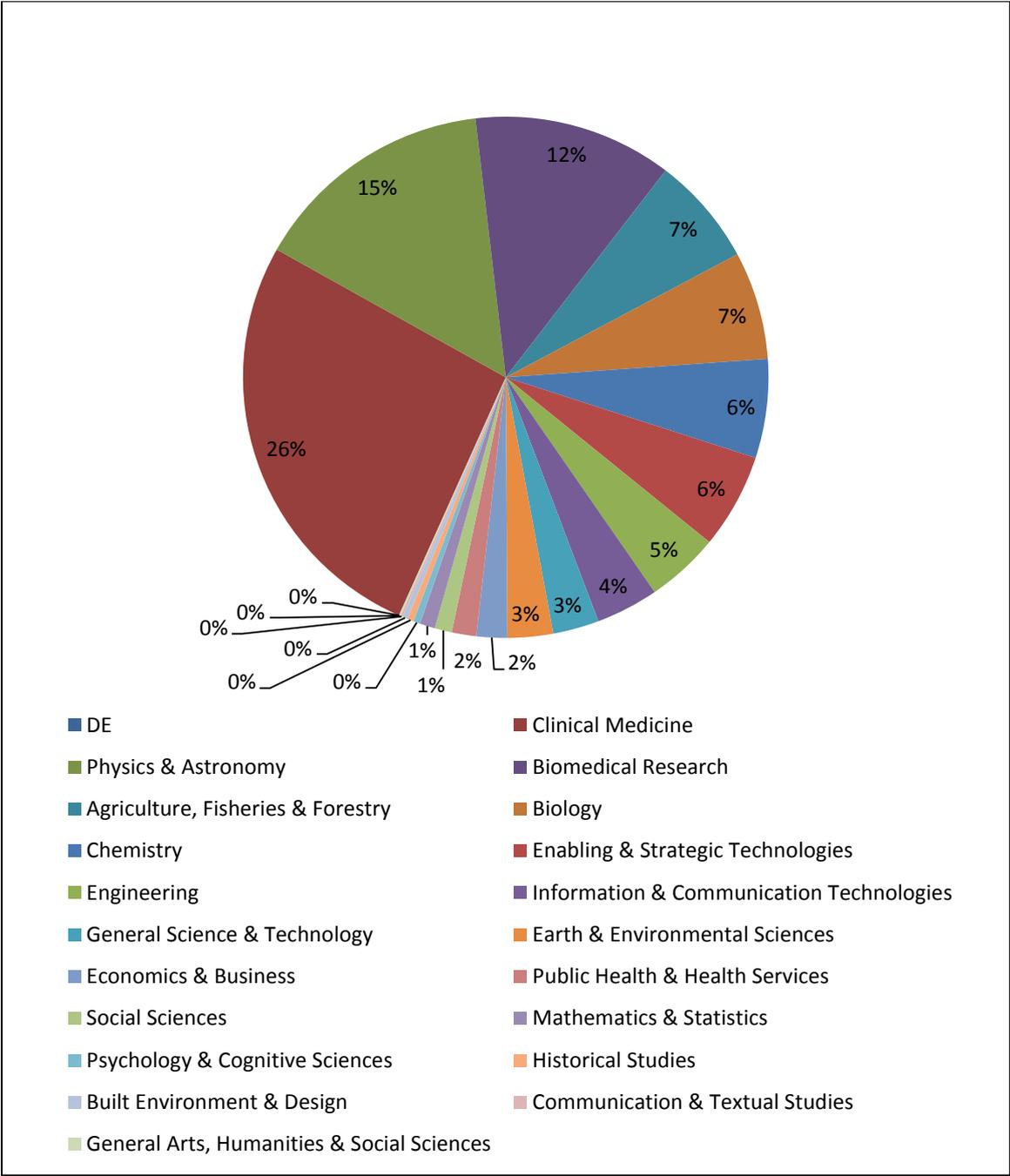


Figure 81: SM research fields of Thailand-Germany co-publications from 2004-2014

**Impact Analysis**

Within the 11 years period from 2004 to 2014, Thai publications were cited on average about 5.6 times. Co-publications involving Thailand were cited more often, i.e. ~9.6 times on average. Those involving Thailand and an ASEAN country or TH and an EU country were cited higher yet, i.e. on average 13.92 and 13.51 times, respectively.

The next section provides a more detailed look into the research topics.

***Overview of average citations per SM research field: Comparison of Singapore's publications, co-publications, co-publications with ASEAN and with EU28/AC***

Thailand's co-publications with ASEAN countries have a higher impact – relative to its overall international co-publications as well as its co-publications with the EU – in Biomedical Research, Clinical Medicine, Earth & Environmental Sciences, General Arts, Humanities & Social Sciences, Historical Studies, Mathematics & Statistics, and Psychology & Cognitive Sciences (see Table 12). In those cases where the impact is higher than that of the co-publications with the EU28/AC, it is only marginally so. That being said, the impact is noticeably higher compared to the overall co-publications in Clinical Medicine. Thai co-publications with the EU28/AC are more often cited on average in the fields Agriculture, Fisheries & Forestry, Biology, Chemistry, Economics & Business, Enabling & Strategic Technologies, Engineering, General Science & Technology (noticeably higher than the overall co-publications), ICT (co-equal with the overall co-publications), Physics & Astronomy, and Public Health & Health Services.

There are a few cases where the impact of the overall co-publications is higher than that of the Thailand-ASEAN co-publications as well as Thailand-EU28/AC co-publications. Those imply that the publication collaboration with countries other than ASEAN or EU28/AC member states is more impactful in the respective fields, if only slightly so. Those are Built Environment & Design, Communication & Textual Studies, Philosophy & Theology, Social Sciences, and Visual & Performing Arts, all of which are smaller fields with a limited number of records.

	TH publications	TH co-publications	TH-ASEAN co-publications	TH-EU co-publications
Agriculture, Fisheries & Forestry	5.28	6.89	6.01	<b>7.55</b>
Biology	3.75	6.38	7.03	<b>9.1</b>
Biomedical Research	10.84	13.66	<b>17.37</b>	16.04
Built Environment & Design	6.29	<b>6.75</b>	6	4.24
Chemistry	8.09	8.92	4.69	<b>10.08</b>
Clinical Medicine	7.43	13.61	<b>24.02</b>	20.9
Communication & Textual Studies	1.74	<b>2.93</b>	0.55	0.82
Earth & Environmental Sciences	5.44	6.57	<b>9.19</b>	7.81
Economics & Business	2.43	4.04	4.15	<b>4.31</b>
Enabling & Strategic Technologies	4.56	7.21	5.73	<b>8.24</b>
Engineering	2.96	5.48	5.4	<b>5.67</b>
General Arts, Humanities & Social Sciences	0.75	1.35	<b>2.44</b>	0.55
General Science & Technology	11.73	25.85	35.75	<b>44.66</b>
Historical Studies	4.21	5.21	<b>9.56</b>	6.39
Information & Communication Technologies (ICT)	1.58	<b>3.66</b>	2.02	<b>3.66</b>
Mathematics & Statistics	3.15	4.3	<b>5.05</b>	4.6
Philosophy & Theology	2.01	<b>2.67</b>	1.8	1.84
Physics & Astronomy	5.63	7.83	2.86	<b>8.71</b>
Psychology & Cognitive Sciences	5.37	7.43	<b>9.84</b>	8

Public Health & Health Services	5.26	7.46	8.36	<b>10.6</b>
Social Sciences	1.22	<b>2.71</b>	1.94	2.17
Visual & Performing Arts	0.29	<b>0.83</b>	#N/A	#N/A

Table 12: Overview of average citations of different SM research fields: Thailand publications, overall co-publications, co-publications with ASEAN countries, and co-publications EU28/AC countries; figures in bold mark the comparatively highest average citation count

### Impact of SM research fields of Thailand's co-publications with ASEAN countries

The Table 13 shows an overview of the impact of co-publications with ASEAN countries. In the underlying analysis, we have cut off research fields with an amount of recorded co-publications of less than 20. Green table cells indicate the impact is 50 % or higher than the impact of the TH overall co-publications, red cells indicate the impact is at least 50 % below. The more impactful research fields (relative to the overall TH co-publications) are Biology (MY, PH, KH), Biomedical Research (Singapore, Vietnam, Myanmar), Clinical Medicine (Singapore, Vietnam, Philippines, Cambodia, Myanmar), Earth & Environmental Sciences (Malaysia, Indonesia, Philippines), Enabling & Strategic Technologies (Philippines), Engineering (Singapore), General Science & Technology (Singapore, Vietnam, Indonesia, Philippines), and Public Health & Health Services (Vietnam, Philippines). Of notably low impact is General Science & Technology with Lao PDR. The other red cells are cases where the Thai overall impact is low already.

	MY	SG	VN	ID	PH	KH	LA	MM
<b>Agriculture, Fisheries &amp; Forestry</b>	5.42	9.6	5.7	6.23	10.29	1.38	6.93	3.26
<b>Biology</b>	9.75	5.33	8.83	8.02	10.54	10.49	6.84	3.72
<b>Biomedical Research</b>	15.26	24.16	21.67	16.12	14.23	17.23	15.86	29.33
<b>Built Environment &amp; Design</b>	#N/A	6.8	9.11	4	0.71	2	#N/A	#N/A
<b>Chemistry</b>	3.71	9.55	5.33	5.17	10.91	12	27.6	#N/A
<b>Clinical Medicine</b>	17.67	33.93	27.88	17.52	30.7	33.61	11.16	31.22
<b>Communication &amp; Textual Studies</b>	1.1	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
<b>Earth &amp; Environmental Sciences</b>	11.57	6.08	8.7	13.36	14.78	13.13	3	10.25
<b>Economics &amp; Business</b>	2.97	5.09	4.98	4.74	3.47	0	2	49
<b>Enabling &amp; Strategic Technologies</b>	3.26	9.67	2.85	3.79	11.32	5.69	3.73	5.1
<b>Engineering</b>	3.22	11.35	7.52	2.03	2.7	2.5	1.64	0
<b>General Arts, Humanities &amp; Social Sciences</b>	4.2	0	#N/A	#N/A	0.5	#N/A	#N/A	#N/A
<b>General Science &amp; Technology</b>	14.55	41.75	44.66	51.46	90.53	21.59	11.81	9.2
<b>Historical Studies</b>	12.47	8	5	23.17	2.5	1	1	6.65
<b>Information &amp; Communication Technologies</b>	2.08	2.93	1.24	2.29	1.5	2.8	0.5	#N/A
<b>Mathematics &amp; Statistics</b>	6.5	0.8	5.83	0	3	#N/A	#N/A	#N/A
<b>Philosophy &amp; Theology</b>	3	#N/A	0	3	#N/A	1.5	#N/A	#N/A
<b>Physics &amp; Astronomy</b>	2.4	4.06	1.39	1	0	3	34	#N/A
<b>Psychology &amp; Cognitive Sciences</b>	8.13	10.5	1.1	8.34	2.4	23.8	1.75	8
<b>Public Health &amp; Health</b>	5.3	8.9	17.86	5.55	19.72	5.23	6.73	1.03

Services									
Social Sciences	1.74	1.43	2.75	2.33	2.83	1.67	3.43	0	

Table 13: Impact of Thailand's co-publications per SM research field with Malaysia, Singapore, Vietnam, Indonesia, the Philippines, Cambodia, Laos, and Myanmar (only SM fields with at least 20 co-publications during the entire period of 2004-2014 are considered). Green table cells indicate the impact is 50 % or higher than the impact of the TH overall co-publications, red cells indicate the impact is at least 50 % below.

*Impact of SM research fields of Thailand's co-publications with EU28/AC countries*

Analogous to the table above with the ASEAN countries, the Table 14 shows the impact of the co-publications with the EU relative to the Thai overall co-publications (green = at least 50 % higher impact, red = at least 50 % lower impact). A relatively high impact has been noted for Agriculture, Fisheries & Forestry (Switzerland, Italy), Biology (Great Britain, France, Switzerland, Sweden, Austria), Biomedical Research (Netherlands, Italy, Austria, Spain, Belgium), Chemistry (Switzerland), Clinical Medicine (all but Austria), Earth & Environmental Sciences (Germany), Economics & Business (Switzerland), Enabling & Strategic Technologies (Netherlands, Switzerland, Sweden, Spain), General Science & Technology (all but Germany and Austria), Mathematics & Statistics (Great Britain), Physics & Astronomy (Switzerland, Italy, Austria, Spain, Belgium), Public Health & Health Services (Great Britain, France, Netherlands), and Social Sciences (France).

	GB	FR	DE	NL	CH	IT	SE	AT	ES	BE
Agriculture, Fisheries & Forestry	7.42	5.36	7.86	9	12.58	12.58	8.15	6.7	6.92	9.61
Biology	11.27	12.02	8.26	7.59	13.79	7.86	45.41	11.63	7.92	8.21
Biomedical Research	19.26	18.77	17.1	24.58	20.34	23.63	20.15	20.89	26.43	29.2
Built Environment & Design	3.65	8.5	7.56	1	3	7.67	#N/A	0	2	0
Chemistry	13	6.45	7.92	9.21	17.22	9.65	11.97	8.21	10.4	7.38
Clinical Medicine	28.26	27.51	24.98	37.19	33.91	37.01	29.26	14.72	41.5	31.06
Communication & Textual Studies	0.79	2.2	1.33	1.65	#N/A	#N/A	#N/A	#N/A	#N/A	1.1
Earth & Environmental Sciences	8.2	7.27	10.25	8.2	6.36	5.85	6.89	9.23	14	3
Economics & Business	3.58	2.05	5.27	5.37	6.95	1.15	3.61	20.37	2.88	0.29
Enabling & Strategic Technologies	8.24	9.46	7.69	12.77	13.36	5.47	11.82	6.78	12.7	18.4
Engineering	6.21	7	3.86	5.87	5.96	2.79	3	3.97	1	5.94
General Arts, Humanities & Social Sciences	0	0	0	2	0	#N/A	2	#N/A	#N/A	#N/A
General Science & Technology	68.91	51.23	38.61	52.27	39.44	43.41	50.78	37.84	84.8	47.59
Historical Studies	5.07	5.8	14.35	7.28	3.17	10	3.5	0.67	#N/A	20
Information & Communication Technologies	4.64	1.52	1.66	2.38	4.78	4.41	0.8	0.07	3.3	21.31
Mathematics & Statistics	7.43	1.89	4.14	3.5	0	6.26	16.67	0	3.88	0.5
Philosophy & Theology	1.94	0.5	0	3	7.5	2	#N/A	#N/A	#N/A	#N/A
Physics & Astronomy	10.25	11.23	10.25	9.32	13.1	12.92	4.79	12.4	13.15	13.11
Psychology & Cognitive Sciences	8.15	5.7	5.83	4.67	17.68	16.69	26.8	#N/A	4.25	4.25
Public Health & Health	12.7	19.9	10.47	14.63	9.91	6.8	7.61	6.86	18.89	8.22

<b>Services</b>										
<b>Social Sciences</b>	2.79	4.3	3.25	4.41	1.3	1.37	8.25	2.14	1.82	1.1

Table 14: Impact of Thailand's co-publications per SM research field with EU28/AC (only SM fields with at least 20 co-publications during the entire period of 2004-2014 are considered). Green table cells indicate the impact is 50 % or higher than the impact of the TH overall co-publications, red cells indicate the impact is at least 50 % below.

### 6.5 Indonesia, the Philippines, Vietnam

#### Output over time

Between 2004 and 2014, authors affiliated in Indonesia have published overall 34,985 scientific publications (indexed in either Scopus or Web of Science), authors affiliated in the Philippines overall 20,343 scientific publications and authors affiliated in Vietnam overall 28,210 scientific publication.

An average Indonesian publication involves 4.46 authors from 1.91 different countries and is cited 4.13 times, an average Philippine publication involves 5.12 authors from 2.24 different countries and is cited 6.68 times and an average Vietnamese publication involves 9.56 authors from 2.2 different countries and is cited 5.54 times.

Out of the 34,985 Indonesian publications, 18,173 publications are (international) co-publications, that is, they include at least two authors – one affiliated at an institution in Indonesia and one affiliated at an institution in another country. Around 51.9% of Indonesia’s scientific publications from 2004 to 2014 are international co-publications. Out of the 20,343 Philippine publications 11,129 publications are (international) co-publications, i.e. 54.7% of all Philippine’s scientific publications from 2004 to 2014 are international co-publications. Out of the 28,210 Vietnamese publications 18,740 publications are (international) co-publications, i.e. 66.4% of all Vietnamese scientific publications from 2004 to 2014 are international co-publications.

4,550 of all 18,173 Indonesian co-publications include at least one author from Indonesia and one from another ASEAN country, and 6,048 of these 18,173 Indonesian co-publications include at least one author from Indonesia and one from an EU28/AC country. For the Philippines overall 11,129 international co-publications 2,377 involve at least one author from the Philippines and one from another ASEAN country and 3,746 involve at least one author from the Philippines and one from an EU28/AC country. Out of the 18,173 Vietnamese international co-publications, 2,255 include at least one author from Vietnam and one from another ASEAN country, and 8,468 at least one author from Vietnam and one from an EU28/AC country.

Figure 82 to Figure 84 show the development of Indonesia’s, Vietnam’s and the Philippines’ annual publication output from 2004 to 2014. While the annual output of Indonesia in 2014 is more than six times as high as in 2004, and the annual output of Vietnam’s publications in 2014 is also almost six times as high as in 2004, the development of annual publication output of the Philippines is growing slower – the annual output not even triples from 2004 to 2014-

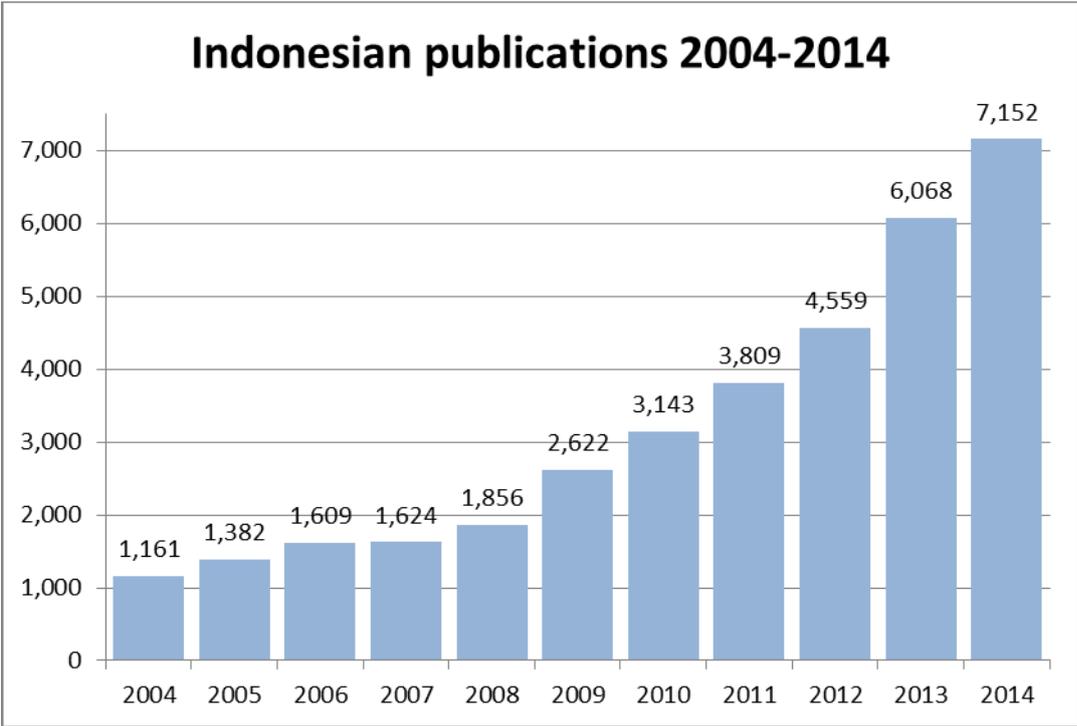


Figure 82: Indonesia's publication output, 2004-2014

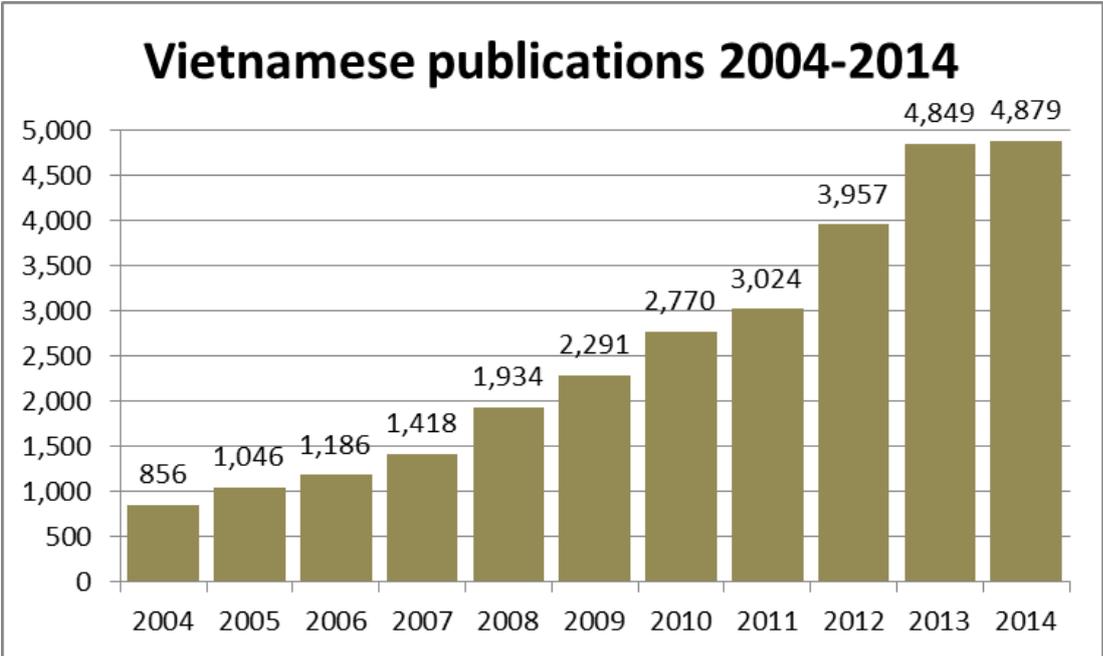


Figure 83: Vietnam's publication output, 2004-2014

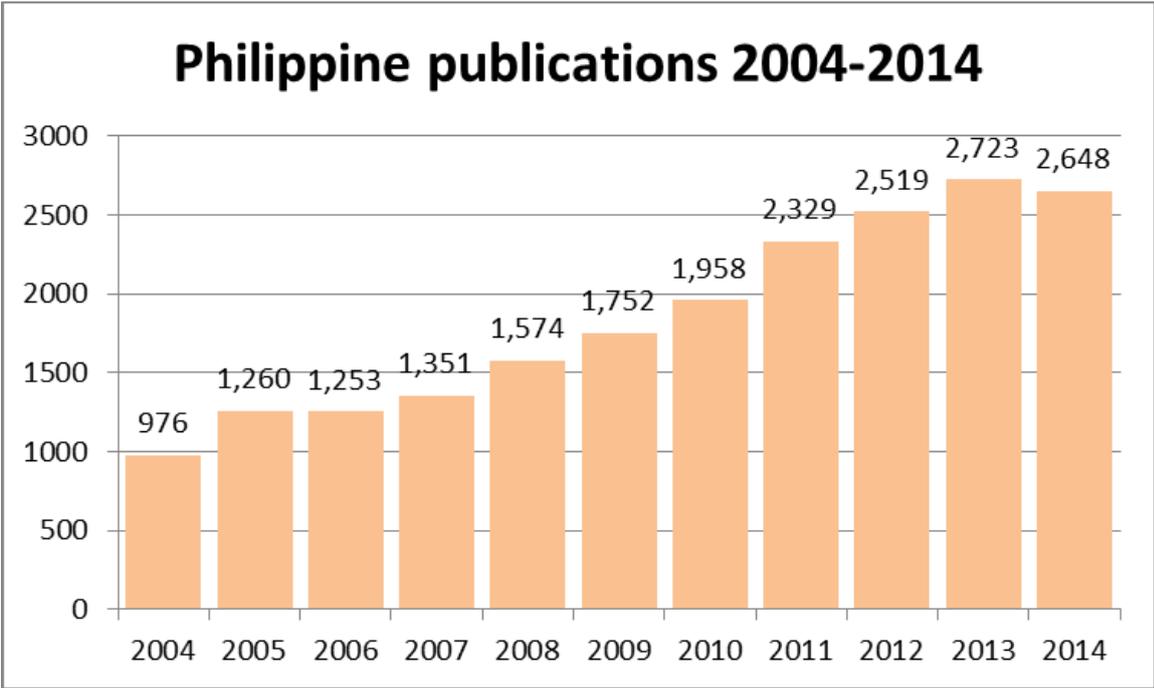


Figure 84: Philippines' publication output, 2004-2014

Compared to the development of Indonesia’s annual co-publication output in the same time frame, the annual Indonesian publication output growth is much higher and especially in the last years (2012 to 2014) the overall annual publication output of Indonesia is growing rapidly whereas for the Indonesian co-publications the growth is rather steady since 2009 and in the years before much smaller. The annual Indonesian publication as well as the co-publication output increases within the period 2004-2014. But whereas the annual Indonesian publication output in 2014 is more than six times as high as in 2004, the annual Indonesian co-publication output only more than triples from 2004, 840 co-publications, to 2014, 2,806 co-publications (cf. Figure 82 and Figure 85).

The development of Vietnam’s annual co-publication output from 2004 to 2014 is quite similar to the development of Vietnam’s annual publication output in the same time frame – both have an (co-) publication output more than five times as high in 2014 as in 2004 (cf. Figure 83 and Figure 86).

The situation for the development of the annual publication and co-publication output for the Philippines is quite similar to that of Vietnam – both develop nearly on the same pace. But whereas the annual (co-)publication output of Vietnam more than quintuples, the annual publication and co-publication output of the Philippines not even triples from 2004 to 2014 (cf. Figure 84 and Figure 87).

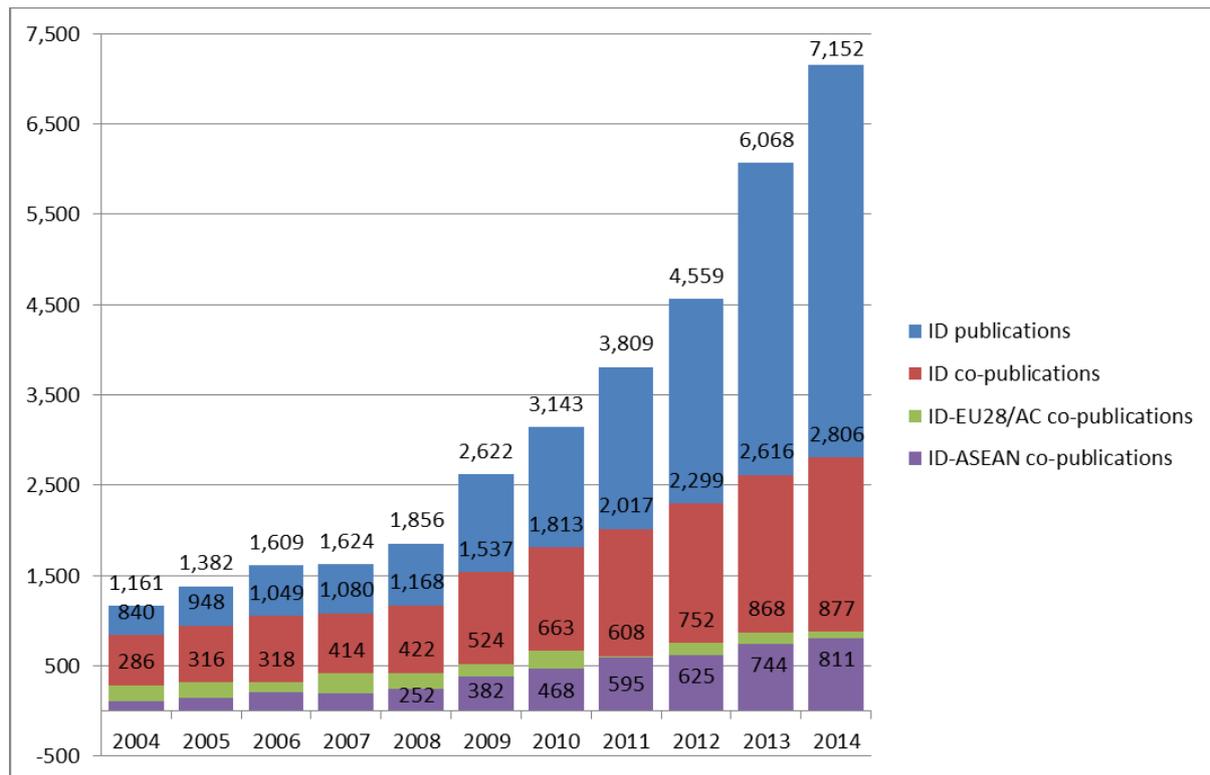


Figure 85: Indonesia's (co-)publication output 2004-2014, – overlay view, i.e. the bars are not stacked but placed “behind” each other (all start from 0)

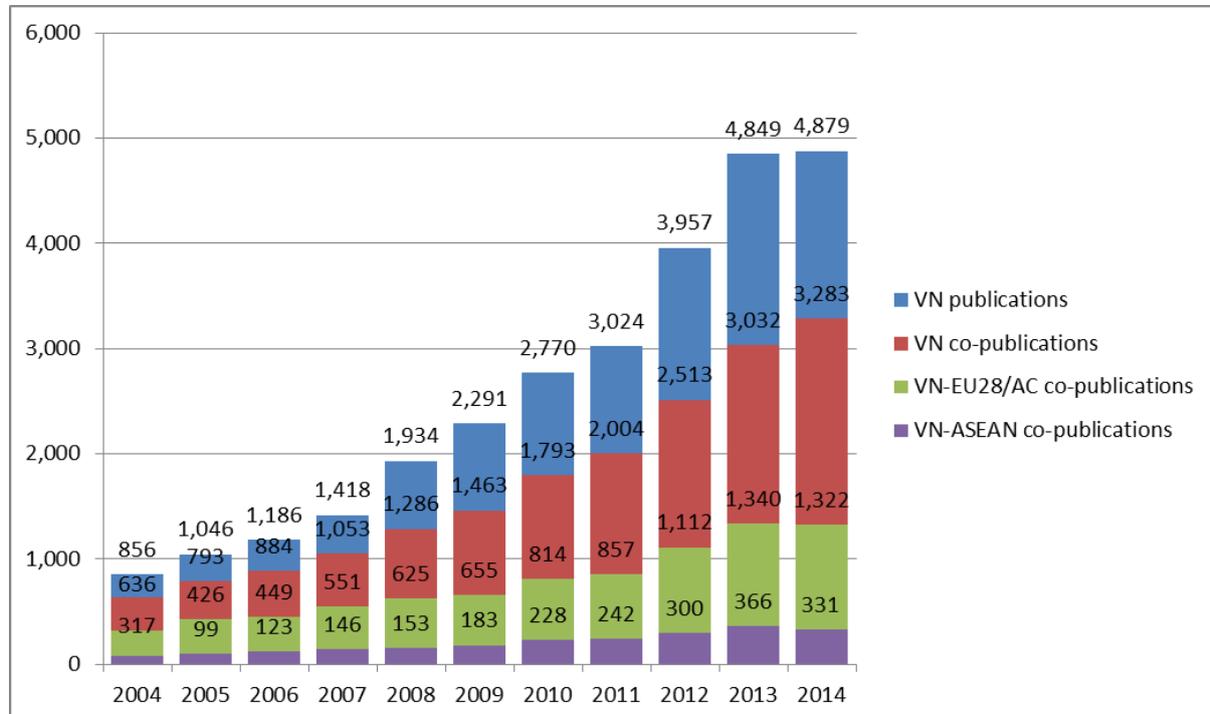


Figure 86: Vietnam's (co-)publication output, 2004-2014, – overlay view, i.e. the bars are not stacked but placed “behind” each other (all start from 0)

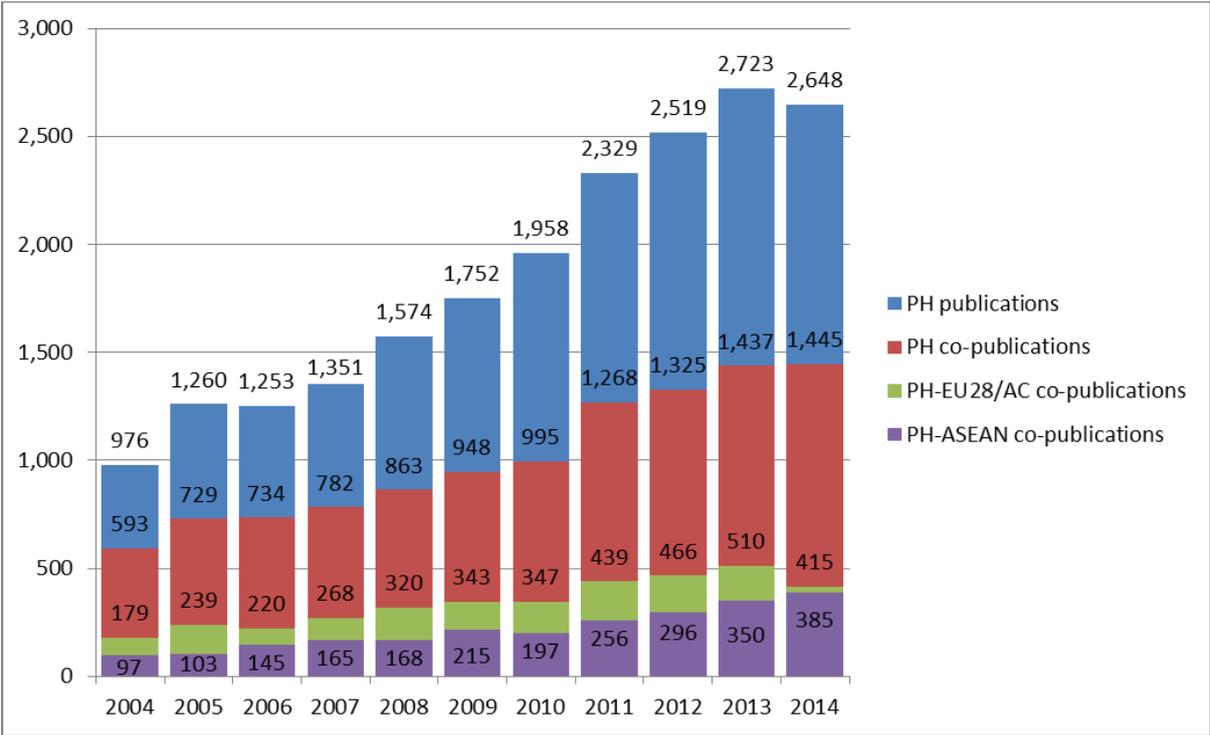


Figure 87: The Philippines' (co-)publication output, 2004-2014 – overlay view, i.e. the bars are not stacked but placed “behind” each other (all start from 0)

Figure 88, Figure 89 and Figure 90 show the annual growth (always compared to the numbers of the year 2004 which are set to 100%) of Indonesia’s, Vietnam’s and the Philippines’ overall publications, co-publications, co-publications with the EU28/AC and co-publications with other ASEAN countries. It is visible that the Indonesian and Philippine co-publications with ASEAN countries are growing much faster than the overall Indonesian/Philippine publications and co-publications. For Indonesia the overall publications are growing faster than the Indonesian overall co-publications and co-publications involving at least one author from Indonesia and one affiliated in an EU28/AC country. For the Philippines the growth development of overall publications, overall co-publications and co-publications with EU28/AC are quite similar. The development of the Vietnamese overall publications, co-publications as well as the co-publications with ASEAN countries and countries of EU28/AC is very similar as well – the overall publication output is only slightly growing faster than the Vietnamese overall co-publications.

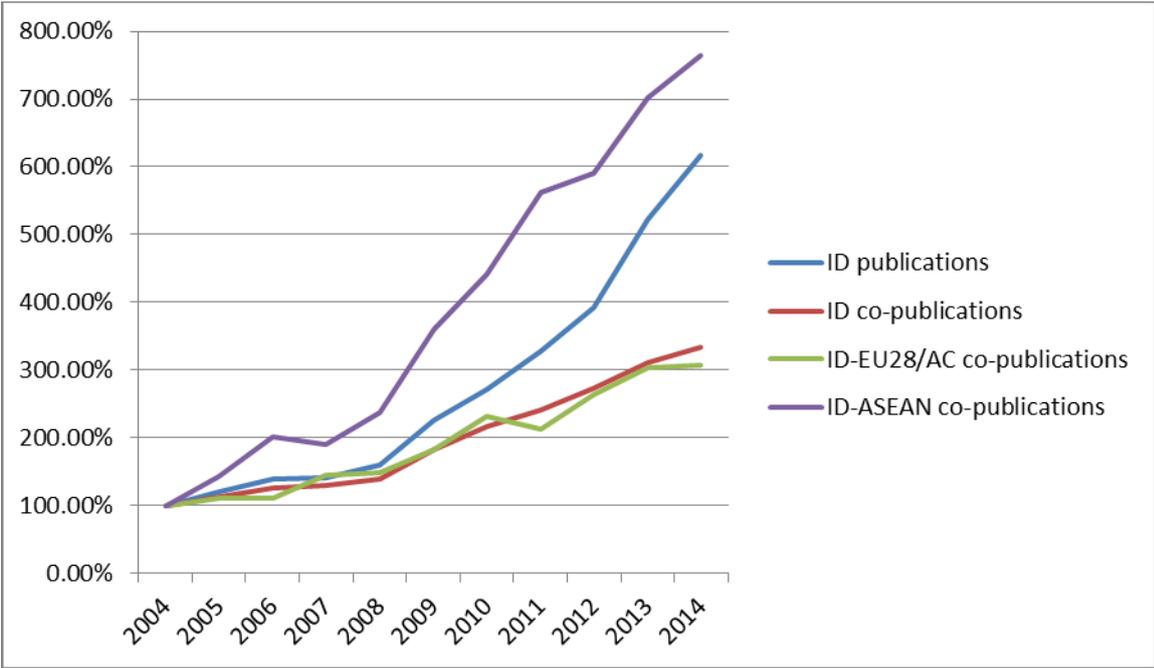


Figure 88: Overview of the annual growth of Indonesian (co-)publications, 2004-2014

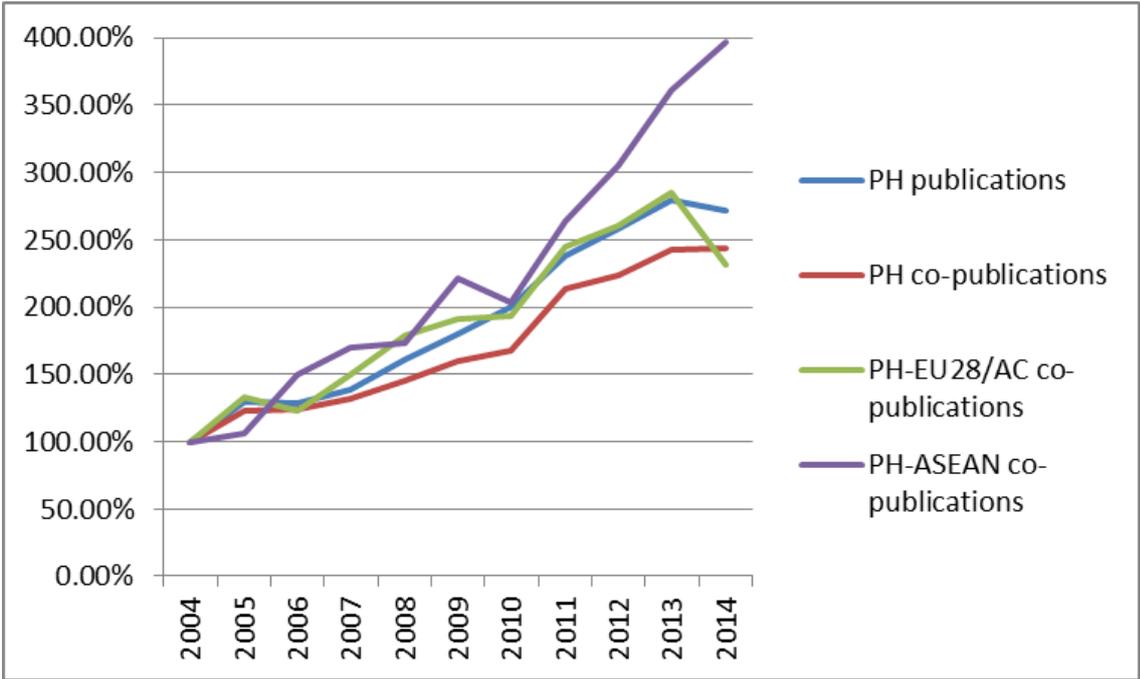


Figure 89: Overview of the annual growth of Philippine (co-)publications, 2004-2014

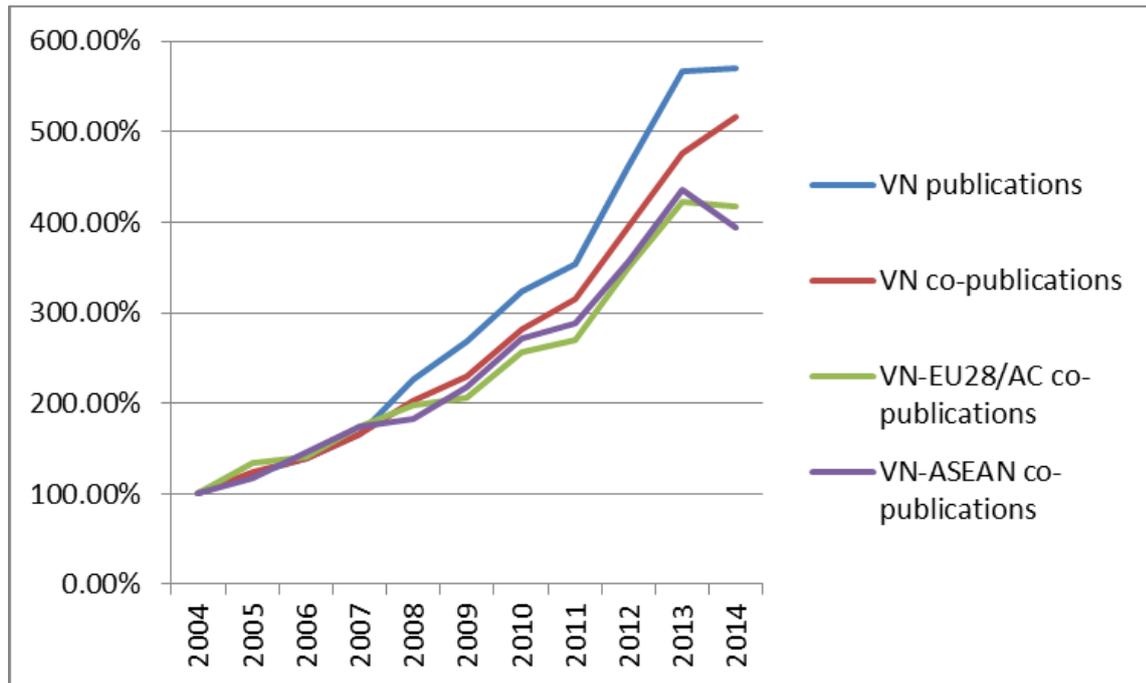


Figure 90: Overview of the annual growth of Vietnamese (co-)publications, 2004-2014

**Analysis of research topics in Indonesian, Vietnamese and Philippine research output**

Figure 91, Figure 92 and Figure 93 show the percentage of the research area distribution of Indonesian, Vietnamese and Philippine publications from 2004 to 2014. Whereas for Indonesia and Vietnam around 40% of all their publications are published in the research area of “Applied Sciences”, for the Philippines the research area with most publications is “Health Science”. Vietnamese publications have a rather big share in “Natural Sciences” (34%), Philippines a comparatively high share of publications in “Economic & Social Sciences” (14%).

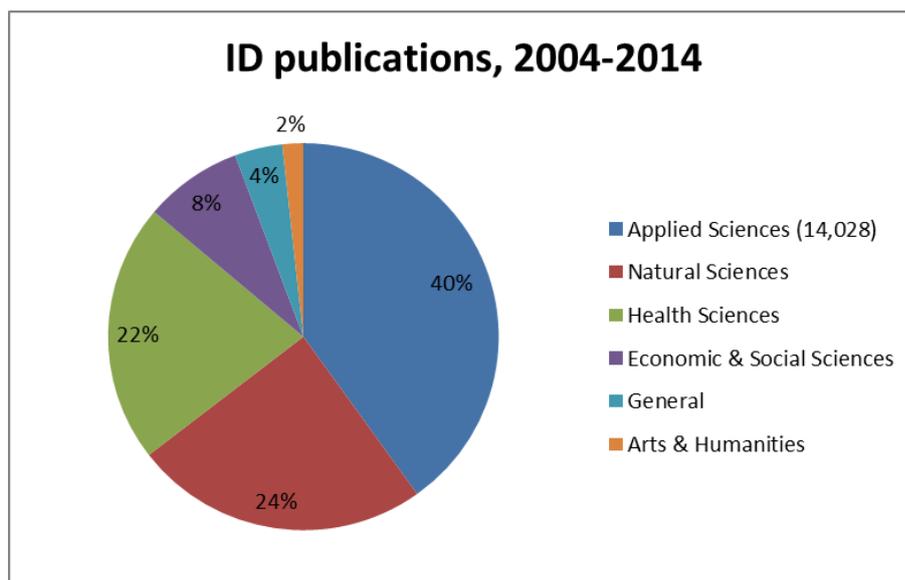


Figure 91: Research areas of Indonesia's publications, 2004-2014

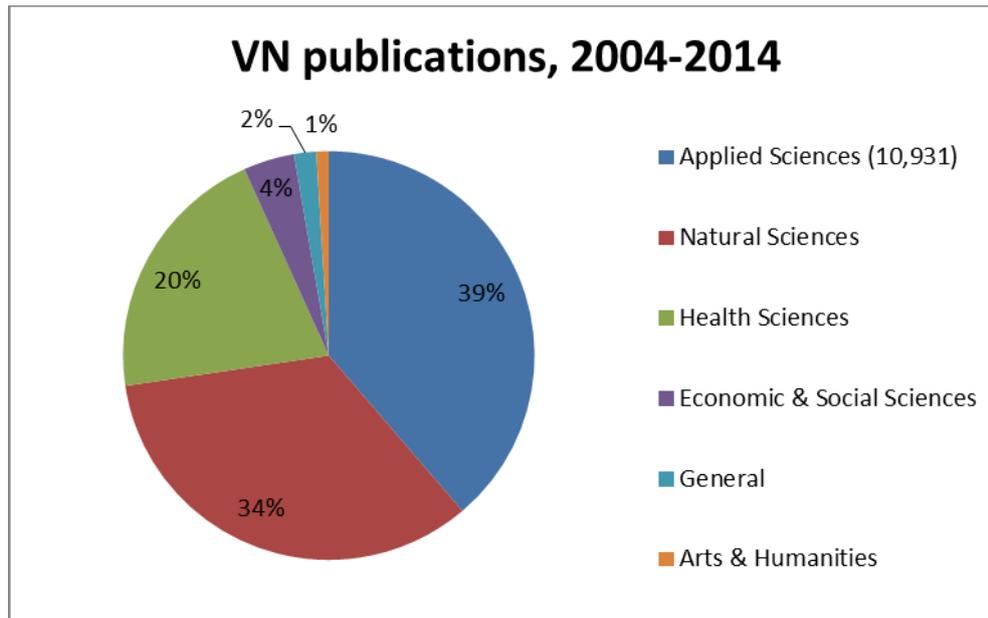


Figure 92: Research areas of Vietnam's publications, 2004-2014

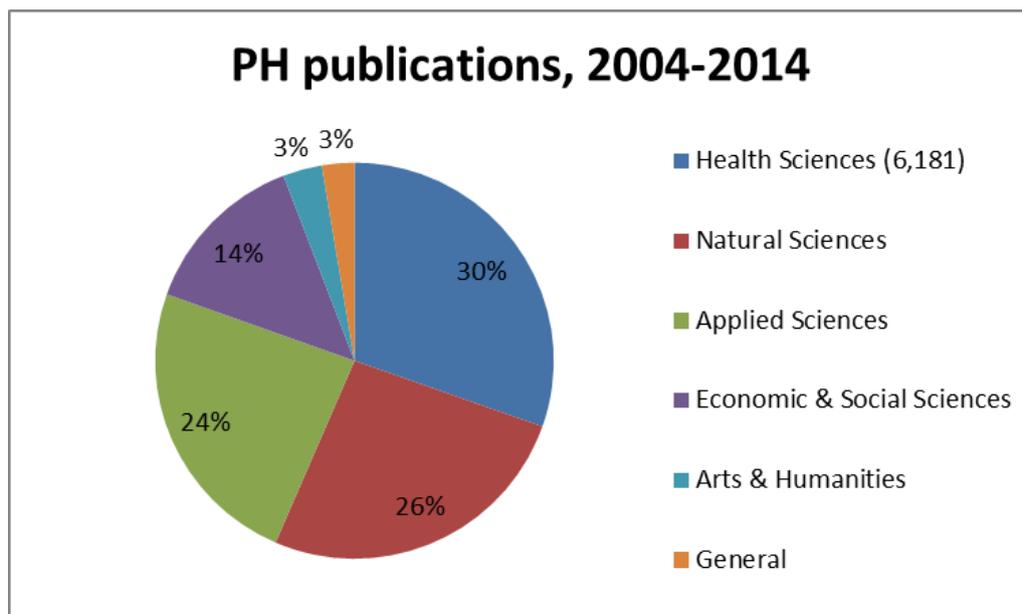


Figure 93: Research areas of Philippines' publications, 2004-2014

On a more detailed level of Science-Metrix fields (Figure 94), 14%, or 4,793 publications, of all Indonesian scientific publications from 2004 to 2014 are published in the field “Engineering”, followed by 13% (4,717 publications) published in the field “Clinical Medicine” and 10% (3,381 publications) in the field “Information & Communication Technologies”. Other research fields with comparatively strong publication output are (in descending order) “Enabling & Strategic Technologies” (9% or 3,295 publications), “Biology” (8% or 2,836 publications), “Agriculture, Fisheries & Forestry” (7% or 2,280 publications), “Physics & Astronomy” (6% or 2,249 publications), “Biomedical Research” (6% or 1,959 publications), “Earth & Environmental Sciences” (4% or 1,539 publications) and “Social Sciences” (4% or 1,449 publications).

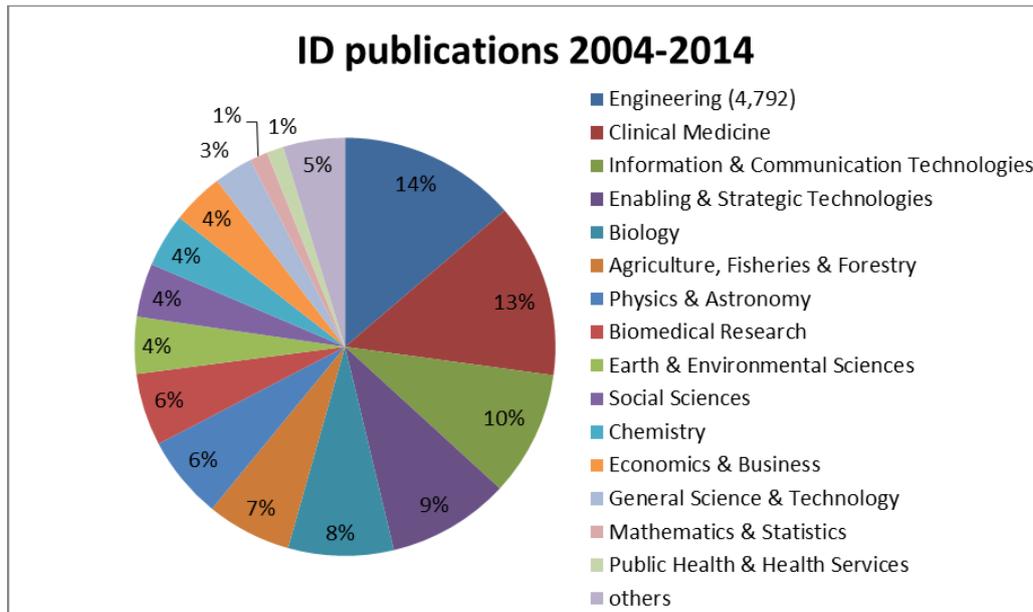


Figure 94: SM research fields of Indonesian publications, 2004-2014

For Vietnam’s publications (Figure 95), the Science-Metrix field “Engineering” is the field with the third highest publication output from 2004 to 2014, 10%, or 2,903 publications, “Information & Communication Technologies” is the research field with the highest publication output, 14% or 3,886 publications, followed by 10% (2,924 publications) in “Clinical Medicine”, which are the same research fields than the top three research fields for Indonesian publications. Other research fields with comparatively strong publication output are (in descending order) “Physics & Astronomy” (10% or 2,726 publications), “Enabling & Strategic Technologies” (8% or 2,339 publications), “Mathematics & Statistics” (8% or 2,294 publications), “Biomedical Research” (7% or 2,070 publications), “Biology” (7% or 1,907 publications), “Chemistry” (6% or 1,670 publications) and “Agriculture, Fisheries & Forestry” (6% or 1,643 publications).

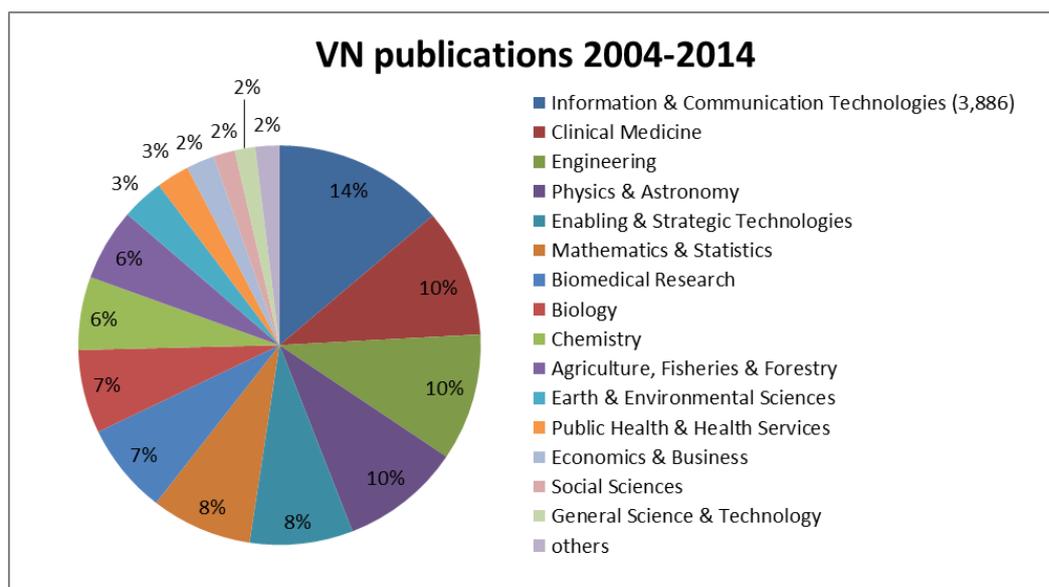


Figure 95: SM research fields of Vietnamese publications, 2004-2014

20%, or 4,011 publications, of all Philippine scientific publications from 2004 to 2014 are published in the field “Clinical Medicine”, followed by 15% (3,022 publications) published in the field “Biology” and 10% (2,014 publications) in the field “Agriculture, Fisheries & Forestry” (Figure 96). Other research fields with comparatively strong publication output are (in descending order) “Social Sciences” (8% or 1,550 publications), “Biomedical Research” (7% or 1,394 publications), “Economics & Business” (6% or 1,247 publications), “Engineering” (5% or 1,042 publications) and “Earth & Environmental Sciences” (5% or 925 publications).

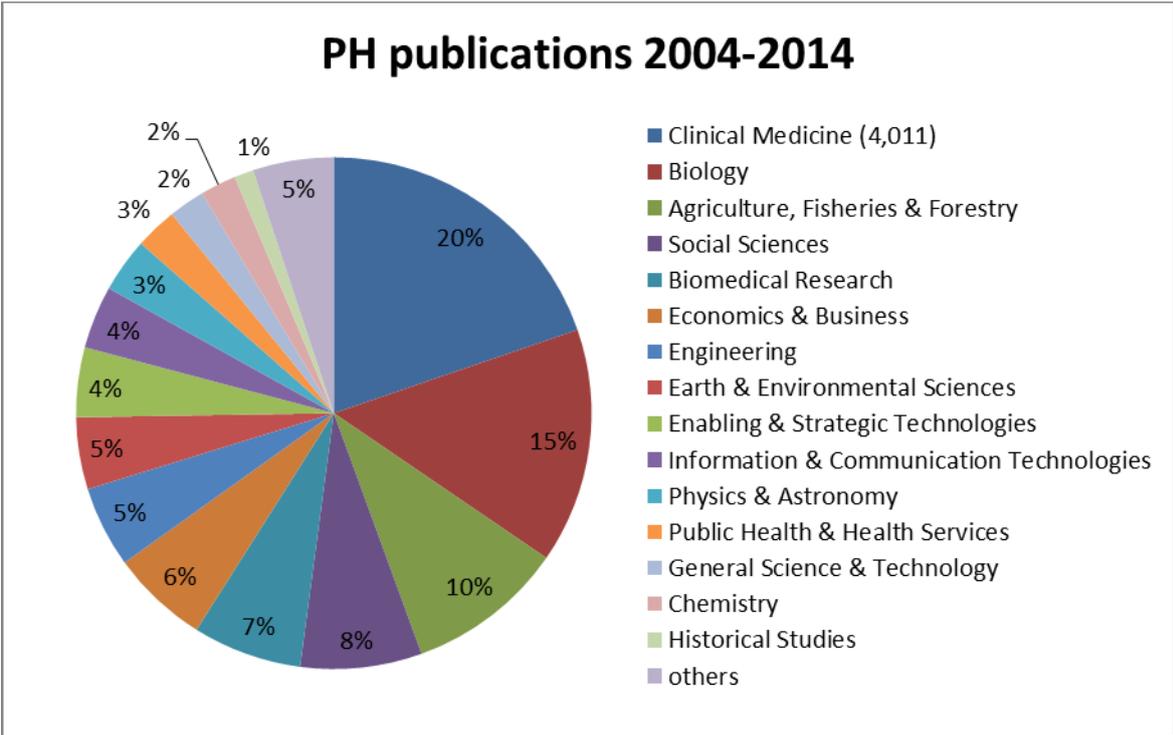


Figure 96: SM research fields of Philippine publications, 2004-2014

Looking at the annual development of Indonesian publications (Figure 97) in the ten research fields with the most publications, it is visible that “Clinical Medicine” is growing strong in the recent years, especially since 2012. “Engineering” is also growing fast from 2008 onwards but with two set-backs from 2009 to 2010 and 2011 to 2012. “Information & Communication Technologies” and “Enabling & Strategic Technologies” have a rather similar development – from 2004 to 2009 the annual publication output is rather stagnating and from 2009 onwards it is growing faster only with a small decline or small rise from 2013 to 2014.

Figure 98 shows the development of annual publication output of Vietnam in the ten research fields with the most publications. “Information & Communication Technologies” is growing the fastest, especially from 2009 onwards. “Engineering” is also a research field which annual publication output is growing faster since 2008 compared to the other research fields. “Clinical Medicine” is the Vietnamese research field with the second most publications in the time frame 2004 to 2014, but its growth of annual publication output is comparatively slower, with two declines from 2010 to 2011 and from 2013 to 2014.

Figure 99 reveals the annual development of the 10 Science-Metrix research fields with the most publications for the Philippines. “Clinical Medicine” is the research field which is growing the fastest, especially since 2009, “Biology” and “Agriculture, Fisheries & Forestry” are growing rather slowly with some declines (“Biology” from 2008 to 2009, from 2011 to 2012 and from 2013 to 2014; “Agriculture, Fisheries & Forestry” from 2009 to 2010 and from 2013 to 2014). The research field “Social Sciences” is growing comparatively fast with one decline of annual publication output from 2010 to 2011.

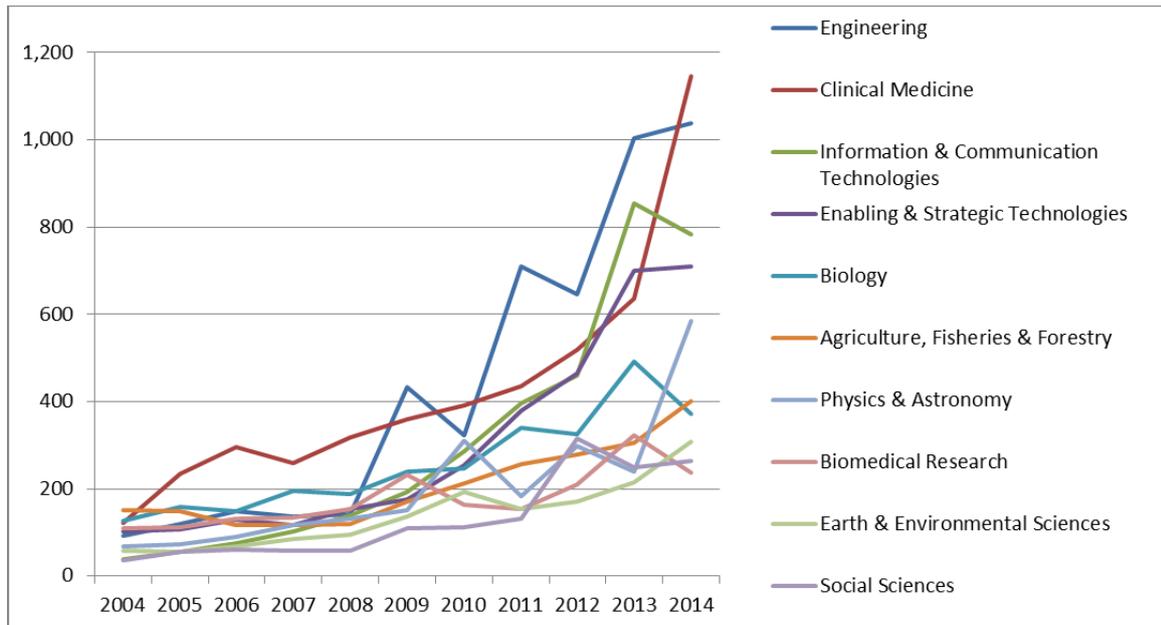


Figure 97: Annual development of the top 10 SM fields of Indonesian publications, 2004-2014

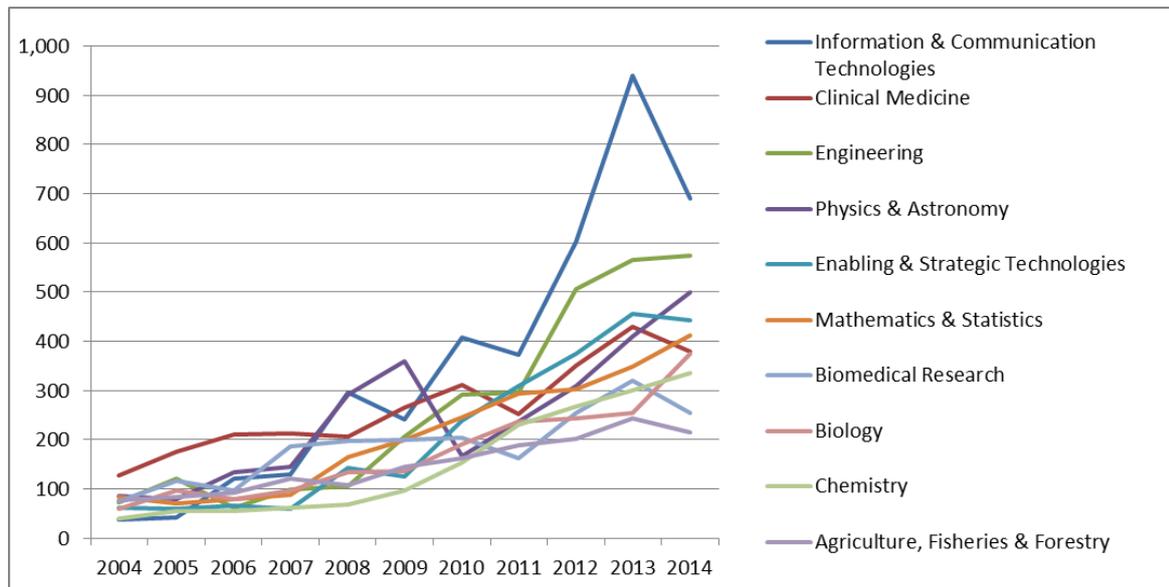


Figure 98: Annual development of the top 10 SM fields of Vietnamese publications, 2004-2014

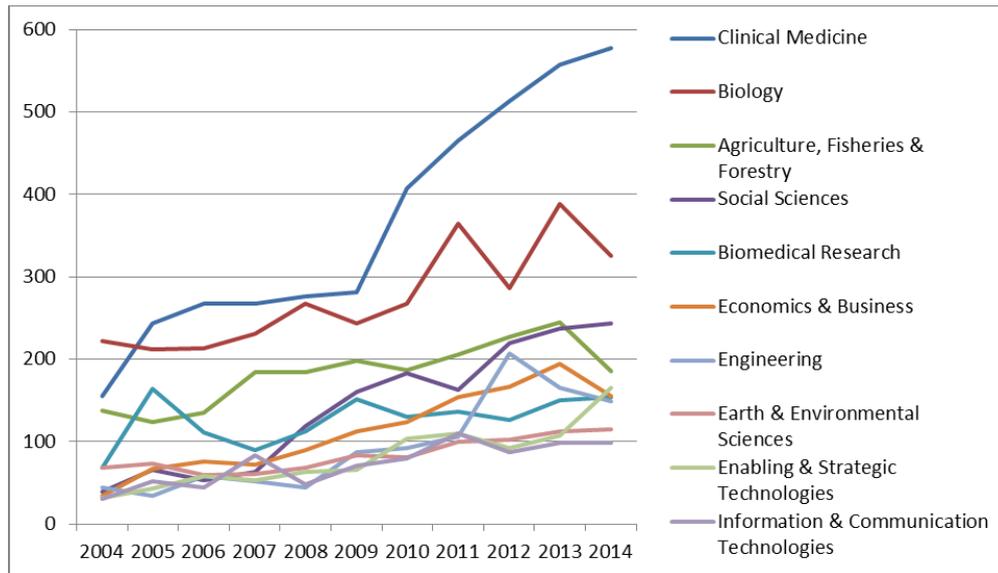


Figure 99: Annual development of the top 10 SM fields of Philippine publications, 2004-2014

Compared to the overall Indonesian publications, the thematic focus of Indonesian co-publications is somewhat different (Figure 100) – “Clinical Medicine” is the research field published most in: 14% or 2,503 co-publications. 53 % of all Indonesian “Clinical Medicine” publications involve at least one author from another country. “Biology” is the research field with the second highest co-publication output: 12% of all Indonesian co-publications or 2,124 co-publications in total, which is nearly 75% of all Indonesian “Biology” publications overall. These two research fields are followed by “Engineering” (10% or 1,794 co-publications, which is around 37% of the overall “Engineering” publications of Indonesia), “Enabling & Strategic Technologies” (9% or 1,629 co-publications, which is around 49% of the overall “Enabling & Strategic Technologies” publications of Indonesia) and “Agriculture, Fisheries & Forestry” (9% or 1,616 co-publications, which is around 70% of the overall “Agriculture, Fisheries & Forestry” publications of Indonesia).

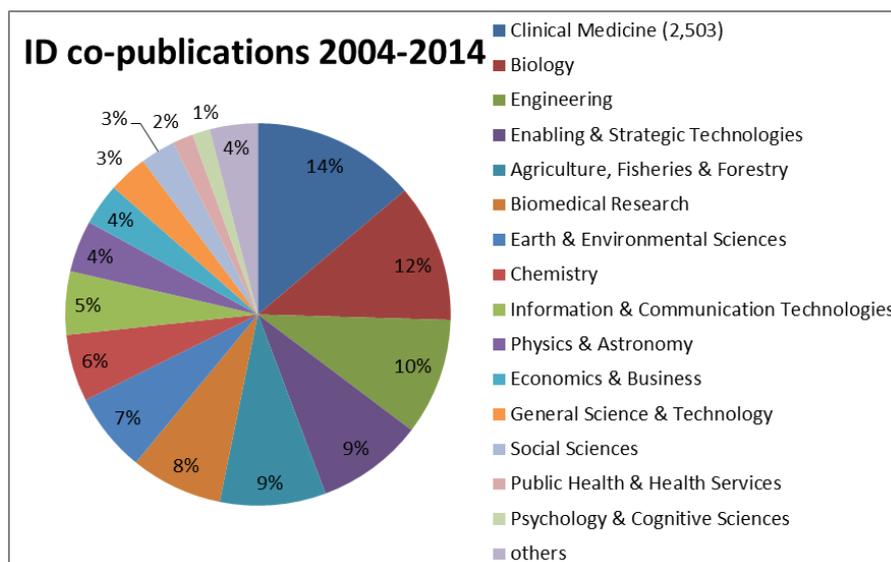


Figure 100: SM research fields of Indonesian co-publications, 2004-2014

Compared to the overall Vietnamese publications, the thematic distribution of Vietnamese co-publications is quite different (Figure 101) – “Clinical Medicine” is the research field published most in: 12% or 2,333 co-publications. Nearly 80% of all Vietnamese “Clinical Medicine” publications involve at least one author from another country. “Biomedical Research” is the research field with the second highest co-publication output: 10% of all Vietnamese co-publications or 1,876 co-publications in total, which is 90% of all Vietnamese “Biomedical Research” publications overall. These two research fields are followed by “Physics & Astronomy” (9% or 1,755 co-publications, which is around 64% of the overall “Physics & Astronomy” publications of Vietnam), “Biology” (9% or 1,697 co-publications, which is around 86% of the overall “Biology” publications of Vietnam) and “Engineering” (9% or 1,613 co-publications, which is around 55% of the overall “Engineering” publications of Vietnam).

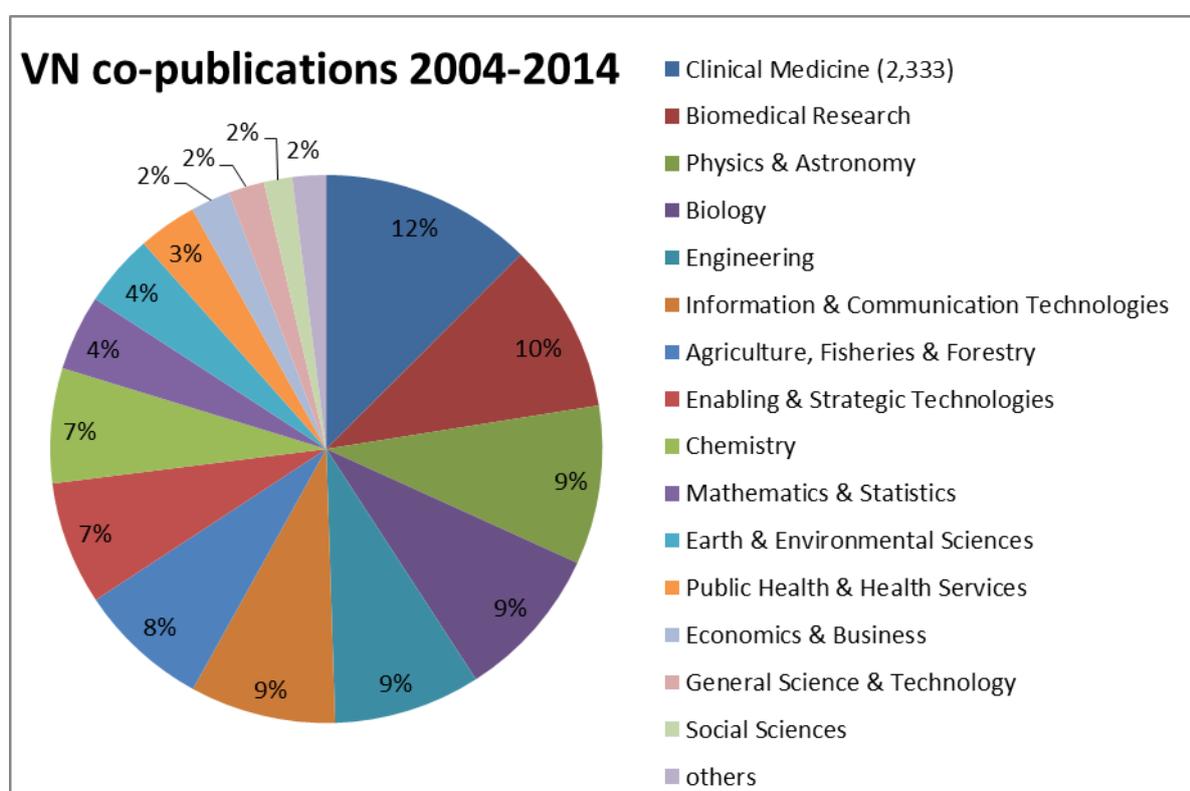


Figure 101: SM research fields of Vietnamese co-publications, 2004-2014

Comparing the overall Philippine publications the thematic distribution of Philippine co-publications is very similar (Figure 102) – “Clinical Medicine” is the research field published most in: 20% or 2,184 co-publications. 54% of all Philippine “Clinical Medicine” publications involve at least one author from another country. “Biology” is the research field with the second highest co-publication output: 17% of all Philippine co-publications or 1,865 co-publications in total, which is nearly 62% of all Philippine “Biology” publications overall. These two research fields are followed by “Agriculture, Fisheries & Forestry” (11% or 1,173 co-publications, which is around 58% of the overall “Agriculture, Fisheries & Forestry” publications of the Philippines), “Biomedical Research” (10% or 1,060 co-publications, which is around 76% of the overall “Biomedical Research” publications of the Philippines) and “Economics & Business” (5% or 612 co-publications, which is around 49% of the overall “Economics & Business” publications of the Philippines).

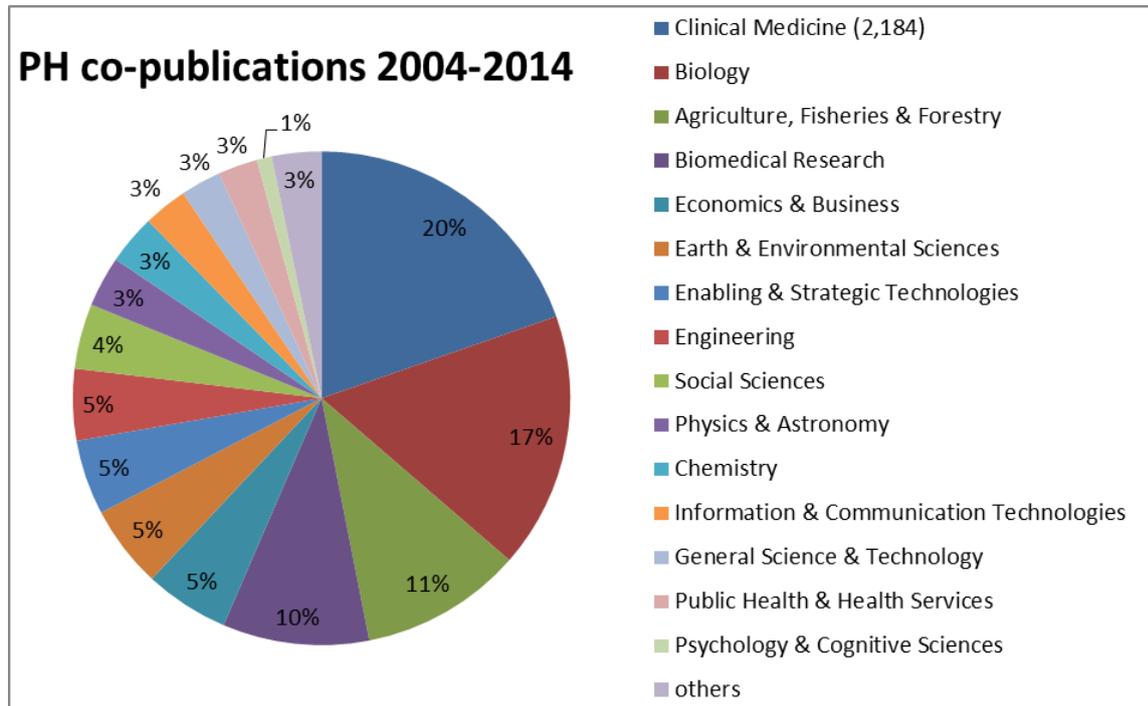


Figure 102: SM research fields of Philippine co-publications, 2004-2014

Looking at the annual development of Indonesian co-publications (Figure 103) in the ten research fields with the highest publication output, it is visible that “Clinical Medicine” is growing a little bit stronger than “Biology”, but that “Engineering” is growing much faster since 2008. Similarly, “Enabling & Strategic Technologies” is growing faster than e.g. “Agriculture, Fisheries & Forestry” or “Biomedical Research”.

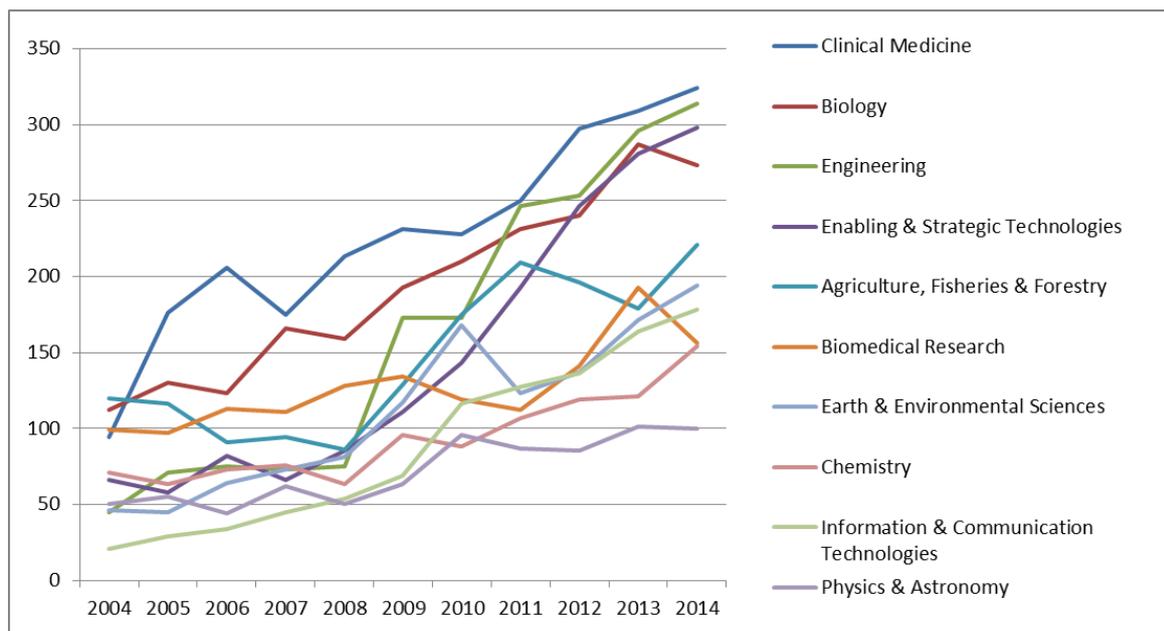


Figure 103: Annual development of the top 10 SM fields of Indonesian co-publications, 2004-2014

The development of the annual co-publication output of Vietnam (Figure 104) in the ten research fields with the highest publication output is rather difficult to describe. The development of most the fields is often changing with ups and downs, but overall, the annual output of all the fields is growing. “Information & Communication Technologies” as well as “Engineering” are growing faster and steadier than the other fields, especially since 2009, “Mathematics & Statistics” is growing rather slowly.

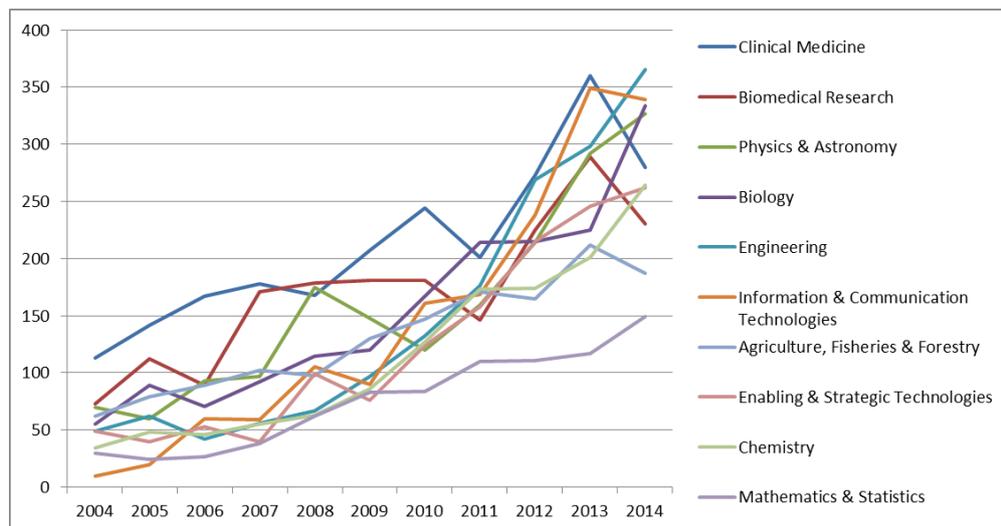


Figure 104: Annual development of the top 10 SM fields of Vietnamese co-publications, 2004-2014

Figure 105 shows the development annual co-publication output of the Philippines in the ten research fields with the highest publication output. Compared to the other research fields, the field “Clinical Medicine”, and the fields “Biology” and “Economics & Business” to some extent as well, are growing faster, the annual output of the fields “Physics & Astronomy” and “Agriculture, Fisheries & Forestry” are growing comparatively slower.

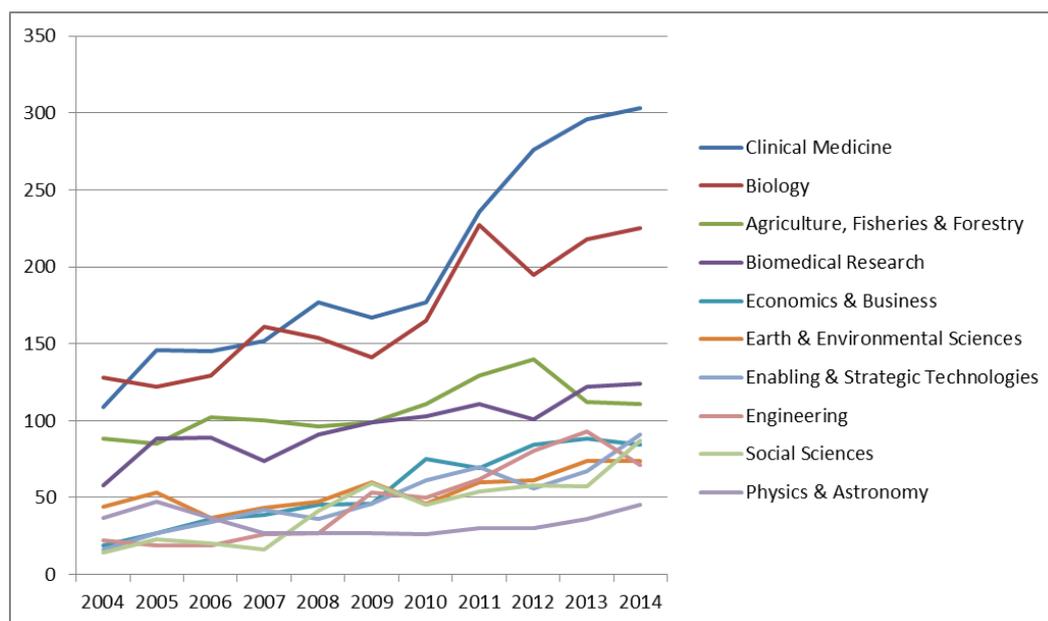


Figure 105: Annual development of the 10 SM fields of Philippine co-publications, 2004-2014

**Strongest collaboration linkages– within the ASEAN region and the EU**

Regarding **Indonesia’s scientific collaboration with other ASEAN countries as well as with the EU28/AC**, the most important co-publication partner countries for Indonesia are – in descending order – Malaysia, the Netherlands, Great Britain, Germany, Thailand, France, Singapore, the Philippines, Switzerland, Vietnam, Italy, Sweden, Belgium, Denmark, Spain, Austria and Cambodia. Table 15 gives a detailed overview of the top 20 collaboration countries of Indonesia in regards to its collaboration with the two regions of ASEAN and EU28/AC. Highlighted in bold are the top values of each category<sup>13</sup>.

Indonesia’s co-publications involving at least one author affiliated in Poland are cited the most on average when looking at Indonesia’s 20 strongest co-publication partner countries in the ASEAN region and within the EU28/AC. Co-publications with Spain (cited 29.09 times on average), the Czech Republic (cited 24.17 times on average), Vietnam (cited 23.07 times on average) and Belgium (cited 18.97 times on average) are cited comparatively frequently as well. Co-publications with Poland, Spain, the Czech Republic, Norway, Belgium, Denmark and Italy also include a rather high number of different authors on average (all involve more than 20 authors).

	Co-publications	mean citations	mean country count	mean author count
MY	<b>2,829</b>	5.11	3.31	7.11
NL	1,807	9.72	3.56	8.25
GB	1,508	16.07	4.85	11.18
DE	1,299	10.17	4.16	9.64
TH	990	14.62	5.81	12.98
FR	878	11.96	4.99	13.02
SG	699	9.39	5.84	14.2
PH	551	12.88	7.47	17.28
CH	423	16.97	6.7	15.55
VN	363	<b>23.07</b>	<b>7.61</b>	17.28
IT	356	16.16	7.06	<b>22.13</b>
SE	247	14.57	6.2	16.11
BE	233	<b>18.97</b>	7.45	<b>22.9</b>
DK	198	11.51	<b>7.82</b>	<b>20.3</b>
ES	195	<b>29.09</b>	<b>9.55</b>	<b>31.06</b>
AT	176	16.24	7.15	18.76
KH	132	13.91	7.48	15.41
NO	131	16.4	7.41	<b>21.34</b>
CZ	106	<b>24.17</b>	<b>8.54</b>	<b>30.4</b>
PL	75	<b>30.73</b>	<b>10.15</b>	<b>23.48</b>

Table 15: Indonesia’s top 20 collaboration countries within ASEAN and with the EU (Source: WoS+Scopus)

Regarding **Vietnam’s scientific collaboration with other ASEAN countries as well as with the EU28/AC**, the most important co-publication partner countries for Vietnam are – in descending order – France, Great Britain, Germany, the Netherlands, Thailand, Belgium, Sweden, Switzerland, Italy, Singapore, Poland and Malaysia. Table 16 gives a detailed overview of the top 20 collaboration

<sup>13</sup> Over 18 citations per average co-publication; over 7.5 involved countries; over 20 involved authors.

countries of Vietnam in regards to its collaboration with the two regions of ASEAN and EU28/AC. Highlighted in bold are the top values of each category<sup>14</sup>.

Vietnam’s co-publications involving at least one author affiliated in Spain are cited the most on average when looking at Vietnam’s 20 strongest co-publication partner countries in the ASEAN region and within the EU28/AC. Co-publications with Indonesia (cited 23.07 times on average), Switzerland (cited 19.83 times on average), Cambodia (cited 19.47 times on average) and Poland (cited 19.36 times on average) are cited comparatively frequently as well. Co-publications with Romania, Ireland, Spain, Poland, Italy, Switzerland and the Netherlands include a very high number of different authors on average (all involve more than 100 authors on average).

	Co-p publications	mean citations	mean country count	mean author count
FR	<b>2,437</b>	9.15	4.52	59.92
GB	1,779	17.64	5.99	82.76
DE	1,526	10.85	5.69	92.25
NL	1,064	16.11	6.68	<b>129.02</b>
TH	1,003	16.69	5.54	11.76
BE	905	9.45	3.29	7.8
SE	679	11.52	4.1	9.86
CH	670	<b>19.83</b>	<b>8.63</b>	<b>166.53</b>
IT	644	17.17	<b>9.61</b>	<b>210.41</b>
SG	589	11.73	5.53	12.23
PL	436	<b>19.36</b>	<b>10.83</b>	<b>302.04</b>
MY	412	13.33	7.55	15.74
DK	409	13.32	4.47	12.42
ES	384	<b>24.54</b>	<b>13.63</b>	<b>346.71</b>
PH	379	13.93	7.55	15.53
ID	363	<b>23.07</b>	7.61	17.28
RO	240	13.08	<b>15.33</b>	<b>484.31</b>
IE	231	10.53	<b>13.81</b>	<b>458.65</b>
KH	226	<b>19.47</b>	6.77	15.01
AT	220	7.52	5.92	14.18

Table 16: Vietnam’s top 20 collaboration countries within ASEAN and with the EU (Source: WoS+Scopus)

Regarding **the Philippines’ scientific collaboration with other ASEAN countries as well as with the EU28/AC**, the most important co-publication partner countries for the Philippines are – in descending order – Great Britain, Malaysia, Thailand, Germany, Singapore, France, Indonesia, the Netherlands, Switzerland, Italy, Vietnam, Italy and Spain. Table 17 gives a detailed overview of the top 20 collaboration countries of the Philippines in regards to its collaboration with the two regions of ASEAN and EU28/AC. Highlighted in bold are the top values of each category<sup>15</sup>.

The Philippines’ co-publications involving at least one author affiliated in Cambodia are cited the most on average when looking at the Philippines’ 20 most involved co-publication partner countries in the ASEAN region and within the EU28/AC. Co-publications with Italy (cited 35.83 times on average), Finland (cited 35.75 times on average), Sweden (cited 32.24 times on average), the

<sup>14</sup> Over 18 citations per average co-publication; over 8 involved countries; over 100 involved authors.

<sup>15</sup> Over 30 citations per average co-publication; over 10 involved countries; over 30 involved authors.

Netherlands (cited 31.25 times on average) and Denmark (cited 30.57 times on average) are cited comparatively frequently as well. Co-publications with Norway, Finland, Sweden, Italy, Denmark and Spain include a rather high number of different authors on average (all involve more than 30 authors on average).

	Co-p publications	mean citations	mean country count	mean author count
GB	1,135	28.52	6.41	16.58
MY	886	15.35	6.5	14.07
TH	841	20.68	7.32	15.56
DE	787	20.15	6.48	17.22
SG	680	22.85	7.39	18.9
FR	663	22.07	7.41	20.83
ID	551	12.88	7.47	17.28
NL	472	31.25	7.39	20.65
CH	416	42.87	8.93	23.85
VN	379	13.93	7.55	15.53
IT	332	35.83	10.29	32.46
ES	324	25.12	9.72	30.9
BE	291	26.14	8.27	22.68
SE	198	32.24	11.36	35.58
AT	194	13.79	9.21	25.9
DK	185	30.57	10.25	32.17
PL	164	29.95	10.98	26.89
FI	133	35.75	11.09	40.59
KH	129	15.95	7.43	13.95
NO	107	23.96	13.14	46.73

Table 17: The Philippines' top 20 collaboration countries within ASEAN and with the EU (Source: WoS+Scopus)

### Analysis of research fields – Indonesia with the ASEAN region and the EU28/AC respectively

With 16% (or 969 co-publications) of all Indonesian co-publications involving at least one author from an EU28/AC country, “Clinical Medicine” is the research field published most in (Figure 106). In nearly 39% of all Indonesian “Clinical Medicine” co-publications or 20.5% of the overall Indonesian “Clinical Medicine” publications at least one author from an EU28/AC country is involved. The research field with the second most Indonesian-EU28/AC co-publications in the time frame 2004 to 2014 is “Biology” with 14% of all Indonesian co-publications with the EU28/AC or 850 co-publications, which are 40% of all Indonesian co-publications in “Biology” or nearly 30% of the overall Indonesian publications in “Biology”. These two research fields are followed by “Biomedical Research” (10% or 614 co-publications, which are nearly 44% of the “Biomedical Research” co-publications of Indonesia or around 31% of the overall “Biomedical Research” publications of Indonesia), “Earth & Environmental Sciences” (9% or 544 co-publications, which are nearly 45% of the “Earth & Environmental Sciences” co-publications or around 35% of the overall “Earth & Environmental Sciences” publications of Indonesia) and “Agriculture, Fisheries & Forestry” (8% or 514 co-publications, which is nearly 32% of the “Agriculture, Fisheries & Forestry” co-publications or around 22% of the overall “Agriculture, Fisheries & Forestry” publications of Indonesia).

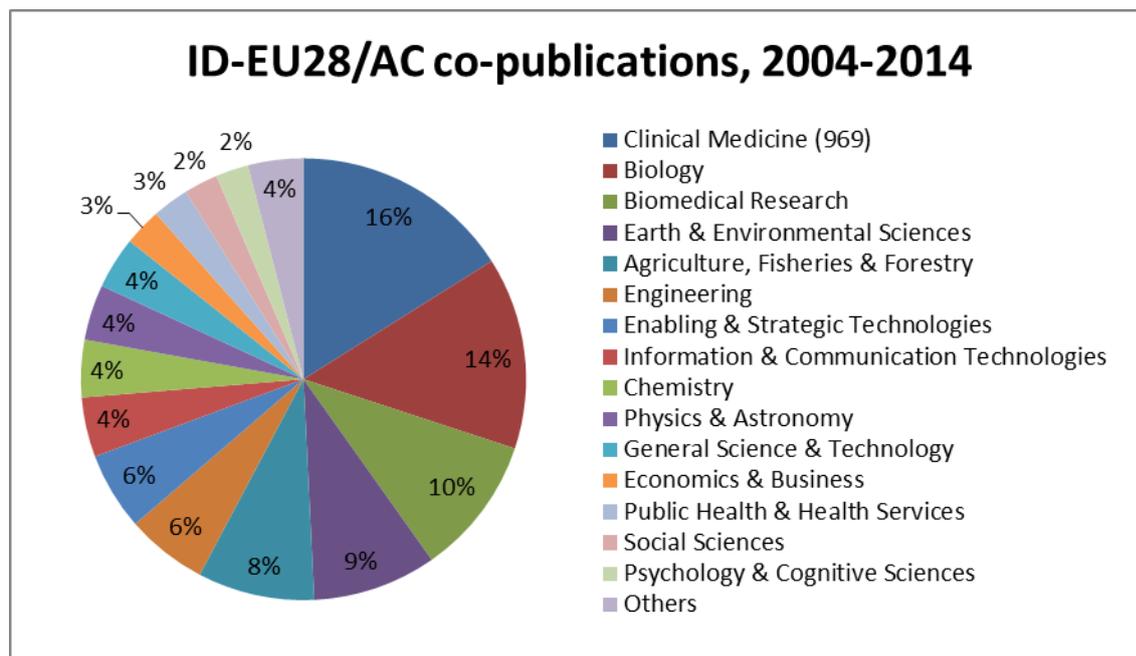


Figure 106: SM research fields of Indonesian co-publications with EU28/AC countries, 2004-2014

For the co-publications of Indonesia involving at least one additional author from another ASEAN country, “Clinical Medicine” is the research field published most in: 20% or 888 co-publications (Figure 107). This is 35% of all Indonesian “Clinical Medicine” co-publications or nearly 19% of all Indonesian “Clinical Medicine” publications. “Engineering” is the research field with the second most Indonesian-ASEAN co-publication output: 11% of all Indonesian-ASEAN co-publications or 494 co-publications in total. This is 27.5% of all Indonesian “Engineering” co-publications or 10% of all Indonesian “Engineering” publications overall. These two research fields are followed by “Enabling & Strategic Technologies” (11% or 479 co-publications, which is around 29% of the “Enabling & Strategic Technologies” co-publications of Indonesia or 14.5% of the overall “Enabling & Strategic Technologies” publications of Indonesia), “Biology” (9% or 347 co-publications, which is around 19% of the “Biology” co-publications or 14.5% of the overall “Biology” publications of Indonesia) and “Biomedical Research” (8% or 347 co-publications, which is nearly 25% of the “Biomedical Research” co-publications or nearly 18% of the overall “Biomedical Research” publications of Indonesia).

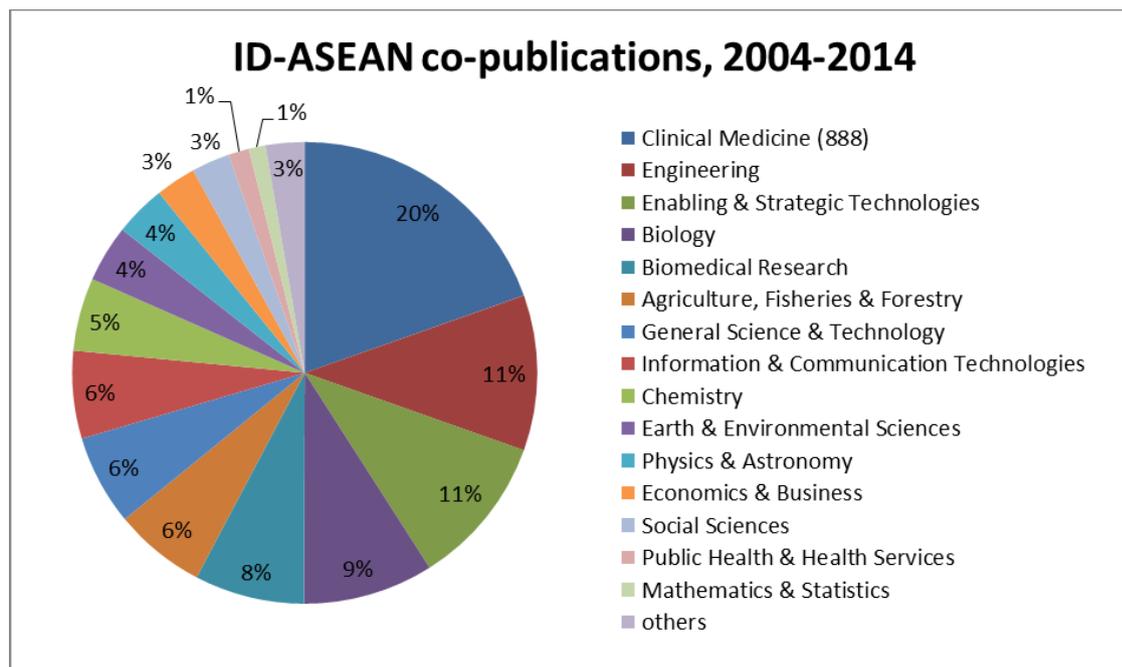


Figure 107: SM research fields of Indonesian co-publications with ASEAN countries, 2004-2014

### Indonesia's Collaboration linkages – within the ASEAN region in detail

In total, Indonesia has 4,550 co-publications which involve at least one author affiliated in another ASEAN country. Figure 108 shows the involvement of the different ASEAN countries in co-publications with Indonesia from 2004-2014. The strongest collaboration partner for Indonesia in the ASEAN region is Malaysia with 2,829 joint co-publications. Second strongest partner is Thailand with 990 and third strongest partner is Singapore with 699 joint co-publications, followed by the Philippines with 551 co-publications.

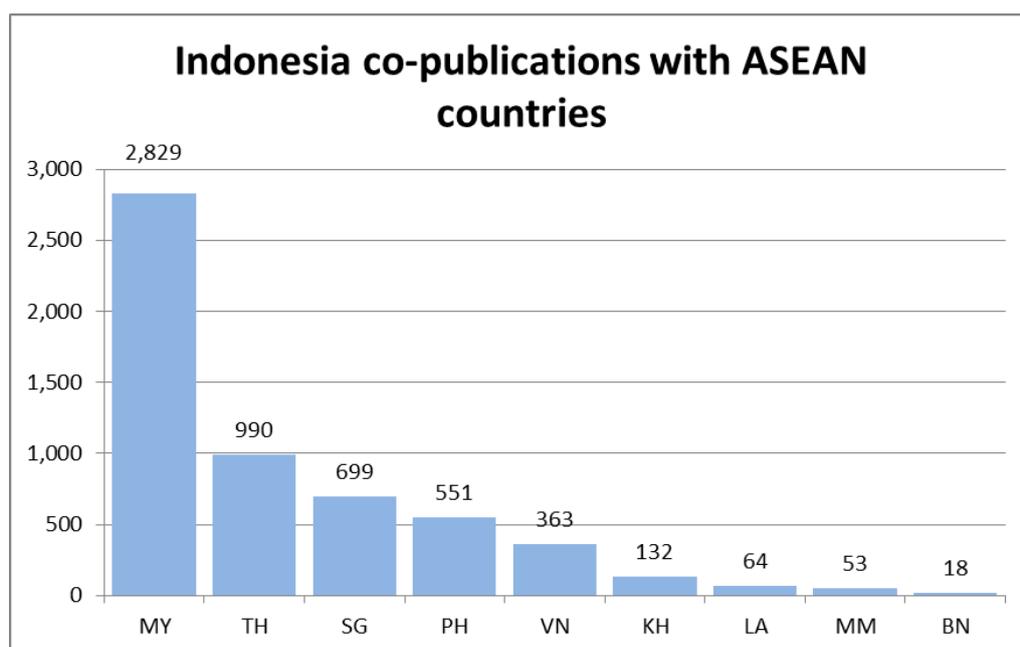


Figure 108: Indonesia's co-publications with ASEAN countries, 2004-2014

Looking at the development over time of Indonesia’s co-publications with its five strongest collaboration partners from the ASEAN region (Figure 109), it is visible that the co-publications involving Malaysian authors are growing particularly fast. Indonesia’s annual co-publication output with Thailand grew rather steadily from 2004 to 2012 with some set-backs (from 2006 to 2007 and from 2009 to 2010), starting just above 30 co-publications in 2004 to over 130 co-publications in 2012, from 2012 to 2014 the annual co-publication output declined slightly. Co-publications with Singapore, the Philippines and Vietnam are growing slightly over time as well with only small set-backs.

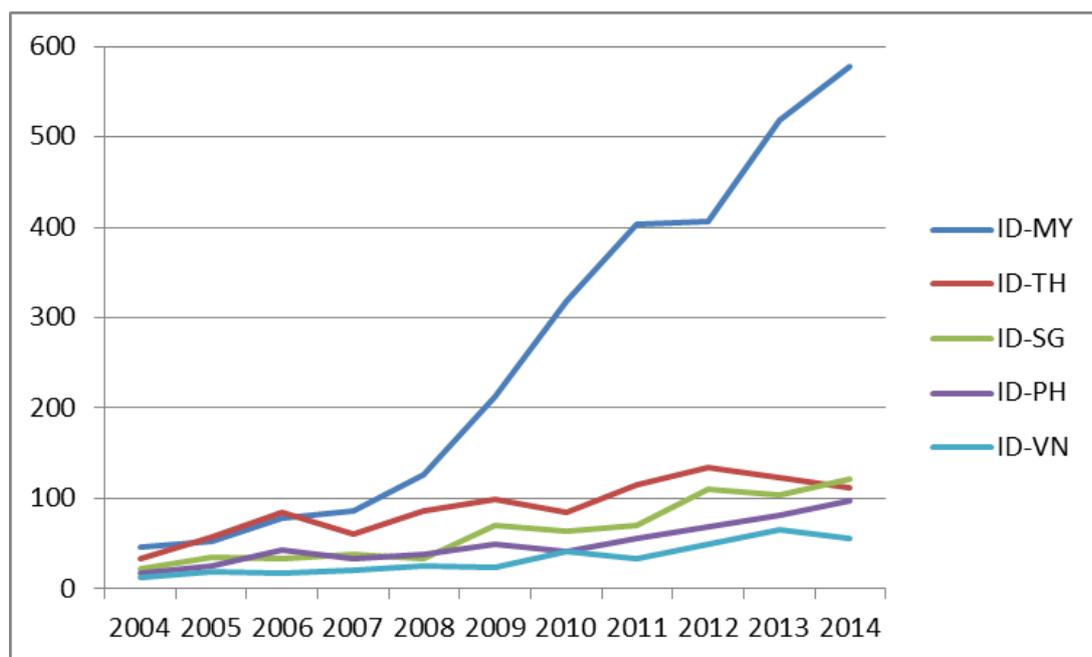


Figure 109: Indonesia’s co-publications with the five strongest ASEAN collaboration countries and their development over time, 2004-2014

Figure 110, Figure 111 and Figure 112 show the overall distribution of SM research fields for Indonesia’s co-publications with Malaysia, Thailand and Singapore in detail. The three SM research fields with the most co-publication output for Indonesia and Malaysia are “Engineering” (405 co-publications), “Enabling & Strategic Technologies” (400 co-publications) and “Clinical Medicine” (346 co-publications), for Indonesia and Thailand “Clinical Medicine” (444 co-publications), “Biomedical Research” (163 co-publications) and “Biology” (62 co-publications), for Indonesia and Singapore “Clinical Medicine” (246 co-publications), “Biology” (121 co-publications) and “Biomedical Research” (63 co-publications), for Indonesia and the Philippines as well “Clinical Medicine” (189 co-publications), “Biology” (78 co-publications) and “Biomedical Research” (65 co-publications) and for Indonesia and Vietnam “Clinical Medicine” (106 co-publications), “Biomedical Research” (69 co-publications) and “Biology” (45 co-publications).

“Clinical Medicine” is the SM research field with the most co-publications in all four cases, and the other SM research fields also do not vary that much – only two other research fields are in the top 3 research fields of each co-publication partnership: “Biomedical Research” and “Biology”. The thematic focus of co-publications with Malaysia, however have, besides “Medicine”, the most output in “Engineering” and “Enabling & Strategic Technologies”.

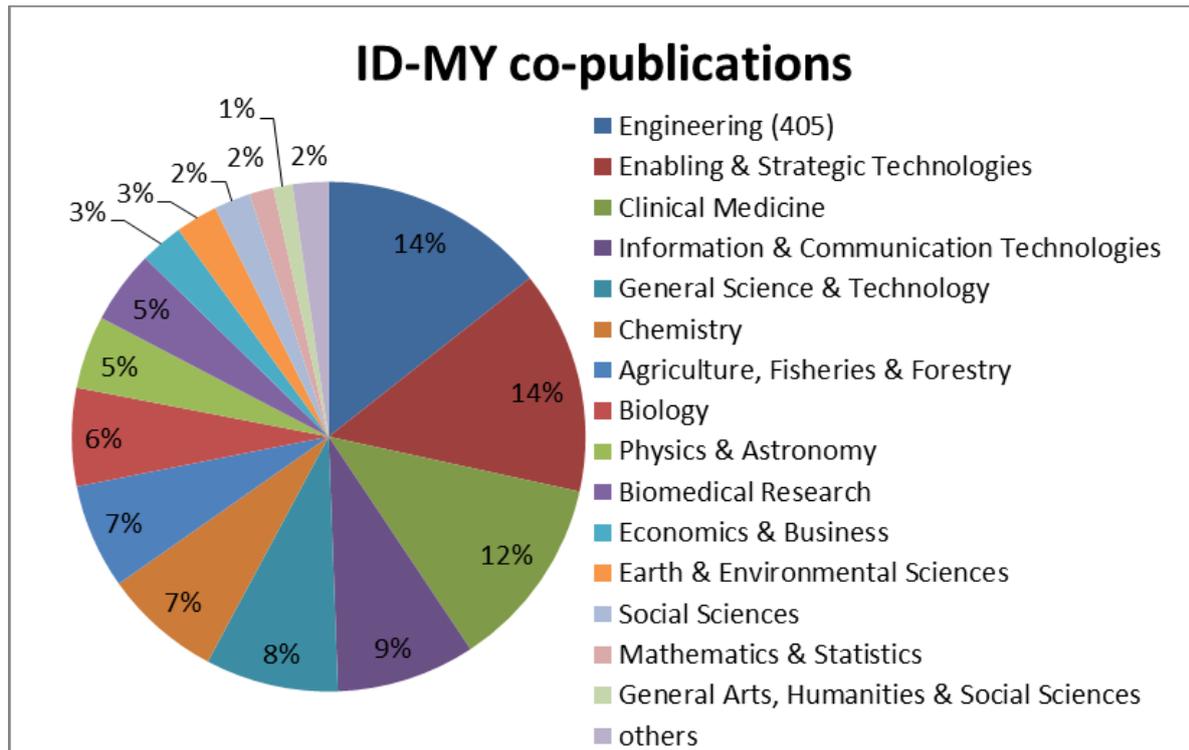


Figure 110: SM research fields of Indonesia-Malaysia co-publications, 2004-2014

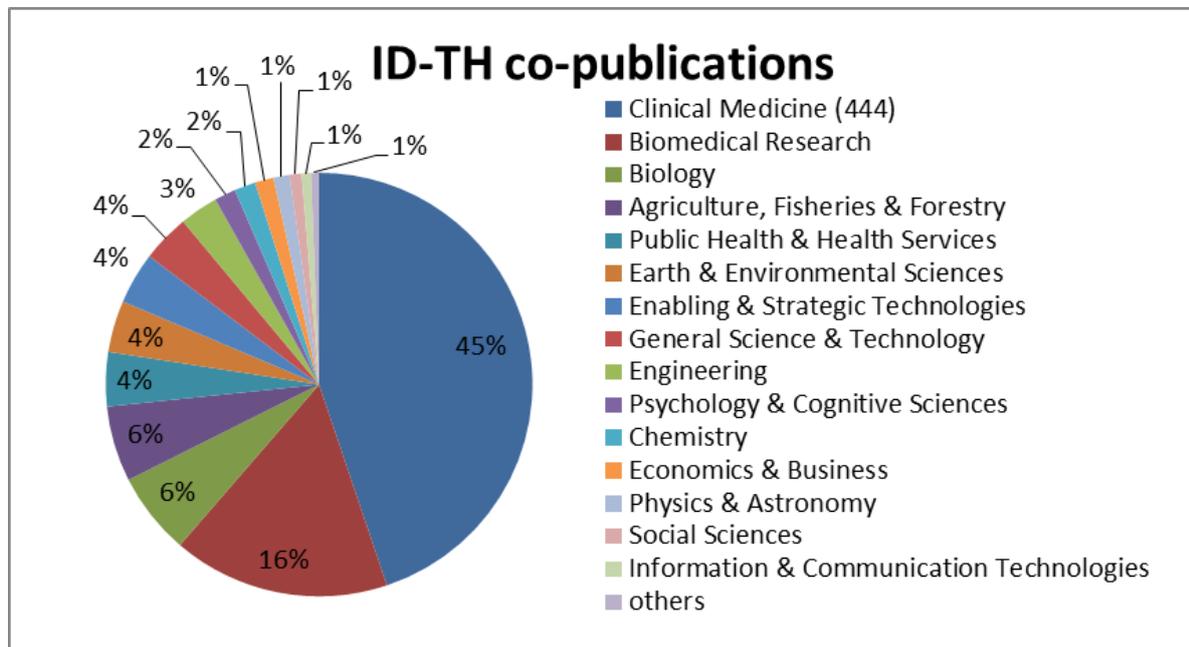


Figure 111: SM research fields of Indonesia-Thailand co-publications, 2004-2014

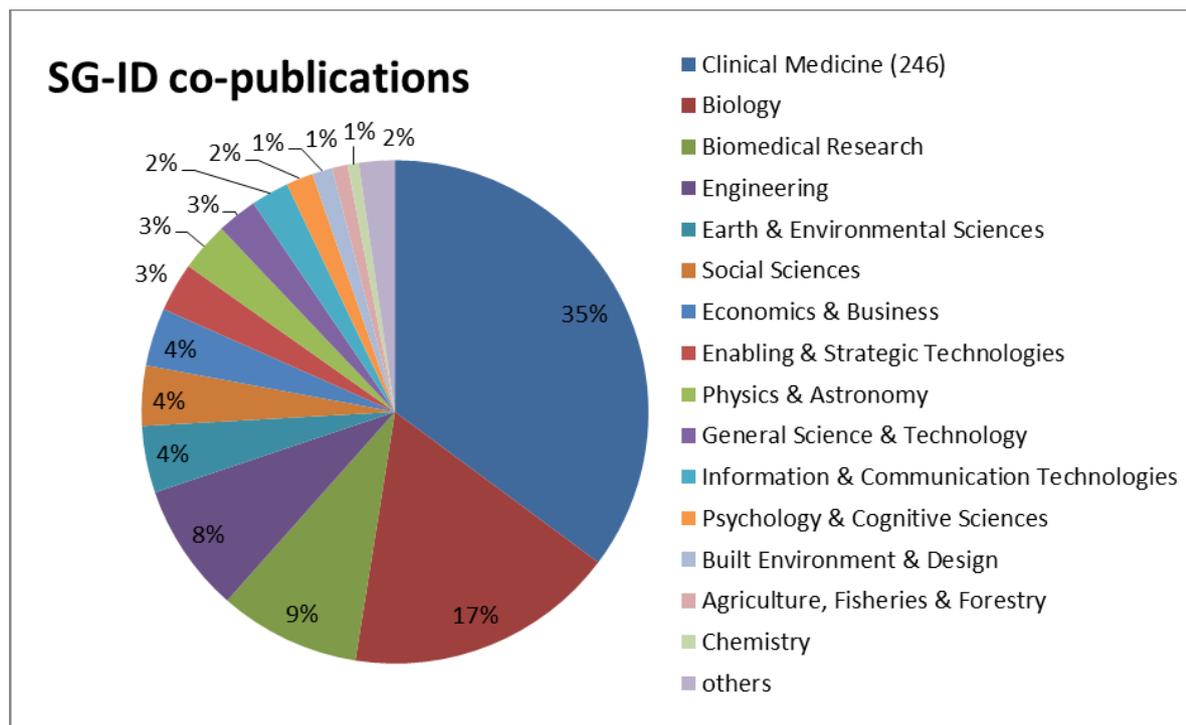


Figure 112: SM research fields of Singapore-Indonesia co-publications, 2004-2014

### Indonesia's Collaboration linkages – with the EU28/AC countries in detail

In total, Indonesia has 6,048 co-publications which involve at least one author affiliated in the EU28/AC. Figure 113 shows the volume of involvement of the 15 EU28/AC countries which are involved most in co-publications with Indonesia from 2004-2014. The strongest collaboration partner for Indonesia in the EU28/AC region is the Netherlands with 1,807 joint co-publications. Second strongest partner is Great Britain with 1,508 and third strongest partner is Germany with 1,299 joint co-publications, followed by France with 878 and Switzerland with 423 co-publications.

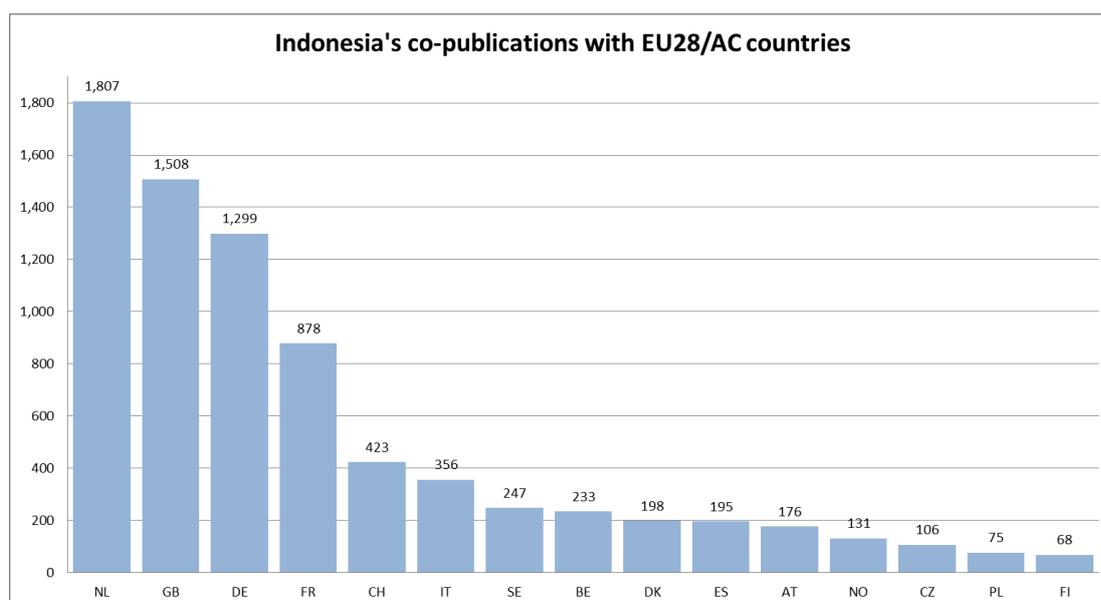


Figure 113: Indonesia's co-publications with EU28/AC countries, 2004-2014

Looking at the development over time of Indonesia’s co-publications with its five strongest collaboration partners from the EU28/AC region (Figure 114), it is visible that the co-publications involving authors affiliated in Great Britain are growing somewhat faster than with the Netherlands, Germany, France and Switzerland. Co-publications with Switzerland have a comparatively slower increase in their annual co-publication output than with the other four countries.

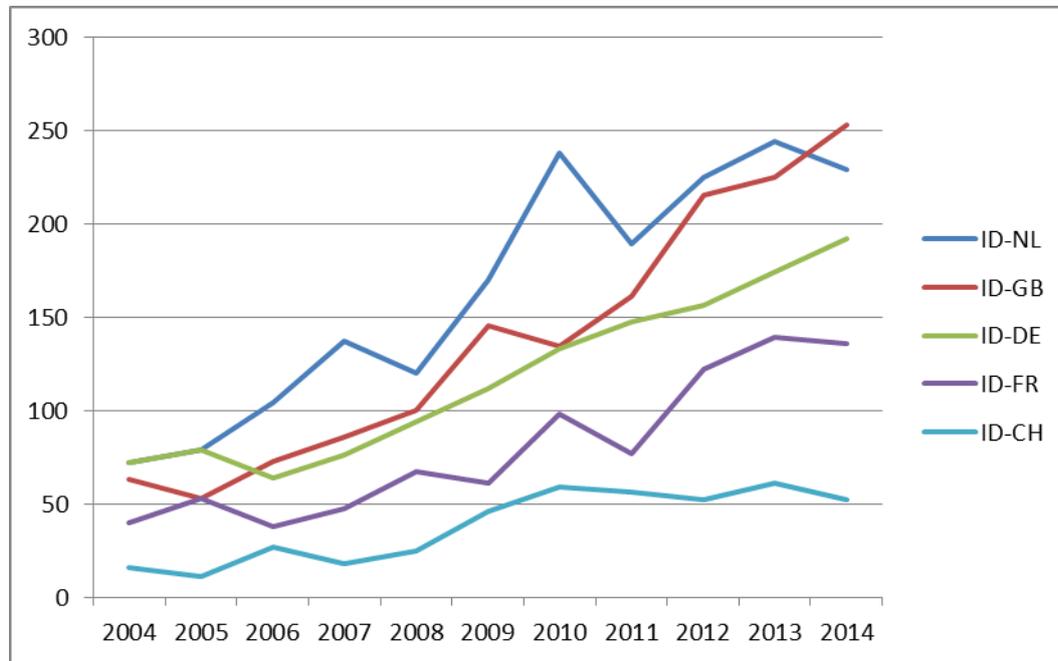


Figure 114: Indonesia’s co-publications with the five strongest EU28/AC collaboration partner countries and their development over time, 2004-2014

The three SM research fields with the most co-publication output for Indonesia and the Netherlands are “Clinical Medicine” (402 co-publications), “Biomedical Research” (235 co-publications) and “Biology” (193 co-publications), for Indonesia and Great Britain “Biology” (271 co-publications), “Clinical Medicine” (267 co-publications) and “Biomedical Research” (171 co-publications), for Indonesia and Germany “Biology” (236 co-publications), “Earth & Environmental Sciences” (165 co-publications) and “Agriculture, Fisheries & Forestry” (156 co-publications), for Indonesia and France “Biology” (134 co-publications), “Earth & Environmental Sciences” (125 co-publications) and “Agriculture, Fisheries & Forestry” (116 co-publications) and for Indonesia and Switzerland “Clinical Medicine” (98 co-publications), “Biology” (78 co-publications) and “Biomedical Research” (66 co-publications).

The SM research fields with the most co-publications for each country-pair do vary quite a bit - “Biology” is the SM research field with the most co-publications in three cases (co-publications with Great Britain, Germany and France), once with the second most (Switzerland) and once with the third most co-publications (the Netherlands), “Clinical Medicine” is the SM research field with the most co-publications in two cases (Indonesian co-publications with the Netherlands and Switzerland) and once with the second most co-publications (with Great Britain), “Biomedical Research” is the SM research field with the second most co-publications twice (Indonesian co-publications with the Netherlands and with Great Britain) and once with the third most co-publications (Switzerland) and

“Earth & Environmental Sciences” and “Agriculture, Fisheries & Forestry” are each once the research field with the second and third most co-publications (co-publications with Germany and France).

Figure 115, Figure 116 and Figure 117 show the overall distribution of SM research fields for Indonesia’s co-publications with the Netherlands, Great Britain and Germany in detail.

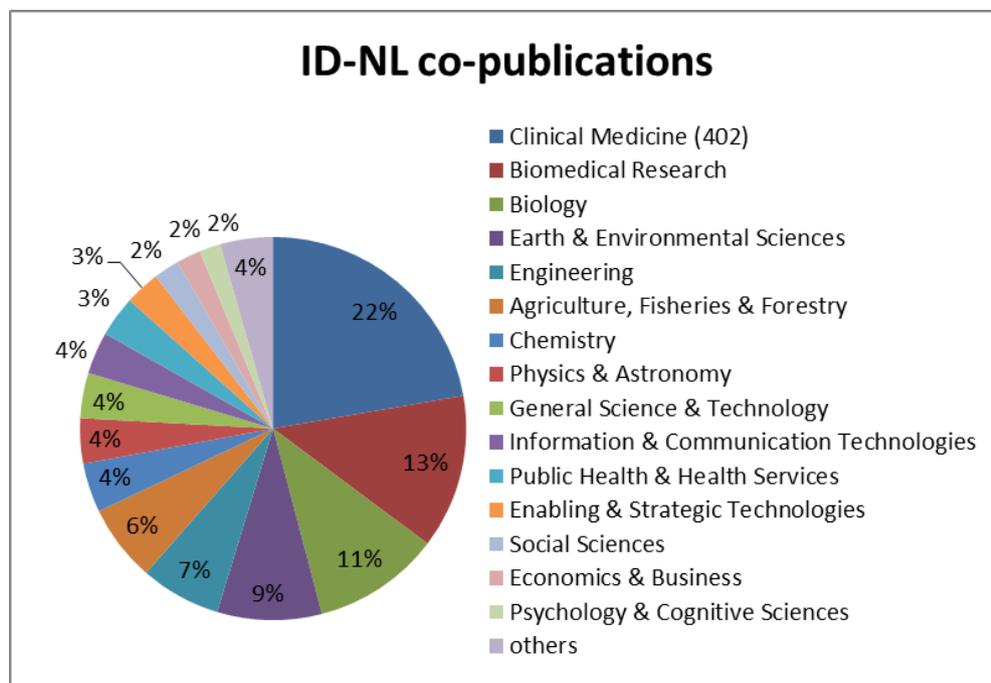


Figure 115: SM research fields of Indonesia-the Netherlands co-publications, 2004-2014

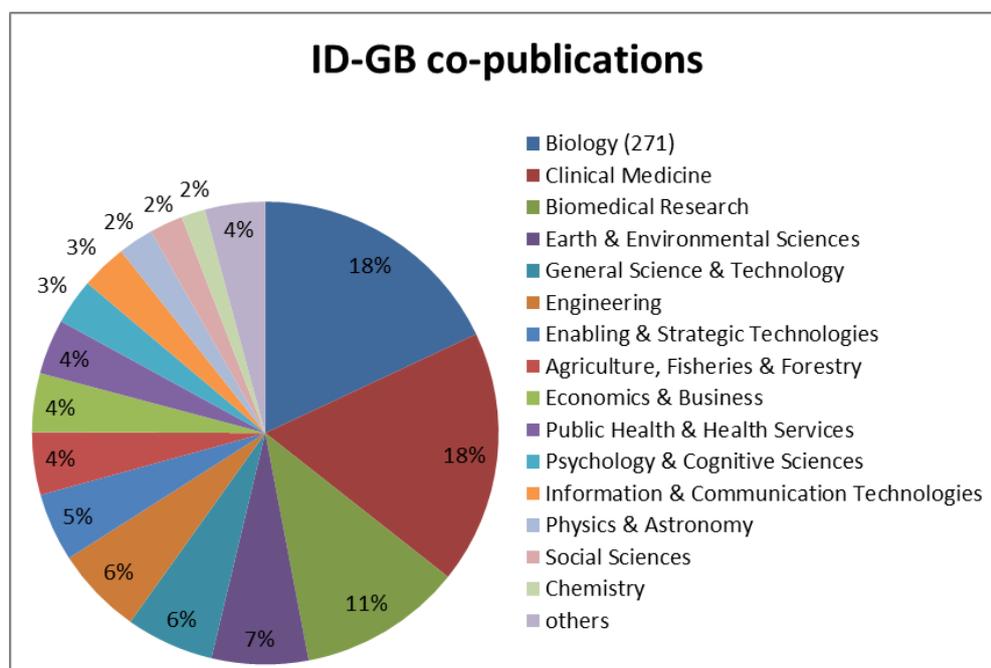


Figure 116: SM research fields of Indonesia-Great Britain co-publications, 2004-2014

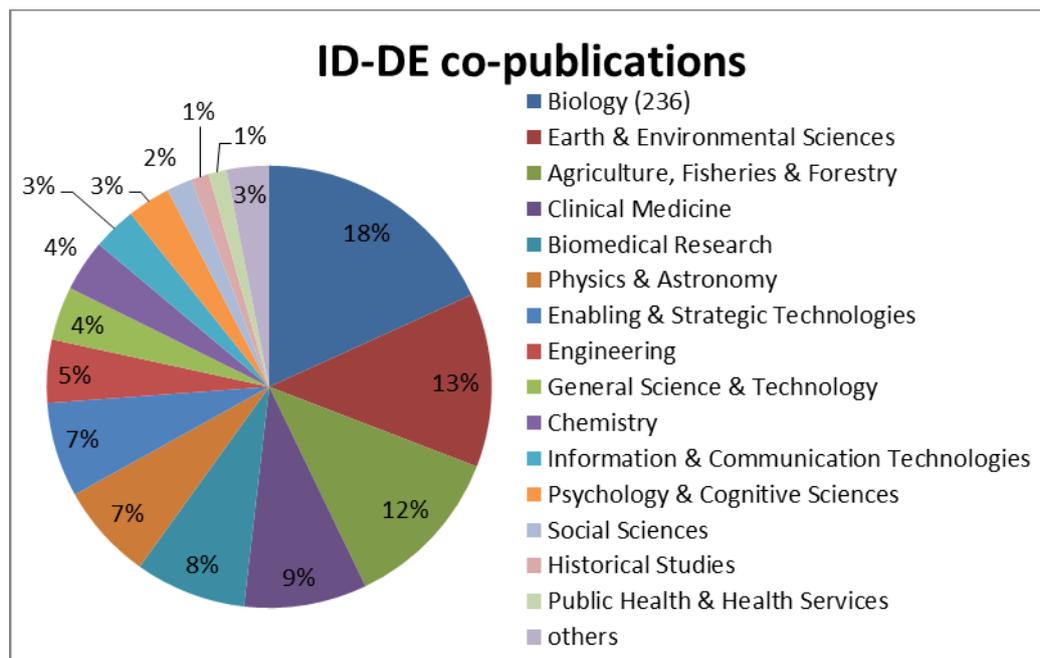


Figure 117: SM research fields of Indonesia-Germany co-publications, 2004-2014

### Analysis of research fields – Vietnam with the ASEAN region and the EU28/AC respectively

For the co-publications of Vietnam involving at least one additional author from another ASEAN country (Figure 118), “Clinical Medicine” is the research field published most in: 23% or 528 co-publications. This is 22.6% of all Vietnamese “Clinical Medicine” co-publications or 18% of all Vietnamese “Clinical Medicine” publications. “Biomedical Research” is the research field with the second most Vietnamese-ASEAN co-publication output: 16% of all Vietnamese-ASEAN co-publications or 353 co-publications in total. This is nearly 19% of all Vietnamese “Biomedical Research” co-publications or 18.5% of all Vietnamese “Biomedical Research” publications overall. These two research fields are followed by “Biology” (11% or 259 co-publications, which is around 15% of the “Biology” co-publications of Vietnam or 13.6% of the overall “Biology” publications of Vietnam), “Agriculture, Fisheries & Forestry” (7% or 162 co-publications, which is around 11% of the “Agriculture, Fisheries & Forestry” co-publications or nearly 10% of the overall “Agriculture, Fisheries & Forestry” publications of Vietnam) and “Engineering” (6% or 143 co-publications, which is nearly 9% of the “Engineering” co-publications or nearly 5% of the overall “Engineering” publications of Vietnam).

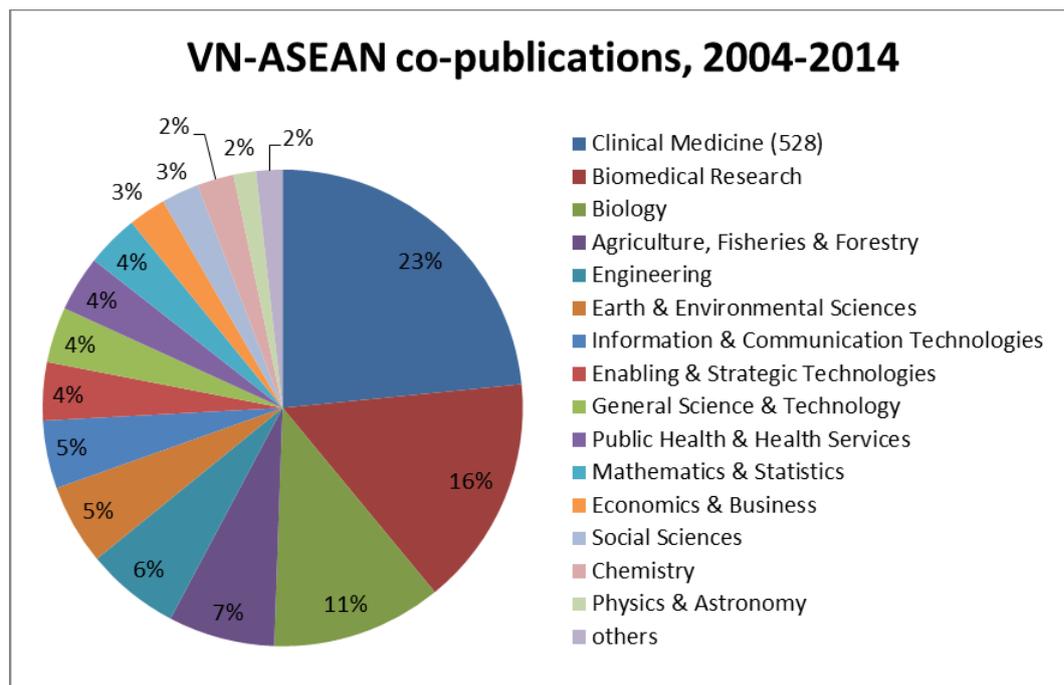


Figure 118: SM research fields of Vietnamese co-publications with ASEAN countries, 2004-2014

With 13% (or 1,135 co-publications) of all Vietnamese co-publications involving at least one author from an EU28/AC country, “Clinical Medicine” is the research field published most in (Figure 119). In nearly 49% of all Vietnamese “Clinical Medicine” co-publications or nearly 39% of the overall Vietnamese “Clinical Medicine” publications at least one author from an EU28/AC country is involved. The research field with the second most Philippine-EU28/AC co-publications in the time frame 2004 to 2014 is “Biomedical Research” with 12% of all Vietnamese co-publications with the EU28/AC or 990 co-publications, which are nearly 53% of all Vietnamese co-publications in “Biomedical Research” or nearly 48% of the overall Vietnamese publications in “Biomedical Research”. These two research fields are followed by “Physics & Astronomy” (10% or 889 co-publications, which are around 50% of the “Physics & Astronomy” co-publications of Indonesia or around 32% of the overall “Physics & Astronomy” publications of Vietnam), “Biology” (9% or 785 co-publications, which are 42% of the “Biology” co-publications or 41% of the overall “Biology” publications of Vietnam) and “Agriculture, Fisheries & Forestry” (9% or 724 co-publications, which is 50% of the “Agriculture, Fisheries & Forestry” co-publications or 44% of the overall “Agriculture, Fisheries & Forestry” publications of Vietnam).

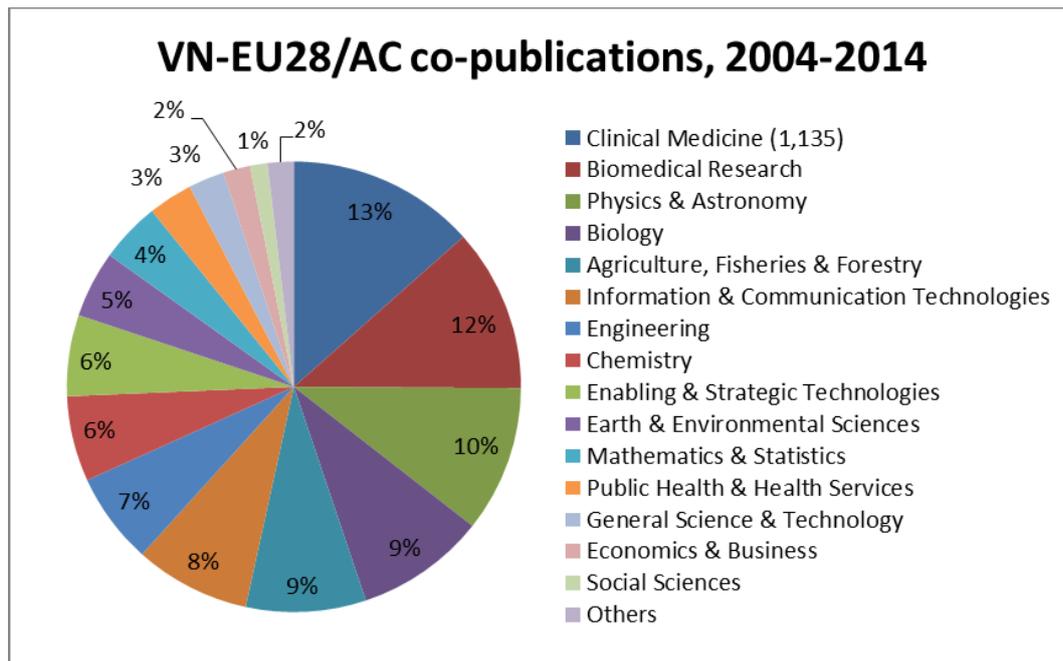


Figure 119: SM research fields of Vietnamese co-publications with EU28/AC countries, 2004-2014

### Vietnam's collaboration linkages – within the ASEAN region in detail

Vietnam has 2,255 co-publications which involve at least one author affiliated in another ASEAN country in total. Figure 120 shows the involvement of the different ASEAN countries in co-publications with Vietnam from 2004-2014. The strongest collaboration partner for Indonesia in the ASEAN region is Thailand with 1,003 joint co-publications. Second strongest partner is Singapore with 589 and third strongest partner is Malaysia with 412 joint co-publications, followed by the Philippines with 379 co-publications.

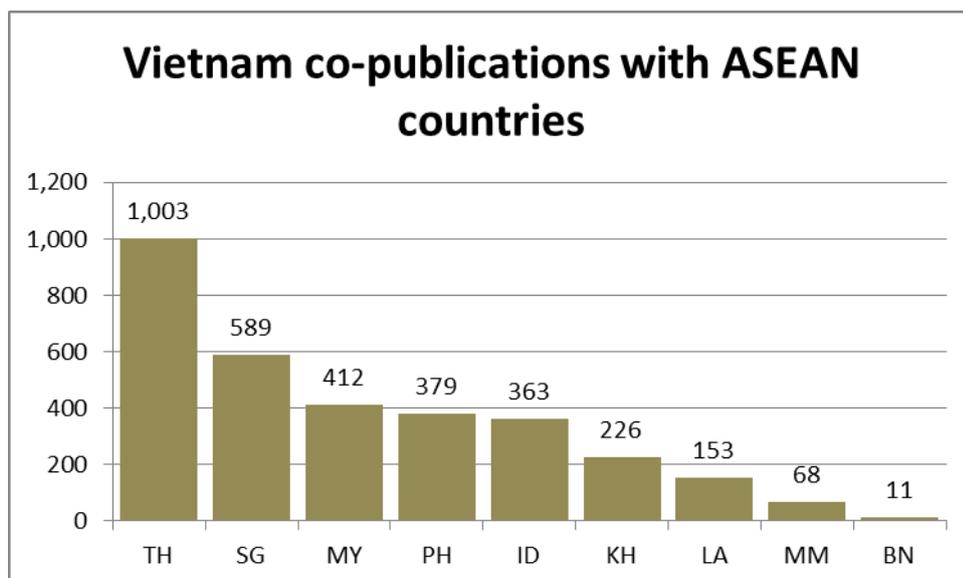


Figure 120: Vietnam's co-publications with ASEAN countries, 2004-2014

Looking at the development over time of Vietnam's co-publications with its five strongest collaboration partners from the ASEAN region, it is visible that the co-publications involving authors

from Thailand and especially from Singapore are growing fast comparatively (Figure 121). Vietnam’s annual co-publication output with Thailand grew rather steadily from 2004 to 2011 with some set-backs (from 2007 to 2008 and from 2010 to 2011), starting just above 40 co-publications in 2004 to nearly 100 co-publications in 2011, from 2011 onwards the annual co-publication output grew fast but declined from 2013 to 2014. This is similar to the development of Vietnam’s co-publications with Singapore, where from 2008 onwards the annual co-publication output grew faster and declined from 2013 to 2014 as well. Co-publications with Malaysia, the Philippines and Indonesia are showing positive trend overall with many small set-backs.

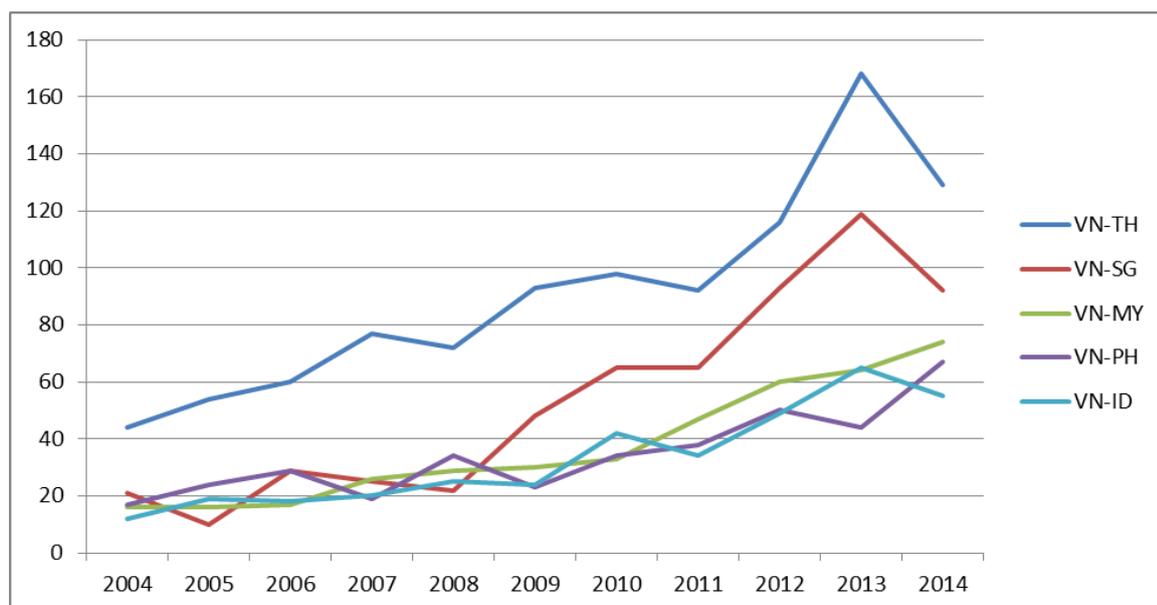


Figure 121: Vietnam's co-publications with the five strongest ASEAN collaboration countries and their development over time, 2004-2014

As shown above, for Indonesia, the Philippines and Vietnam the strongest collaboration partner countries of the ASEAN region are Malaysia, Thailand and Singapore. Figure 122, Figure 123 and Figure 124 show the overall distribution of SM research fields for the Philippines’ co-publications with Malaysia, Thailand and Singapore in detail.

The three SM research fields with the most co-publication output for Vietnam and Thailand are “Clinical Medicine” (238 co-publications), “Biomedical Research” (212 co-publications) and “Biology” (84 co-publications), for Vietnam and Singapore “Clinical Medicine” (230 co-publications), “Information & Communication Technologies” (59 co-publications) and “Biomedical Research” (52 co-publications), for Vietnam and Malaysia “Clinical Medicine” (110 co-publications), “Biomedical Research” (56 co-publications) and “Biology” (46 co-publications), for Vietnam and the Philippines as well “Clinical Medicine” (99 co-publications), “Biology” (56 co-publications) and “Biomedical Research” (52 co-publications) and for Vietnam and Indonesia “Clinical Medicine” (106 co-publications), “Biomedical Research” (69 co-publications) and “Biology” (45 co-publications).

“Clinical Medicine” is the SM research field with the most co-publications in all five cases, and in these, the other SM research fields do not vary much – only three other research fields are

represented in the top 3 research fields of each co-publication partnership: “Biomedical Research”, “Biology” and “Information & Communication Technologies”.

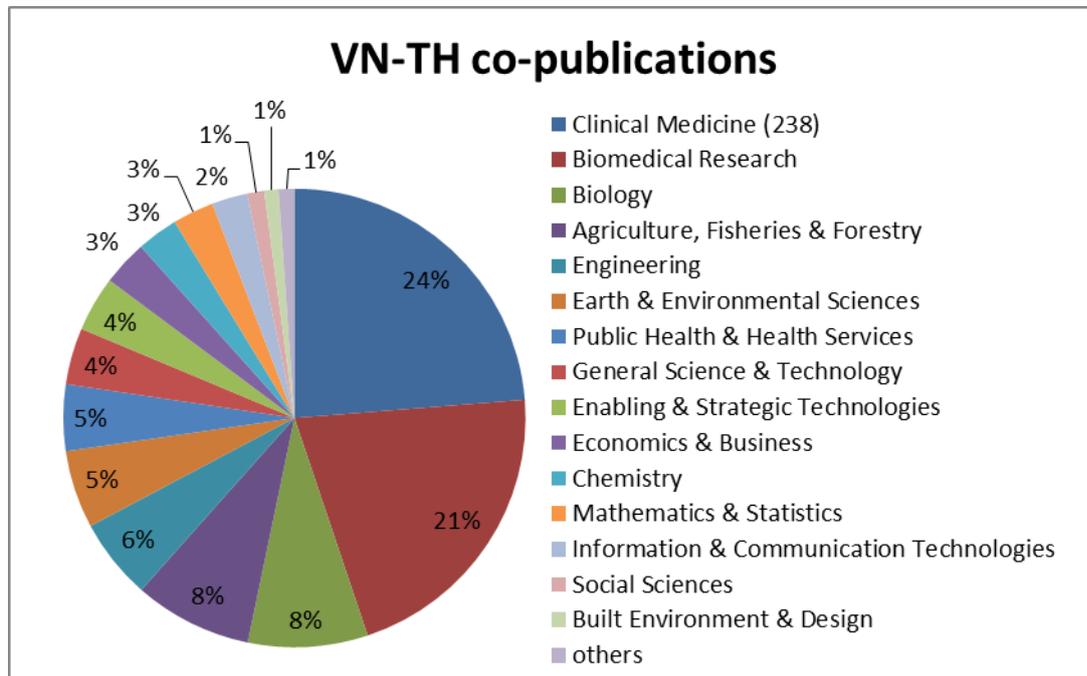


Figure 122: SM research fields of Vietnam-Thailand co-publications, 2004-2014

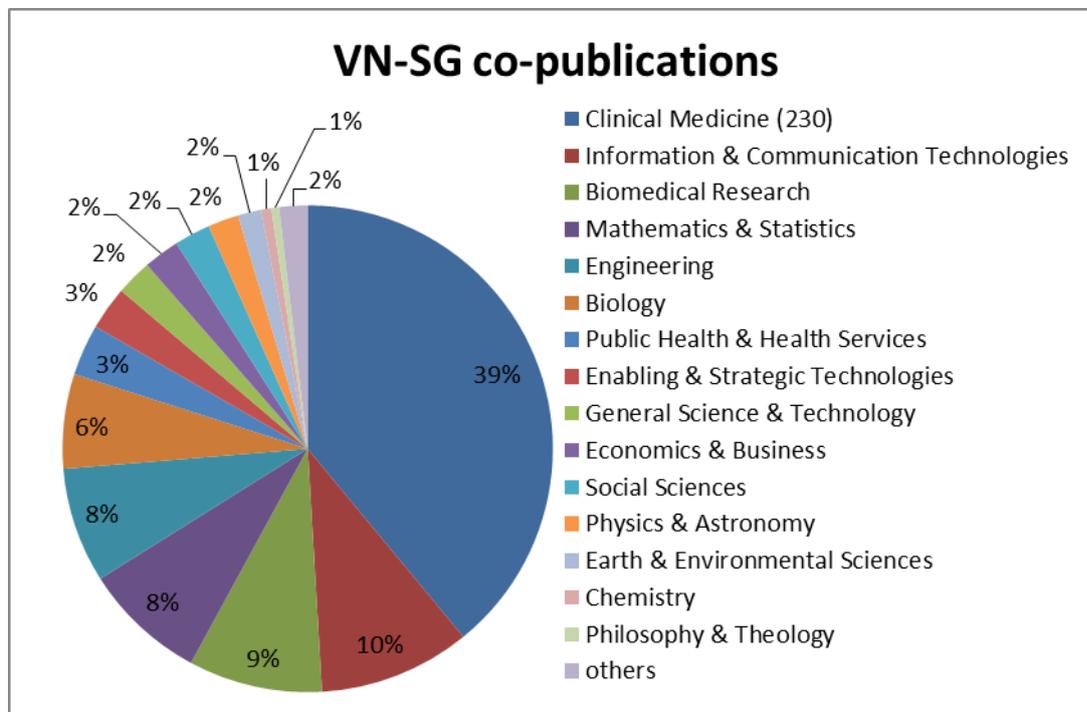


Figure 123: SM research fields of Vietnam-Singapore co-publications, 2004-2014

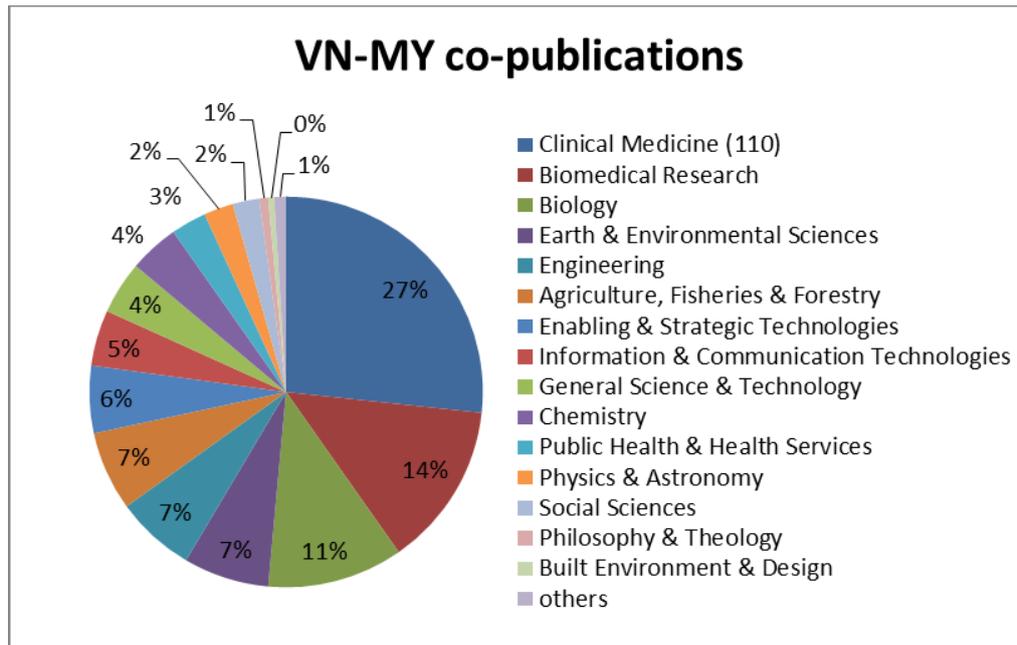


Figure 124: SM research fields of Vietnam-Malaysia co-publications, 2004-2014

**Vietnam’s collaboration linkages – with the EU28/AC countries in detail**

In total, Vietnam has 8, 468 co-publications which involve at least one author affiliated in one of the EU’s 28 member states or the countries associated to FP7 (further: EU28/AC). Figure 125 shows the involvement of the 15 EU28/AC countries which are involved most in co-publications with Vietnam from 2004-2014. The strongest collaboration partner for Vietnam in the EU28/AC region is France with 2,437 joint co-publications. Second strongest partner is Great Britain with 1,779 and third strongest partner is Germany with 1,526 joint co-publications, followed by the Netherlands with 1,064 and Belgium with 905 co-publications.

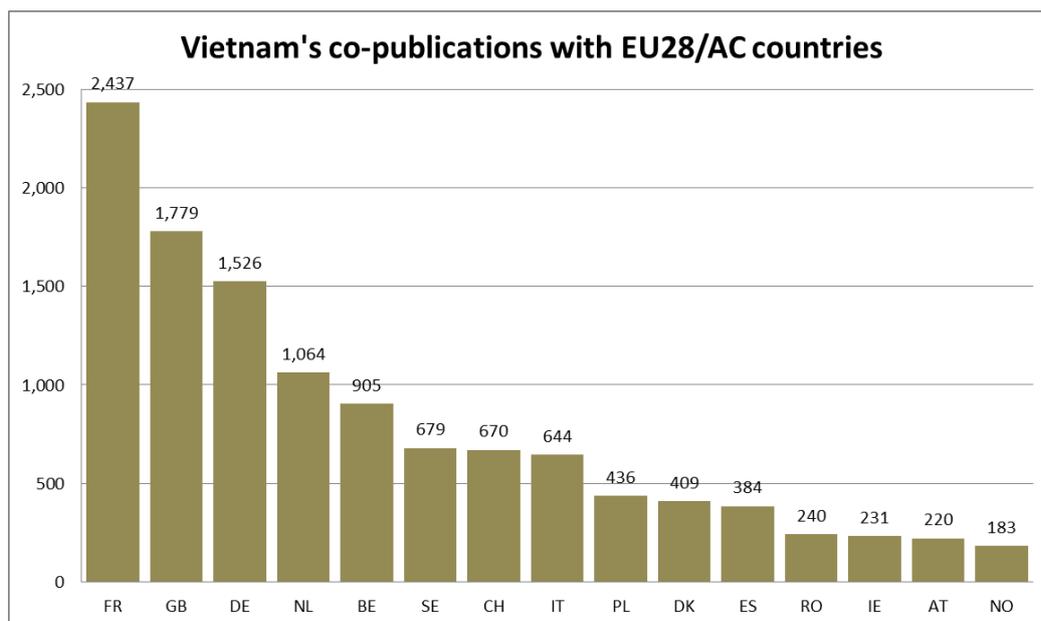


Figure 125: Vietnam’s co-publications with EU28/AC countries, 2004-2014

Looking at the development over time of Vietnam’s co-publications with its five strongest collaboration partners from the EU28/AC region (Figure 126), it is visible that the co-publications involving authors affiliated in Germany are growing somewhat faster than with France, Great Britain, the Netherlands and Belgium, especially since 2009. Co-publications with Belgium and the Netherlands have a comparatively slower increase in their annual co-publication output than the other three countries.

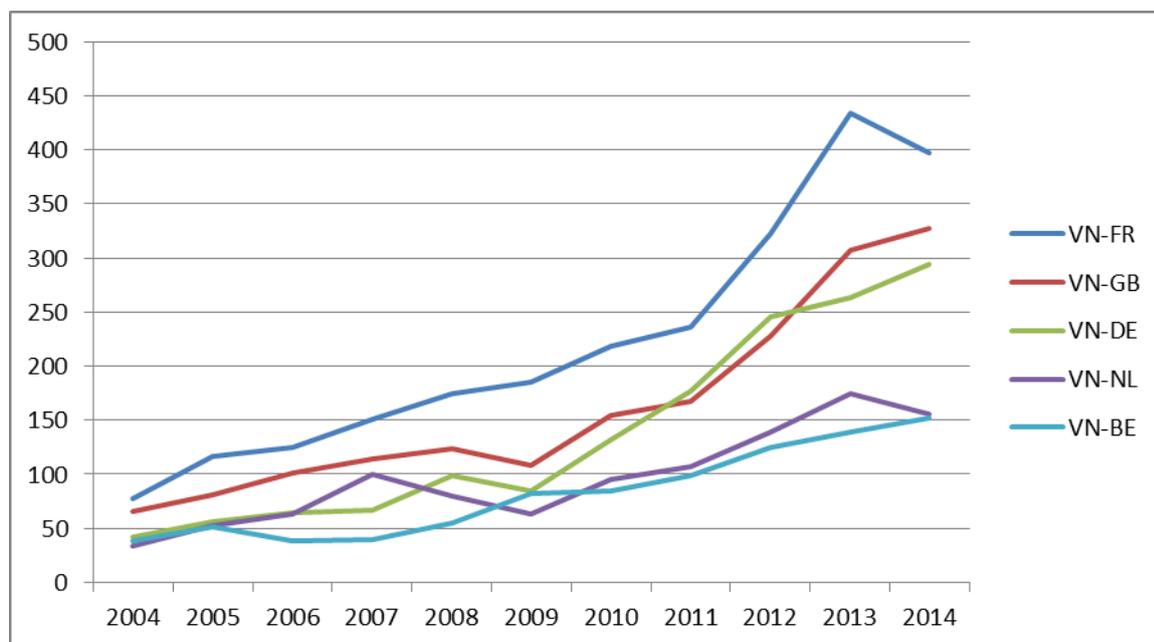


Figure 126: Vietnam’s co-publications with the five strongest EU28/AC collaboration partner countries and their development over time, 2004-2014

Figure 127, Figure 128 and Figure 129 show the overall distribution of SM research fields for Vietnam’s co-publications with France, Great Britain and Germany in detail.

The three SM research fields with the most co-publication output for Vietnam and France are “Physics & Astronomy” (429 co-publications), “Information & Communication Technologies” (349 co-publications) and “Biomedical Research” (215 co-publications), for Vietnam and Great Britain “Clinical Medicine” (372 co-publications), “Biomedical Research” (332 co-publications) and “Physics & Astronomy” (285 co-publications), for Vietnam and Germany “Physics & Astronomy” (347 co-publications), “Biology” (252 co-publications) and “Clinical Medicine” (135 co-publications), for Vietnam and the Netherlands “Physics & Astronomy” (226 co-publications), “Biomedical Research” (204 co-publications) and “Clinical Medicine” (128 co-publications) and for Vietnam and Belgium “Agriculture, Fisheries & Forestry” (126 co-publications), “Physics & Astronomy” (121 co-publications) and “Chemistry” (116 co-publications).

“Physics & Astronomy” is the SM research field with the most co-publications in three cases (co-publications with France, Germany and the Netherlands) and once with the second and third most co-publications (Belgium and Great Britain), “Biomedical Research” and “Clinical Medicine” are also two fields which are rather prominent in the top three SM research fields of these five country pairs.

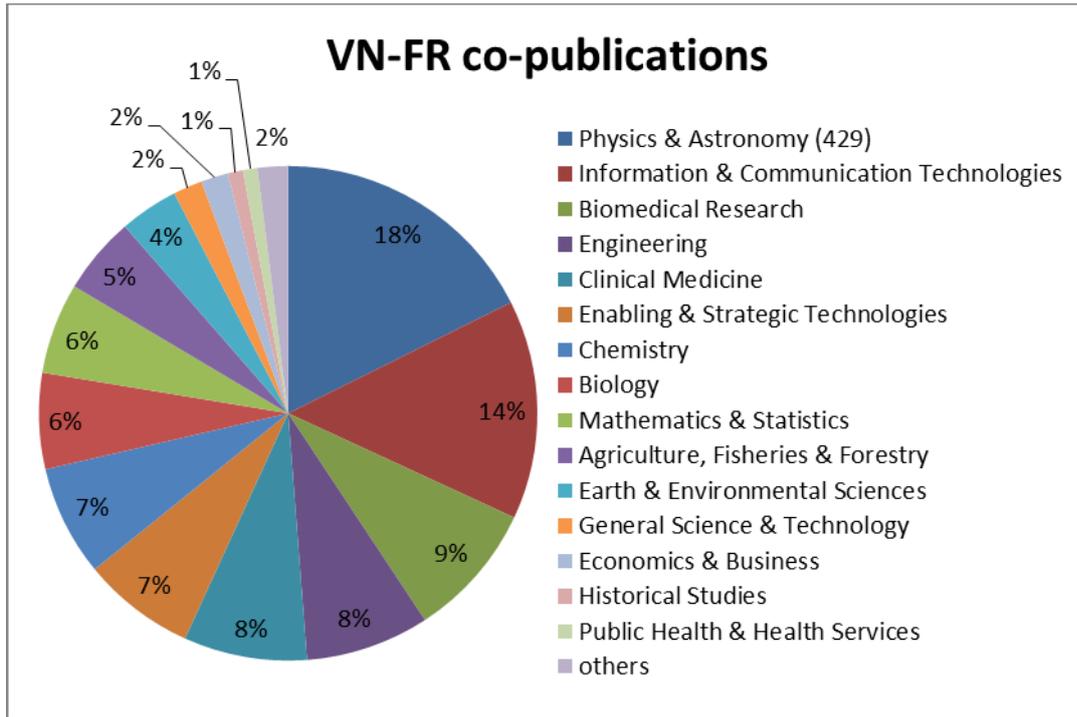


Figure 127: SM research fields of Vietnam-France co-publications, 2004-2014

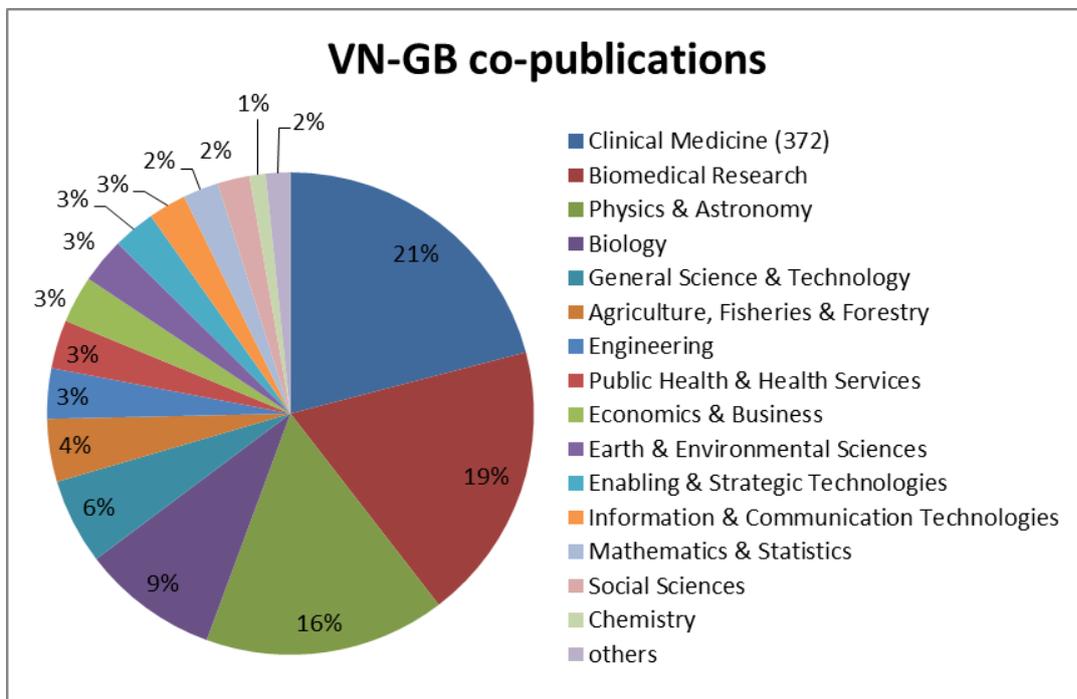


Figure 128: SM research fields of Vietnam-Great Britain co-publications, 2004-2014

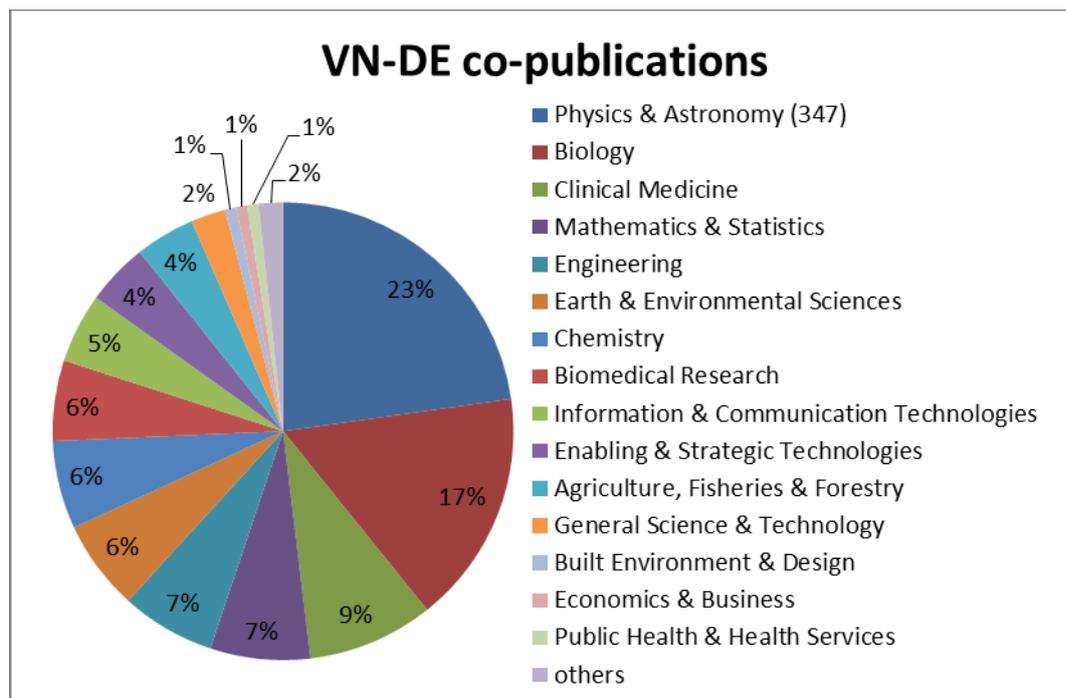


Figure 129: SM research fields of Vietnam-Germany co-publications, 2004-2014

### Analysis of research fields – the Philippines with the ASEAN region and the EU28/AC respectively

For the co-publications of the Philippines involving at least one additional author from another ASEAN country, “Clinical Medicine” is, once again, the research field published most in: 28% or 669 co-publications (see Figure 130). This is 30% of all Philippine “Clinical Medicine” co-publications or 16% of all Philippine “Clinical Medicine” publications. “Biology” is the research field with the second most Philippine-ASEAN co-publication output: 12% of all Philippine-ASEAN co-publications or 291 co-publications in total. This is nearly 15% of all Philippine “Biology” co-publications or 9% of all Philippine “Biology” publications overall. These two research fields are followed by “Biomedical Research” (11% or 257 co-publications, which is around 24% of the “Biomedical Research” co-publications of the Philippines or 18% of the overall “Biomedical Research” publications of the Philippines), “Agriculture, Fisheries & Forestry” (7% or 168 co-publications, which is around 14% of the “Agriculture, Fisheries & Forestry” co-publications or 8% of the overall “Agriculture, Fisheries & Forestry” publications of the Philippines) and “Earth & Environmental Sciences” (6% or 137 co-publications, which is nearly 23% of the “Earth & Environmental Sciences” co-publications or nearly 15% of the overall “Earth & Environmental Sciences” publications of the Philippines).

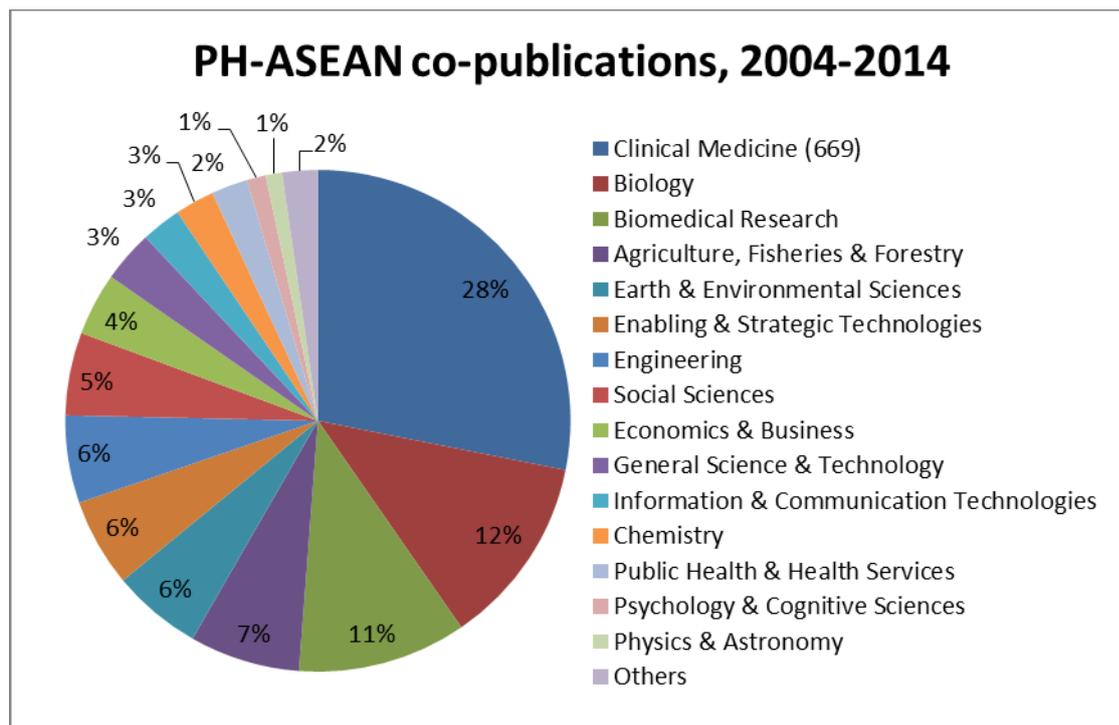


Figure 130: SM research fields of Philippine co-publications with ASEAN countries, 2004-2014

With 24% (or 901 co-publications) of all Philippine co-publications involving at least one author from an EU28/AC country “Clinical Medicine” is the research field published most in (Figure 131). In 41% of all Philippine “Clinical Medicine” co-publications or around 22% of the overall Philippine “Clinical Medicine” publications, at least one author from an EU28/AC country is involved. The research field with the second most Philippine-EU28/AC co-publications in the time frame 2004 to 2014 is “Biology” with 15% of all Philippine co-publications with the EU28/AC or 557 co-publications, which are nearly 30% of all Philippine co-publications in “Biology” or around 18% of the overall Philippine publications in “Biology”. These two research fields are followed by “Biomedical Research” (11% or 397 co-publications, which are around 37% of the “Biomedical Research” co-publications of the Philippines or around 28% of the overall “Biomedical Research” publications of the Philippines), “Agriculture, Fisheries & Forestry” (8% or 286 co-publications, which are 24% of the “Agriculture, Fisheries & Forestry” co-publications or 14% of the overall “Agriculture, Fisheries & Forestry” publications of the Philippines) and “Earth & Environmental Sciences” (6% or 211 co-publications, which is 35% of the “Earth & Environmental Sciences” co-publications or nearly 23% of the overall “Earth & Environmental Sciences” publications of the Philippines).

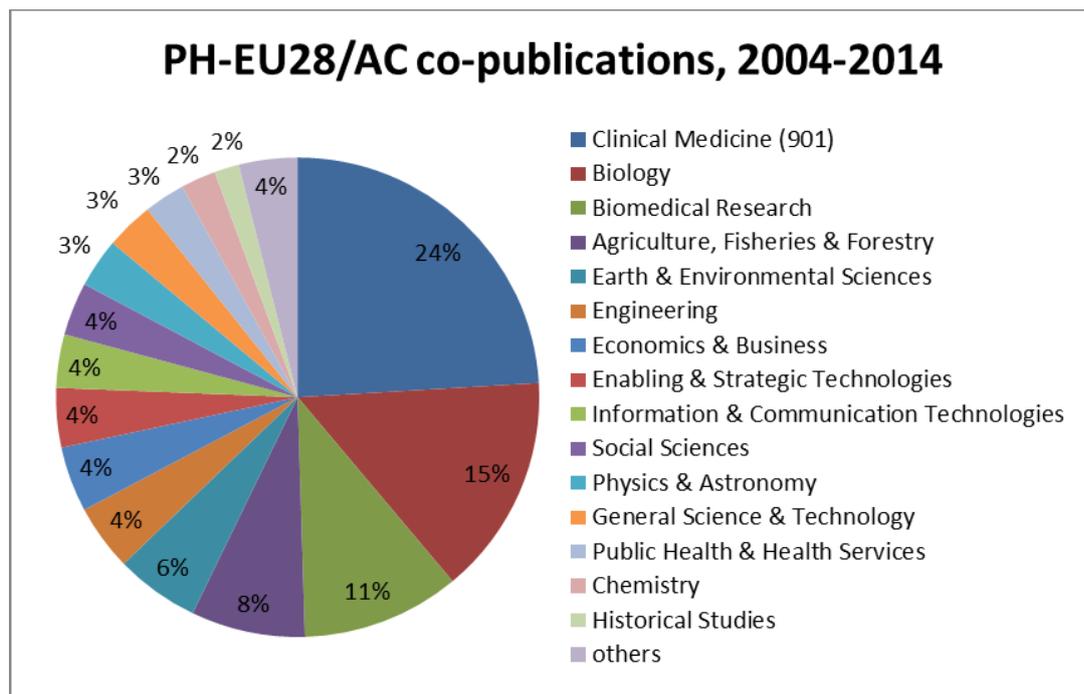


Figure 131: SM research fields of Philippine co-publications with EU28/AC countries, 2004-2014

### The Philippines' collaboration linkages - within the ASEAN region in detail

2,255 Philippine co-publications involve at least one author affiliated in another ASEAN country. Figure 132 shows the involvement of the different ASEAN countries in co-publications with the Philippines from 2004-2014. The strongest collaboration partner for the Philippines in the ASEAN region is Malaysia with 886 joint co-publications. Second strongest partner is Thailand with 841 and third strongest partner is Singapore with 680 joint co-publications, followed by Indonesia with 551 co-publications.

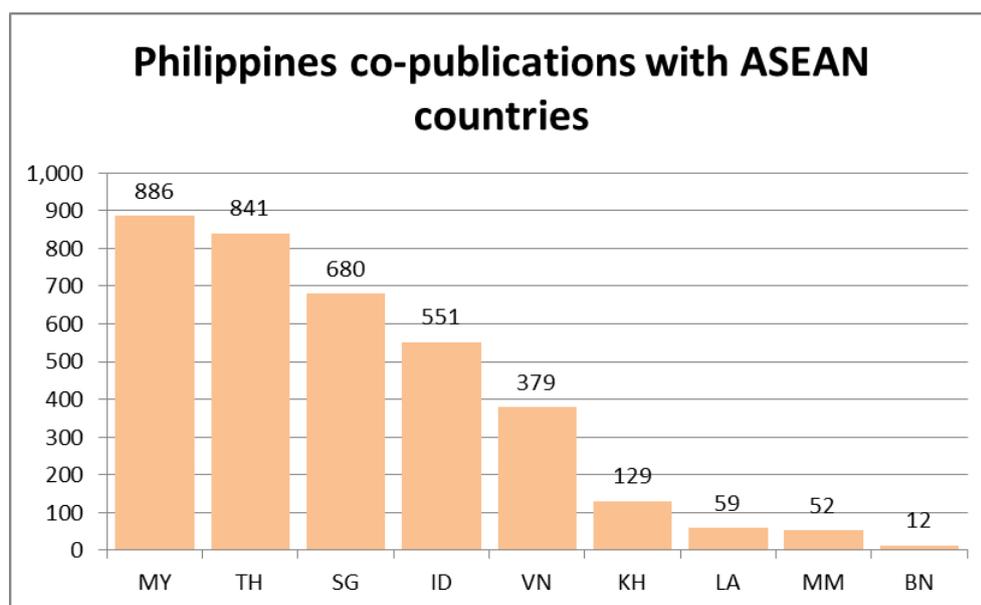


Figure 132: Philippines' co-publications with ASEAN countries, 2004-2014

Looking at the development over time of the Philippines co-publications with its five strongest collaboration partners from the ASEAN region (Figure 133), it is visible that the co-publications involving authors from Malaysia and from Thailand are growing somewhat faster and more continuously comparatively. Vietnam’s annual co-publication output with Malaysia grew steadily from 2004 with just above 20 co-publications to over 160 co-publications in 2014 with no set-backs. The co-publications involving authors from Thailand are growing more slowly, with two set-backs from 2009 to 2010 and 2013 to 2014. As the number of annual co-publications of the Philippines with Singapore, Indonesia and Vietnam are quite low, the annual output of these varies frequently. Overall, number of co-publications with all countries is continuously growing in the period 2004-2014.

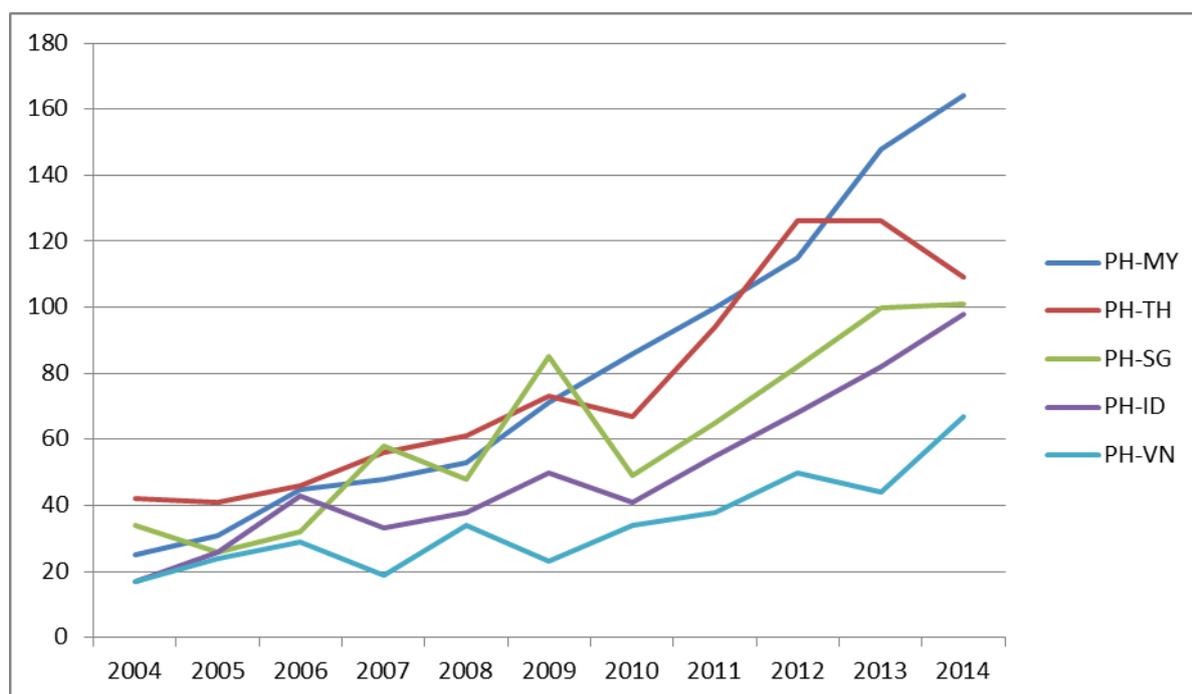


Figure 133: The Philippines' co-publications with the five strongest ASEAN collaboration countries and their development over time, 2004-2014

Figure 134, Figure 135 and Figure 136 show the overall distribution of SM research fields for the Philippines’ co-publications with Malaysia, Thailand and Singapore in detail.

The three SM research fields with the most co-publication output for the Philippines and Malaysia are “Clinical Medicine” (288 co-publications), “Biomedical Research” (88 co-publications) and “Biology” (71 co-publications), for the Philippines and Thailand “Clinical Medicine” (326 co-publications), “Biomedical Research” (144 co-publications) and “Biology” (70 co-publications), for the Philippines and Singapore “Clinical Medicine” (303 co-publications), “Biology” (74 co-publications) and “Biomedical Research” (63 co-publications), for the Philippines and Indonesia as well “Clinical Medicine” (189 co-publications), “Biology” (78 co-publications) and “Biomedical Research” (65 co-publications) and for the Philippines and Vietnam “Clinical Medicine” (99 co-publications), “Biology” (56 co-publications) and “Biomedical Research” (52 co-publications).

“Clinical Medicine” is the SM research field with the most co-publications in all five cases, and in these the other SM research fields do not vary as well – only two other research fields are in the top 3 research fields of each co-publication partnership: “Biomedical Research” and “Biology”.

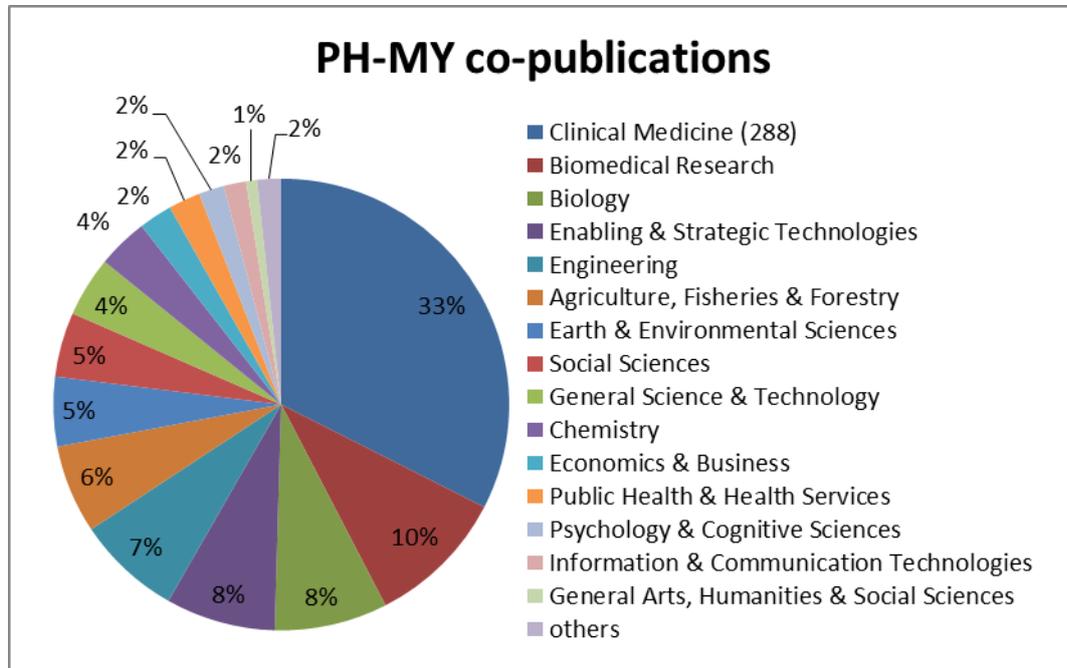


Figure 134: SM research fields of Philippines-Malaysia co-publications, 2004-2014

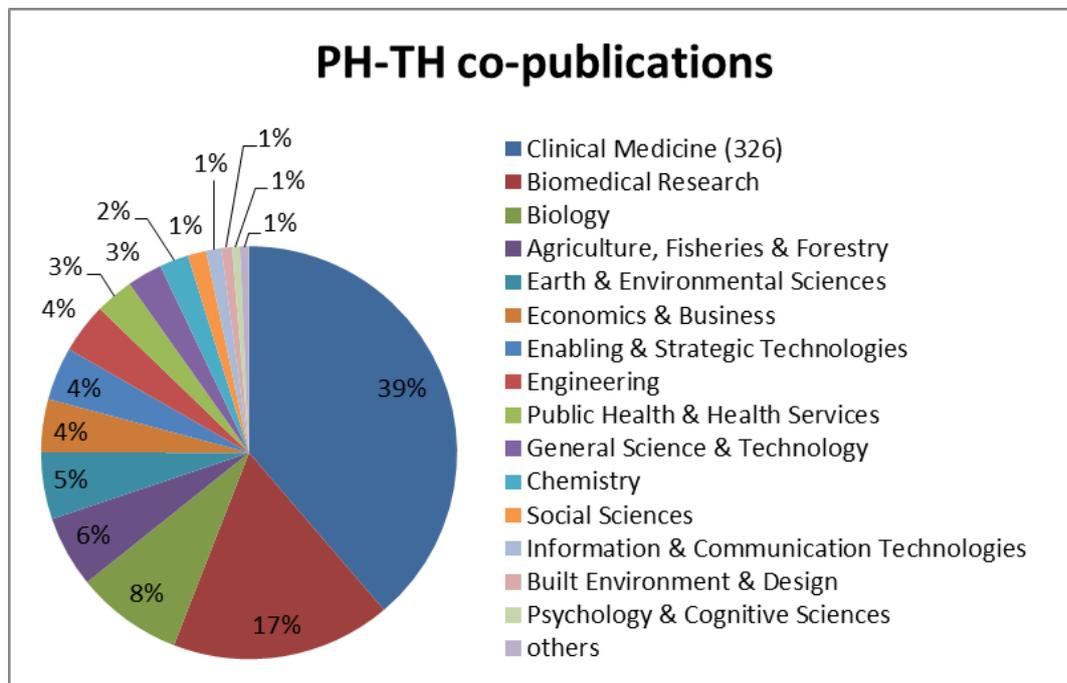


Figure 135: SM research fields of Philippines-Thailand co-publications, 2004-2014

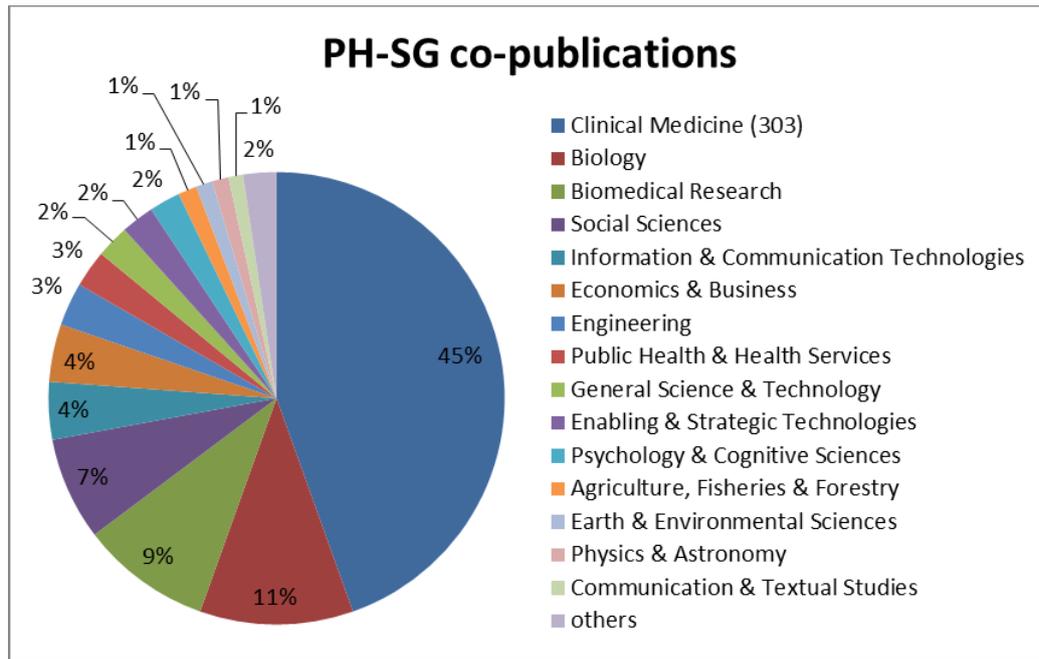


Figure 136: SM research fields of Philippines-Singapore co-publications, 2004-2014

**The Philippines' collaboration linkages- with the EU28/AC countries in detail**

In total, the Philippines have 3,746 co-publications which involve at least one author affiliated in one of the EU's 28 member states or the countries associated to FP7 (further: EU28/AC). Figure 137 shows the involvement of the 15 EU28/AC countries which are involved most in co-publications with the Philippines from 2004-2014. The strongest collaboration partner for the Philippines in the EU28/AC region is Great Britain with 1,135 joint co-publications. Second strongest partner is Germany with 787 and third strongest partner is France with 663 joint co-publications, followed by the Netherlands with 472 and Switzerland with 416 co-publications.

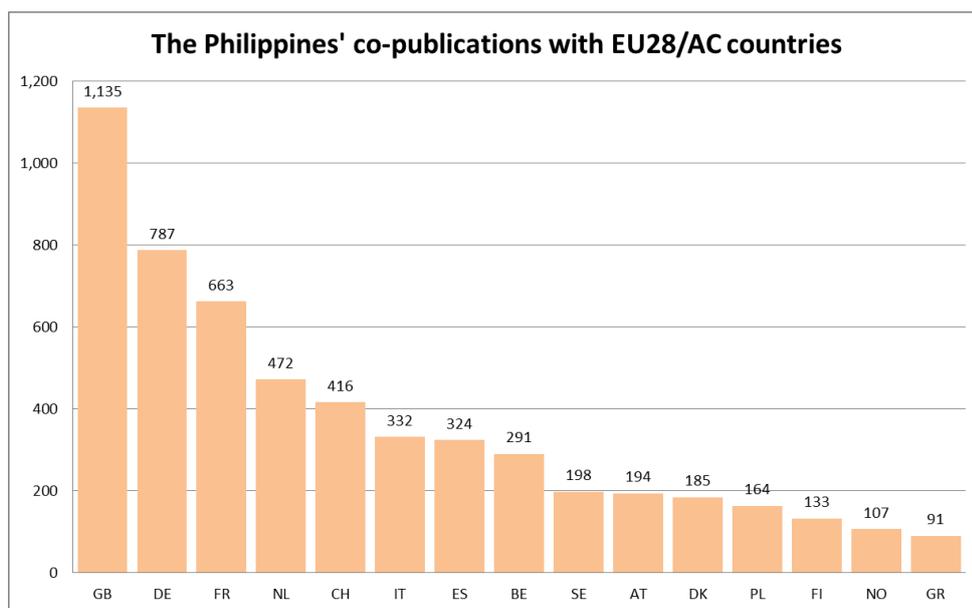


Figure 137: The Philippines' co-publications with EU28/AC countries, 2004-2014

Looking at the development over time of the Philippines’ co-publications with its five strongest collaboration partners from the EU28/AC region, it is visible that the co-publications involving authors affiliated in Great Britain are growing somewhat faster than with Germany, France, the Netherlands and Switzerland (Figure 138), even though the growth stops in 2012 and has slightly declined from 2012 to 2014. Co-publications with Germany are growing also comparatively fast, with two set-backs from 2005 to 2016 and from 2009 to 2010. The development of the annual co-publication output with the Netherlands and Switzerland is rather similar – their annual co-publication output doubled from 2004 to 2014.

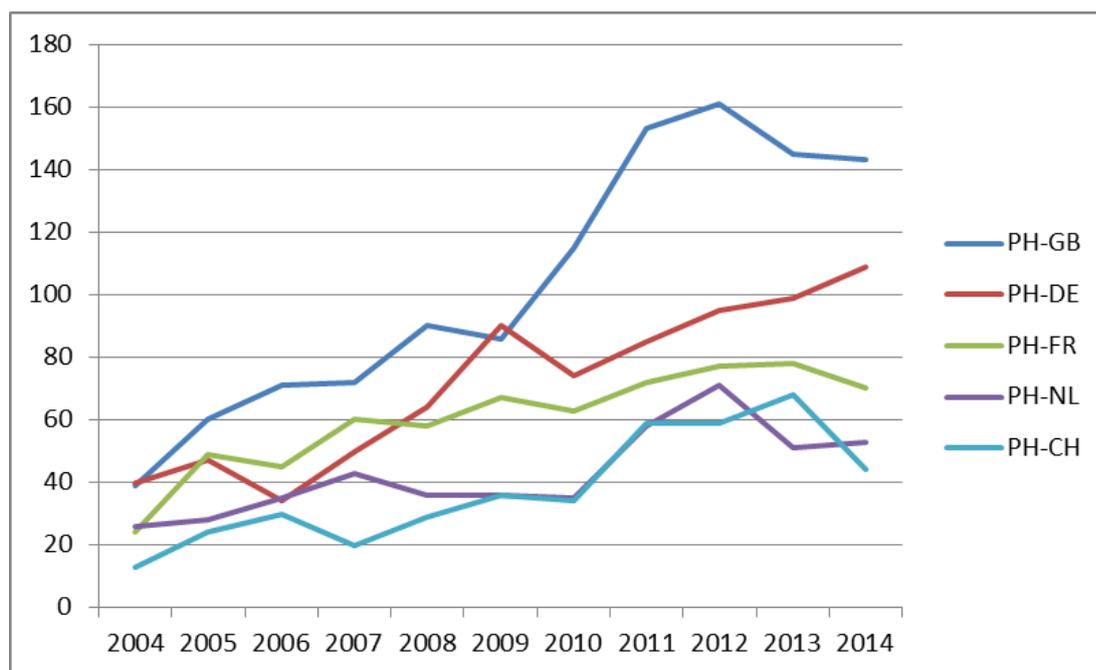


Figure 138: The Philippines’ co-publications with the five strongest EU28/AC collaboration partner countries and their development over time, 2004-2014

Figure 139, Figure 140 and Figure 141 show the overall distribution of SM research fields for the Philippines’ co-publications with Great Britain, Germany and France in detail.

The three SM research fields with the most co-publication output for the Philippines and Great Britain are “Clinical Medicine” (288 co-publications), “Biology” (157 co-publications) and “Biomedical Research” (97 co-publications), for the Philippines and Germany “Clinical Medicine” (181 co-publications), “Biology” (145 co-publications) and “Earth & Environmental Sciences” (81 co-publications), for the Philippines and France “Clinical Medicine” (144 co-publications), “Biology” (91 co-publications) and “Biomedical Research” (87 co-publications), for the Philippines and the Netherlands “Clinical Medicine” (107 co-publications), “Biology” (67 co-publications) and “Biomedical Research” (66 co-publications) and for the Philippines and Switzerland “Clinical Medicine” (164 co-publications), “Biomedical Research” (90 co-publications) and “Biology” (32 co-publications).

“Clinical Medicine” is the SM research field with the most co-publications in all five cases, the other SM research fields do also vary not that much – only three other different research fields are in the top 3 research fields of each co-publication partnership: “Biology”, “Biomedical Research” and “Earth & Environmental Sciences”.

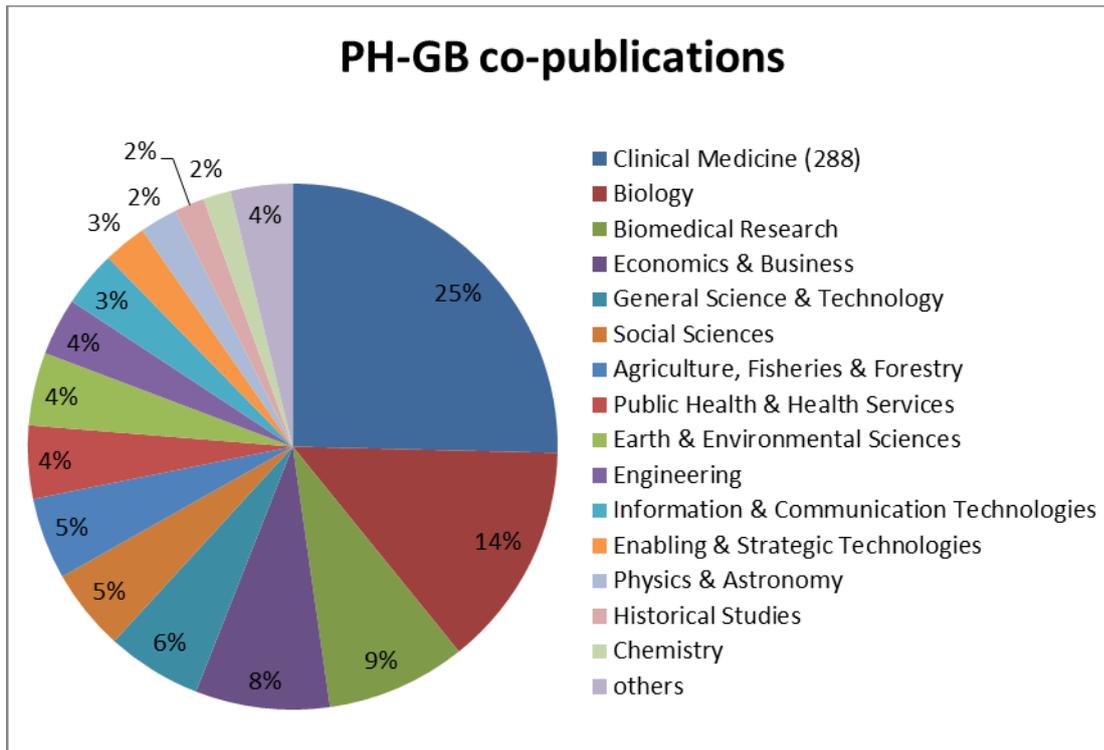


Figure 139: SM research fields of the Philippines-Great Britain co-publications, 2004-2014

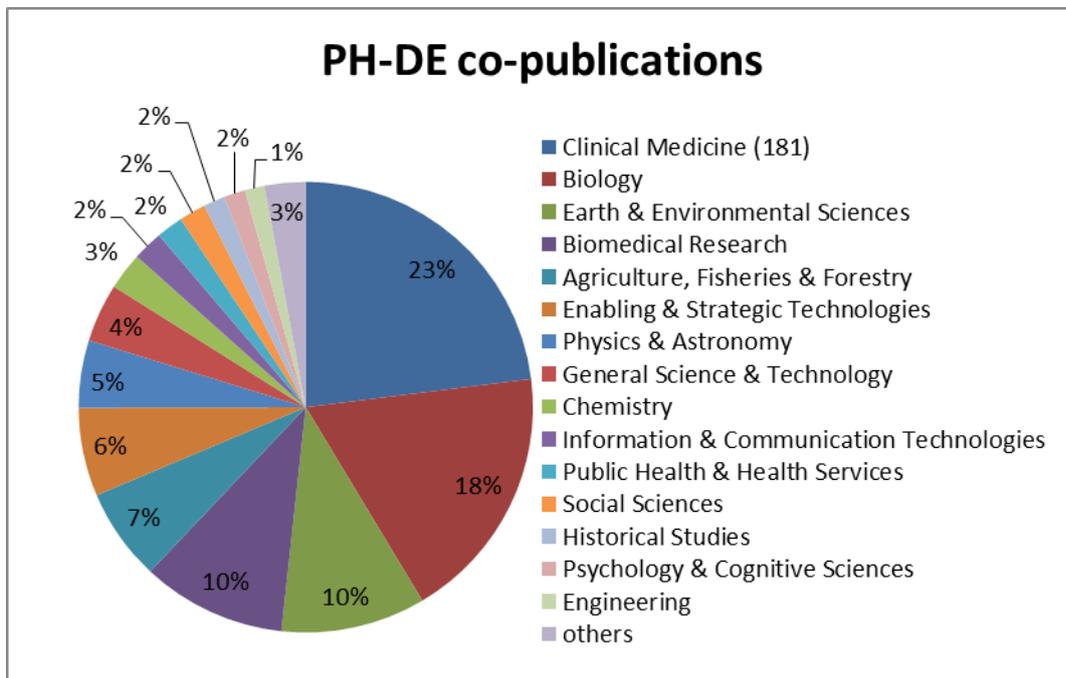


Figure 140: SM research fields of the Philippines-Germany co-publications, 2004-2014

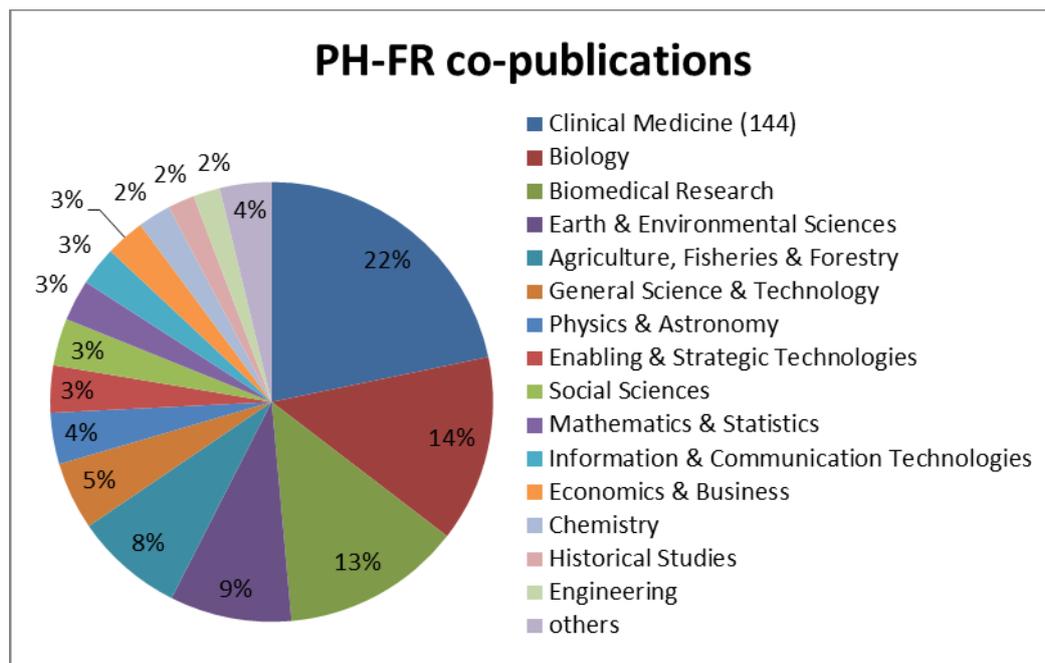


Figure 141: SM research fields of the Philippines-France co-publications, 2004-2014

### Impact Analysis

Within the analysed time span of 2004 to 2014, the average citation of a publication involving at least one author from Indonesia amounts to 4.13, i.e. each publication has been cited on average 4.13 times. Works co-authored with at least one author from a foreign country are cited more often: 7.19 is the number of average citations for internationally co-authored works. Works co-authored with at least one author from EU28/AC are cited 10.24 times on average and co-publications with at least one author from an ASEAN country are cited 7.65 times on average.

The situation for Vietnam is quite similar with slightly higher average citation counts: the average citation of a publication involving at least one author from Vietnam amounts to 5.54, i.e. each publication has been cited on average 5.54 times. Works co-authored with at least one author from a foreign country are cited more often: 7.36 is the number of average citations for internationally co-authored works. Works co-authored with at least one author from EU28/AC are cited 9.37 times on average and co-publications with at least one author from an ASEAN country are cited 13.61 times on average. Thus, interestingly, the citation count of co-publications with an ASEAN country exceeds the impact of co-publications with EU27/AC, unlike in other country cases.

The situation for the Philippines is quite similar as well with even higher average citation counts: the average citation of a publication involving at least one author from the Philippines amounts to 6.68, i.e. each publication has been cited on average 6.68 times. Works co-authored with at least one author from a foreign country are cited more often: 10.84 is the number of average citations for internationally co-authored works. Works co-authored with at least one author from EU28/AC are cited 16.93 times on average and co-publications with at least one author from an ASEAN country are cited 15.47 times on average.

*Overview of average citations per SM research field: Comparison of Indonesia's/Vietnam's/the Philippines' publications, co-publications, co-publications with ASEAN and with EU28/AC*

Table 18, Table 19 and Table 20 give an overview of the average citations of the different Science Metrix fields of Indonesian, Vietnamese and Philippine overall publications, co-publications as well as Indonesian, Vietnamese and Philippine co-publications with the ASEAN and EU28/AC countries. Figures in bold mark the comparatively highest average citation count.

Indonesia's co-publications with ASEAN countries have a comparatively high impact in "Built Environment & Design" and "Psychology & Cognitive Science" - fields with rather low (co-)publication output. Co-publications with EU28/AC countries have a comparatively high impact in most of the fields, except for "Built Environment & Design" and "Psychology & Cognitive Science" (Indonesia-ASEAN co-publications have the highest average citations) and "Mathematics & Statistics" and "Social Sciences" (overall Indonesia international co-publications have the highest average citations).

	ID publications	ID co-publications	ID-EU28/AC co-pubs	ID-ASEAN co-pubs
<b>Agriculture, Fisheries &amp; Forestry</b>	4.51	5.69	<b>6.19</b>	4.82
<b>Biology</b>	5.95	7.54	<b>9.64</b>	6.55
<b>Biomedical Research</b>	10.11	13.51	<b>17.23</b>	15.37
<b>Built Environment &amp; Design</b>	3.77	5.74	3.27	<b>9.9</b>
<b>Chemistry</b>	6.56	8.56	<b>10.14</b>	5.24
<b>Clinical Medicine</b>	6.48	11.37	<b>18</b>	14.15
<b>Communication &amp; Textual Studies</b>	0.84	1.86	<b>3.51</b>	0.81
<b>Earth &amp; Environmental Sciences</b>	6.34	7.62	<b>8.74</b>	8.23
<b>Economics &amp; Business</b>	2.42	4.23	<b>5.82</b>	1.73
<b>Enabling &amp; Strategic Technologies</b>	2.9	4.78	<b>5.15</b>	4.8
<b>Engineering</b>	1.54	3.17	<b>5.39</b>	2.12
<b>General Arts, Humanities &amp; Social Sciences</b>	0.6	2.3	<b>2.78</b>	1.64
<b>General Science &amp; Technology</b>	9.7	16.64	<b>19.76</b>	15.27
<b>Historical Studies</b>	5.33	7.98	<b>9.65</b>	8.61
<b>Information &amp; Communication Technologies</b>	0.79	1.86	<b>2.24</b>	1.45
<b>Mathematics &amp; Statistics</b>	1.85	<b>2.29</b>	2.27	1.16
<b>Philosophy &amp; Theology</b>	0.96	1.14	<b>2.23</b>	1.25
<b>Physics &amp; Astronomy</b>	2.06	4.85	<b>7.02</b>	2.07
<b>Psychology &amp; Cognitive Sciences</b>	3.76	5.94	7.03	<b>11.54</b>
<b>Public Health &amp; Health Services</b>	4.7	5.97	<b>6.49</b>	4.68
<b>Social Sciences</b>	1.35	<b>2.57</b>	2.5	1.03
<b>Visual &amp; Performing Arts</b>	0.27	0	--	--

Table 18: Overview of average citations of different SM research fields: Indonesian publications, co-publications, ASEAN co-publications and EU28/AC co-publications

Vietnam's co-publications with ASEAN countries have a comparatively high impact in most of the SM research fields: "Biology", "Biomedical Research", "Built Environment & Design", "Clinical Medicine",

“Communication & Textual Studies”, “Economics & Business”, “Engineering”, “General Arts, Humanities & Social Sciences”, “General Science & Technology”, “Information & Communication Technologies”, “Mathematics & Statistics”, “Philosophy & Theology”, “Public Health & Health Services” and “Social Sciences”. Co-publications with EU28/AC countries have a comparatively high impact in the remaining seven fields: “Agriculture, Fisheries & Forestry”, “Chemistry”, “Earth & Environmental Sciences”, “Enabling & Strategic Technologies”, “Historical Studies”, “Physics & Astronomy” and “Psychology & Cognitive Sciences”.

	<b>VN publications</b>	<b>VN co-publications</b>	<b>VN-EU28/AC co-pubs</b>	<b>VN-ASEAN co-pubs</b>
<b>Agriculture, Fisheries &amp; Forestry</b>	5	5.47	<b>6.36</b>	5.98
<b>Biology</b>	4.9	5.32	6.25	<b>6.94</b>
<b>Biomedical Research</b>	13.66	14.53	16.46	<b>21.53</b>
<b>Built Environment &amp; Design</b>	6.03	6.99	10.88	<b>17.79</b>
<b>Chemistry</b>	5.57	5.87	<b>6.33</b>	5.57
<b>Clinical Medicine</b>	11.01	13.08	17.47	<b>20.7</b>
<b>Communication &amp; Textual Studies</b>	0.97	1.71	1.57	<b>3.33</b>
<b>Earth &amp; Environmental Sciences</b>	7.72	8.79	<b>9.95</b>	9.31
<b>Economics &amp; Business</b>	2.94	3.65	3.73	<b>5.98</b>
<b>Enabling &amp; Strategic Technologies</b>	3.59	4.6	<b>5.77</b>	4.28
<b>Engineering</b>	2.64	3.5	3.79	<b>4.83</b>
<b>General Arts, Humanities &amp; Social Sciences</b>	0.78	1.78	1.77	<b>2</b>
<b>General Science &amp; Technology</b>	20.04	23.21	27.46	<b>43.58</b>
<b>Historical Studies</b>	4.75	5.68	<b>7.07</b>	0.83
<b>Information &amp; Communication Technologies</b>	1.02	1.61	1.7	<b>3.27</b>
<b>Mathematics &amp; Statistics</b>	3.14	4.95	5.82	<b>10.36</b>
<b>Philosophy &amp; Theology</b>	2.96	3.17	1.67	<b>3.5</b>
<b>Physics &amp; Astronomy</b>	5.44	6.73	<b>8.89</b>	3.23
<b>Psychology &amp; Cognitive Sciences</b>	5.02	6.24	<b>6.8</b>	3.44
<b>Public Health &amp; Health Services</b>	6.75	7.34	8.05	<b>11.56</b>
<b>Social Sciences</b>	1.93	2.42	2.91	<b>3</b>
<b>Visual &amp; Performing Arts</b>	0	0	--	--

Table 19: Overview of average citations of different SM research fields: Vietnam publications, co-publications, ASEAN co-publications and EU28/AC co-publications

The Philippines’ co-publications with ASEAN countries have a comparatively high impact in “Chemistry”, “Engineering”, “Historical Studies”, “Information & Communication Technologies”, “Psychology & Cognitive Science” and “Public Health & Health Services”. Co-publications with EU28/AC countries have a comparatively high impact in nearly all of the other fields.

	PH publications	PH co-publications	PH-EU28/AC co-pubs	PH-ASEAN co-pubs
Agriculture, Fisheries & Forestry	7.07	9.72	<b>10.53</b>	8.05
Biology	7.6	10.66	<b>12.71</b>	7.79
Biomedical Research	10.37	12.86	<b>16.4</b>	15.88
Built Environment & Design	2.81	3.38	<b>8.81</b>	8.06
Chemistry	7.91	8.52	8.7	<b>11.75</b>
Clinical Medicine	10.49	18.11	<b>31.23</b>	26.76
Communication & Textual Studies	0.58	1.63	<b>2.95</b>	0.14
Earth & Environmental Sciences	6.98	9.25	<b>13.24</b>	10.37
Economics & Business	2.01	3.15	<b>3.23</b>	2.32
Enabling & Strategic Technologies	5.22	7.38	<b>11.27</b>	6.82
Engineering	2.73	4.75	3.45	<b>7.86</b>
General Arts, Humanities & Social Sciences	0.91	<b>1.98</b>	1	0.92
General Science & Technology	23.53	36.43	<b>68.88</b>	59.82
Historical Studies	3.78	7.77	9.97	<b>31.13</b>
Information & Communication Technologies	1.53	2.3	1.9	<b>2.39</b>
Mathematics & Statistics	2	2.47	<b>2.76</b>	2.5
Philosophy & Theology	0.26	0.77	<b>0.82</b>	0
Physics & Astronomy	3.56	5.22	<b>5.6</b>	1.92
Psychology & Cognitive Sciences	4.85	8.68	12.83	<b>14.88</b>
Public Health & Health Services	5.39	8.55	12.64	<b>13.37</b>
Social Sciences	1.01	2.06	<b>2.18</b>	1.74
Visual & Performing Arts	<b>0.22</b>	0	--	0

Table 20: Overview of average citations of different SM research fields: Philippine publications, co-publications, ASEAN co-publications and EU28/AC co-publications

### *Impact of SM research fields of Indonesia's, Vietnam's and the Philippines' co-publications with ASEAN countries*

Table 21 shows the average number of citations of each Indonesian co-publication with at least one Malaysian/Singaporean... author in the different Science-Metrix research fields. Values marked with red are below 50% of the average citation the Indonesian co-publications received in the respective research field and 2004-2014 time frame; values marked in green are more than 50% higher than the average value of citations of the Indonesian co-publications. E.g. co-publications with Vietnam and Cambodia have an above-average impact in "Clinical Medicine", co-publications with Thailand, the Philippines and Vietnam in "General Science & Technology" and co-publications with Vietnam in "Biomedical Research".

	ID co-publications	ID-MY co-publications	ID-TH co-publications	ID-SG co-publications	ID-PH co-publications	ID-VN co-publications	ID-KH co-publications
Agriculture, Fisheries & Forestry	5.69	3.73	6.23	--	8.36	7.65	--
Biology	7.54	6.9	8.02	7.81	5.06	7.2	--
Biomedical Research	13.51	11.25	16.12	10.93	15.73	29.89	11
Built Environment & Design	5.74	8.16	--	--	--	--	--
Chemistry	8.56	4.9	--	--	--	--	--
Clinical Medicine	11.37	10.95	17.52	13.51	16.23	27.71	24.02
Earth & Environmental Sciences	7.62	6.27	13.36	6.84	14.03	9.87	--
Economics & Business	4.23	0.99	--	1.46	--	--	--
Enabling & Strategic Technologies	4.78	5.08	3.79	2.77	--	--	--
Engineering	3.17	2.04	2.03	2.4	--	--	--
General Arts, Humanities & Social Sciences	2.3	1.74	--	--	--	--	--
General Science & Technology	16.64	6.81	51.46	--	48	114.6	--
Information & Communication Technologies	1.86	1.46	--	--	--	--	--
Mathematics & Statistics	2.29	1.36	--	--	--	--	--
Physics & Astronomy	4.85	2	--	3.77	--	--	--
Psychology & Cognitive Sciences	5.94	--	8.34	--	--	--	--
Public Health & Health Services	5.97	--	5.55	--	--	--	--
Social Sciences	2.57	0.56	--	0.85	--	--	--

Table 21: Impact of Indonesia’s co-publications per SM research field with Malaysia, Thailand, Singapore, the Philippines, Vietnam and Cambodia, 2004-2014 (Threshold: only SM fields with over 20 co-publications in the time frame 2004-2014 are considered). Green table cells indicate the impact is 50 % or higher than the impact of the TH co-publications, red cells indicate the impact is at least 50 % below.

Table 22 shows the average number of citations of each Vietnamese co-publication with at least one Thai/Singaporean... author in the different Science-Matrix research fields. Values marked with red are below 50% of the average citation the Vietnamese co-publications received in the respective research field and 2004-2014 time frame; values marked in green are more than 50% higher than the average value of these citations. E.g. co-publications with Thailand in the field “Engineering” have a rather high impact; co-publications with Malaysia and Indonesia have a high impact in “Biomedical Research” as well as co-publications with Thailand in “Engineering” and “Public Health & Health Services” and co-publications VN with Malaysia, the Philippines and Cambodia in “Biology”.

	VN co-publications	VN-TH co-publications	VN-SG co-publications	VN-MY co-publications	VN-PH co-publications	VN-ID co-publications	VN-KH co-publications	VN-LA co-publications	VN-MM co-publications
Agriculture, Fisheries & Forestry	5.47	5.7	--	6.57	8.4	7.65	--	6.14	--
Biology	5.32	8.83	3.33	11.1	11.49	7.2	10.66	7.03	6.19
Biomedical Research	14.53	21.67	28.13	29.49	23.15	29.89	18.49	--	--
Chemistry	5.87	5.33	--	--	--	--	--	--	--
Clinical Medicine	13.08	27.88	13.72	13.96	15.43	27.71	36.86	18.33	--
Earth & Environmental Sciences	8.79	8.7	--	13.97	10.62	9.87	--	--	--
Economics & Business	3.65	4.98	--	--	--	--	--	--	--
Enabling & Strategic Technologies	4.6	2.85	--	3.87	--	--	--	--	--
Engineering	3.5	7.52	6.47	2.3	--	--	--	--	--
General Science & Technology	23.21	44.66	--	--	--	114.6	--	--	--
Information & Communication Technologies	1.61	1.24	4.75	--	--	--	--	--	--
Mathematics & Statistics	4.95	5.83	13.2	--	--	--	--	--	--
Public Health & Health Services	7.34	17.86	--	--	--	--	--	--	--

Table 22: Impact of Vietnam’s co-publications per SM research field with Thailand, Singapore, Malaysia, the Philippines, Indonesia, Cambodia, Lao PDR and Myanmar, 2004-2014 (Threshold: only SM fields with over 20 co-publications in the time frame 2004-2014 are considered). Green table cells indicate the impact is 50 % or higher than the impact of the TH co-publications, red cells indicate the impact is at least 50 % below.

Table 23 shows the average number of citations of each Philippine co-publication with at least one Thai/Singaporean... author in the different Science-Matrix research fields. Values marked with red are below 50% of the average citation the Philippine co-publications received in the respective research field and 2004-2014 time frame; values marked in green are more than 50% higher than the

average value of these citations. E.g. co-publications with Malaysia in the field “Engineering” have a rather high impact and co-publications with Thailand have a high impact in “Public Health & Health Sciences” and “General Science & Technology”.

	PH co-publications	PH-MY co-publications	PH-TH co-publications	PH-SG co-publications	PH-ID co-publications	PH-VN co-publications	PH-KH co-publications
Agriculture, Fisheries & Forestry	9.72	5.86	10.29	--	8.36	8.4	--
Biology	10.66	9.69	10.54	9.96	5.06	11.49	--
Biomedical Research	12.86	15.49	14.23	23.29	15.73	23.15	17.86
Chemistry	8.52	11.66	--	--	--	--	--
Clinical Medicine	18.11	25.81	30.7	34.32	16.23	15.43	24.29
Earth & Environmental Sciences	9.25	8.87	14.78	--	14.03	10.62	--
Economics & Business	3.15	1.3	3.47	1.07	--	--	--
Enabling & Strategic Technologies	7.38	6.45	11.32	--	--	--	--
Engineering	4.75	12.79	2.7	1.43	--	--	--
General Science & Technology	36.43	13.71	90.53	--	48	--	--
Information & Communication Technologies	2.3	--	--	3.03	--	--	--
Public Health & Health Services	8.55	--	19.72	--	--	--	--
Social Sciences	2.06	1.02	--	1.92	--	--	--

Table 23: Impact of the Philippines' co-publications per SM research field with Malaysia, Thailand, Singapore, Indonesia, Vietnam and Cambodia, 2004-2014 (Threshold: only SM fields with over > 20 co-publications in the time frame 2004-2014 are considered). Green table cells indicate the impact is 50 % or higher than the impact of the TH co-publications, red cells indicate the impact is at least 50 % below.

**Impact of SM research fields of Indonesia's, Vietnam's and the Philippines' co-publications with EU28/AC countries**

Table 24 shows the average number of citations of each Indonesian co-publication with at least one Dutch/British/German... author in the different Science-Metrix research fields. Values marked with red are below 50% of the average citation the Indonesian co-publications received in the respective research field and 2004-2014 time frame; values marked in green are more than 50% higher than the average value of citations of the Indonesian co-publications. E.g. co-publications with Great Britain, France and Switzerland have a rather high impact in the field “Clinical Medicine”, co-publications with Germany have a high impact in “Engineering” as well as co-publications with France in “Social Science” and “Physics & Astronomy”.

	ID co-publications	ID-NL co-publications	ID-GB co-publications	ID-DE co-publications	ID-FR co-publications	ID-CH co-publications
Agriculture, Fisheries & Forestry	5.47	4.68	6.82	5.29	5.28	--
Biology	5.32	14.29	10.96	11.23	7.71	14.17
Biomedical Research	14.53	16.89	26.49	19.8	19.67	14.42
Built Environment & Design	6.99	3.52	--	--	--	--
Chemistry	5.87	13.41	5.97	8.52	6.36	--
Clinical Medicine	13.08	9.42	36.73	17.83	26.32	33.93
Earth & Environmental Sciences	8.79	4.64	11.64	8.89	12.54	9.22
Economics & Business	3.65	7.01	6.53	--	--	--
Enabling & Strategic Technologies	4.6	5.98	3.38	4.57	3.33	--
Engineering	3.5	4.32	3.8	7.14	5.41	--
General Science & Technology	23.21	26.1	29.33	23.73	31.43	25.33
Historical Studies	5.68	12.32	10.73	--	7.8	--
Information & Communication Technologies	1.61	2.45	2.47	1.66	0.83	--
Mathematics & Statistics	4.95	3.04	--	--	--	--
Physics & Astronomy	6.73	7.82	4.57	6.56	13	--
Psychology & Cognitive Sciences	6.24	10.47	6.27	12.26	--	9.28
Public Health & Health Services	7.34	5.06	7.04	--	--	--
Social Sciences	2.42	1.03	2.89	0.88	5.87	--

Table 24: Impact of Indonesia's co-publications per SM research field with the Netherlands, Great Britain, Germany, France and Switzerland (Threshold: only SM fields with over > 20 co-publications in the time frame 2004-2014 are considered). Green table cells indicate the impact is 50 % or higher than the impact of the TH overall co-publications, red cells indicate the impact is at least 50 % below.

Table 25 shows the average number of citations of each Vietnamese co-publication with at least one French/British/German... author in the different Science-Metrix research fields. Values marked with red are below 50% of the average citation the Vietnamese co-publications received in the respective research field and 2004-2014 time frame; values marked in green are more than 50% higher than the average value of these citations. E.g. co-publications with France have a rather high impact in the field "Public Health & Health Services", co-publications with France, Germany, Great Britain and the Netherlands have a high impact in "Physics & Astronomy" as well as co-publications with Great Britain, the Netherlands and Belgium in "Clinical Medicine".

	VN co-publications	VN-FR co-publications	VN-GB co-publications	VN-DE co-publications	VN-NL co-publications	VN-BE co-publications
Agriculture, Fisheries & Forestry	5.69	9.08	7.85	5.08	6.69	6.31
Biology	7.54	7.35	7.91	6.75	7.27	6.37
Biomedical Research	13.51	16.39	24.18	20.76	20.56	16.12
Chemistry	8.56	6.84	--	6.12	--	6.08
Clinical Medicine	11.37	20.26	27.18	20.79	35.38	27.1
Earth & Environmental Sciences	7.62	10.48	10.85	8.71	7.21	6.31
Economics & Business	4.23	2.69	4.28	--	1.78	--
Enabling & Strategic Technologies	4.78	5.77	9.08	4.51	3.11	4.66
Engineering	3.17	2.78	5.61	3.34	4.82	5.99
General Science & Technology	16.64	36.58	37.29	56.16	43.49	--
Historical Studies	7.98	7.63	--	--	--	--
Information & Communication Technologies	1.86	1.32	2.54	1.69	3.51	0.75
Mathematics & Statistics	2.29	4.51	16.85	7.15	--	--
Physics & Astronomy	4.85	11.77	15.38	13.21	15.79	5.83
Public Health & Health Services	5.97	14.57	5.42	--	8.23	--
Social Sciences	2.57	--	4.21	--	--	--

Table 25: Impact of Vietnam's co-publications per SM research field with France, Great Britain, Germany, the Netherlands and Belgium (Threshold: only SM fields with over > 20 co-publications in the time frame 2004-2014 are considered). Green table cells indicate the impact is 50 % or higher than the impact of the TH overall co-publications, red cells indicate the impact is at least 50 % below.

Table 26 shows the average number of citations of each Philippine co-publication with at least one British/German... author in the different Science-Matrix research fields. Values marked with red are below 50% of the average citation the Philippine co-publications received in the respective research field and 2004-2014 time frame; values marked in green are more than 50% higher than the average value of these citations. E.g. co-publications with Great Britain have a rather high impact in the field “Historical Studies”, co-publications with France have a high impact in “Enabling & Strategic Technologies” as well as co-publications with Great Britain, Germany, France and Switzerland have a big impact in “General Science & Technology”, and co-publications with the Netherlands in “Biomedical Research”.

	PH co-publications	PH-GB co-publications	PH-DE co-publications	PH-FR co-publications	PH-NL co-publications	PH-CH co-publications
Agriculture, Fisheries & Forestry	9.72	11.22	8.21	12.34	16.23	--
Biology	10.66	16.52	12.68	11.98	17.67	26.75
Biomedical Research	12.86	23.51	22.43	24.07	26.31	21.23
Chemistry	8.52	--	5.33	--	--	--
Clinical Medicine	18.11	58.01	33.93	34.68	68.26	69.3
Earth & Environmental Sciences	9.25	12.68	13.27	11.67	--	12.34
Economics & Business	3.15	3.05	--	--	4.13	--
Enabling & Strategic Technologies	7.38	11.74	10.3	20.41	11.74	--
Engineering	4.75	2.5	--	--	9.45	--
General Science & Technology	36.43	104.14	90.41	107.02	--	87.36
Historical Studies	7.77	22.43	--	--	--	--
Information & Communication Technologies	2.3	1.18	--	--	--	--
Physics & Astronomy	5.22	3.73	7.89	5.04	--	--
Public Health & Health Services	8.55	13.05	--	--	--	17.39
Social Sciences	2.06	1.84	--	2.04	--	--

Table 26: Impact of the Philippines' co-publications per SM research field with Great Britain, Germany, France, the Netherlands and Switzerland (Threshold: only SM fields with over > 20 co-publications in the time frame 2004-2014 are considered). Green table cells indicate the impact is 50 % or higher than the impact of the TH overall co-publications, red cells indicate the impact is at least 50 % below.

## 6.6 Cambodia, Lao PDR, Myanmar

### Output over time

Cambodia, Lao PDR and Myanmar have a relatively small co-publication output compared to the other ASEAN countries. This makes it sometimes difficult to issue clear statements, as the significance of the numbers is quite limited. As a consequence, this chapter covers the three countries Cambodia, Lao PDR and Myanmar both in single cases and as a group. Whenever the term “group” is used, it refers to the three countries together.

**Cambodia's publication output from 2004-2014 is 2,445 publications** (indexed in either Scopus or Web of Science). An average Cambodian publication (including also co-publications) involves approx. 7 authors from 3 different countries and is cited 10.25 times. They amount to 2,445 publications, out of which 2,143 are co-publications. This means that nearly 90 % of all Cambodian scientific publications in the observed time period include more than one author from more than one institution. 729 of these co-publications include authors from the ASEAN region, 1,081 co-publications include one or more author(s) from EU28/AC countries. The trend in Cambodia's

publications is quite positive. Apart from a small decrease from 2009 to 2010, the publication output is constantly increasing (see Figure 142).

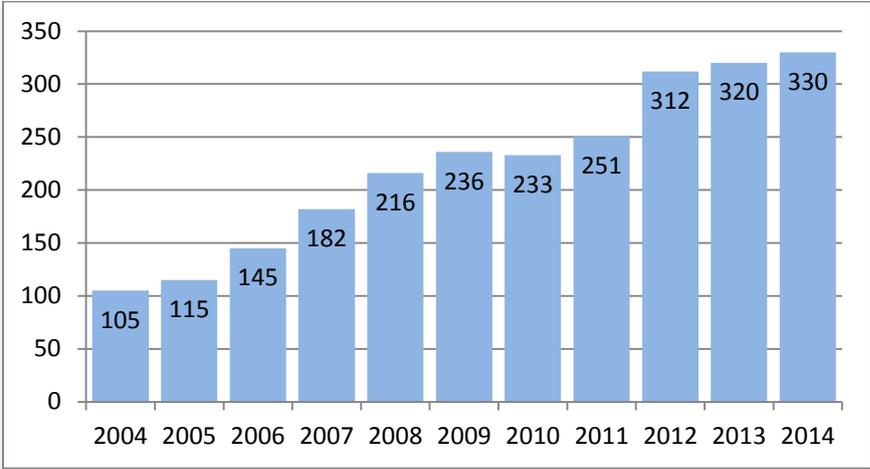


Figure 142: Cambodia's publication output, 2004-2014

**Lao PDR's publication output from 2004-2014 is 1,704 publications** (indexed in either Scopus or Web of Science). An average Laotian publication (including co-publications) involves approx. 6 authors from 3 different countries and is cited 7.3 times. Of these 1,704 publications, 1,544 are co-publications, which means, that 90.6% of all Cambodian scientific publications in the observed time period include more than one author from more than one institution. 644 of these co-publications include authors from the ASEAN region, 801 co-publications include one or more author(s) from EU28/AC countries. As regards the trend in Lao PDR's publications, we can observe a distinctive growth from 2010 to 2011. 2012 was the best performing year as regards the output – 252 publications from Lao PDR are indexed (see Figure 143).

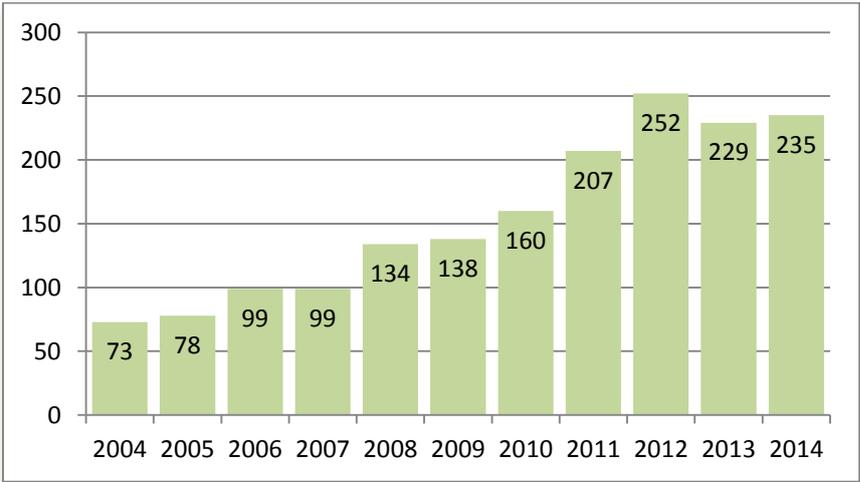


Figure 143: Lao PDR's publication output, 2004-2014 (combination of Scopus & WoS)

**Myanmar’s publication output from 2004-2014 is 1,404 publications** (indexed in either Scopus or Web of Science). An average Myanmar publication (including co-publications) involves approx. 5 authors from 2 different countries and is cited 5.61 times. Of these 1,404 publications, 897 are co-publications, which means that roughly 63.9% of all Myanmar scientific publications in the observed time period include more than one author from more than one institution. 319 of these co-publications include authors from the ASEAN region, 273 co-publications include one or more author(s) from EU28/AC countries. Looking at the overall trend, Myanmar faced some ups and downs. While the year 2004 was quite weak in its publication output, the output in the following years in general increased (see Figure 144).

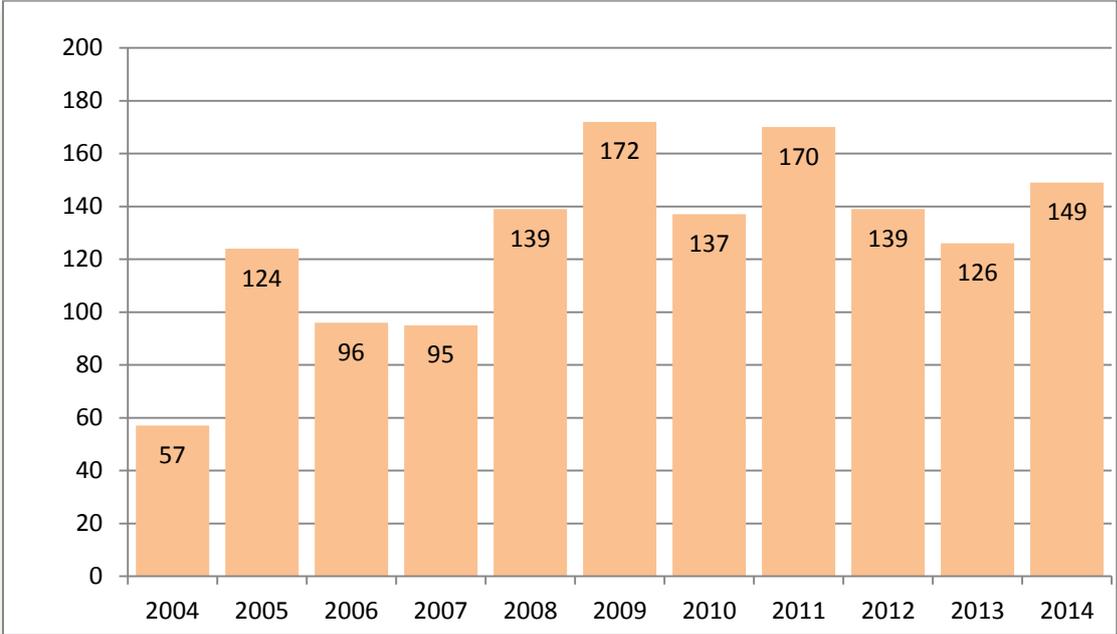


Figure 144: Myanmar's publication output, 2004-2014 (combination of Scopus & WoS)

### Co-publication share within total publication numbers: Proportions in Cambodia’s, Lao PDR’s and Myanmar’s publication output

Figure 145 gives a detailed overview of the **composition of Cambodia’s total publication number**. Cambodia’s publications in total (blue column) include both the co-publications with ASEAN (green column) and the co-publications with the rest of the world (red column). Cambodia’s co-publications with ASEAN again are part of the total co-publication number.

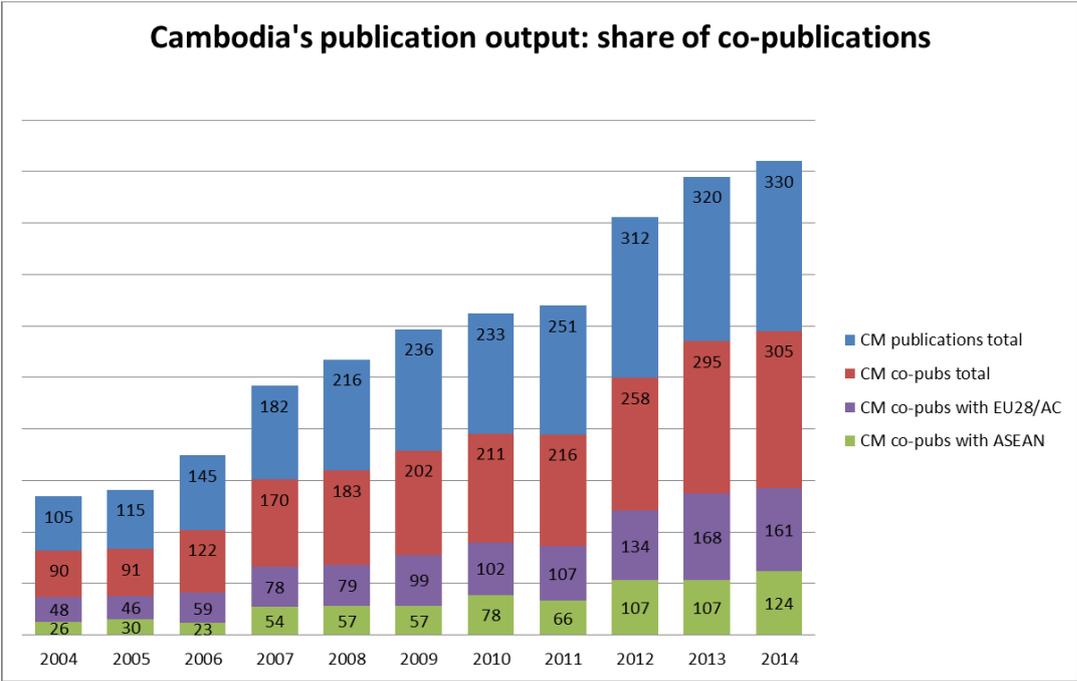


Figure 145: Overview of the annual Cambodian publication and co-publication output 2004-2014– overlay view, i.e. the bars are not stacked but placed “behind” each other (all start from 0)

Figure 146 shows again the overall growth of Cambodia’s publication and co-publication output. For the year 2004 all trend lines are set to 100%, which is the earliest data we have in this report and to which the annual growth is compared.

It becomes evident that Cambodia’s co-publications with ASEAN grew fastest in the period 2004 – 2014. The number of jointly published co-publications rose by more than 370% (purple trend line). The average growth of the remaining sectors (Cambodian publications total, CM co-publications total and CM co-publications with EU28/AC) is between 200 and 240%. After a significant drop of Cambodia’s co-publications with ASEAN in 2011, the yearly output climbed up step by step to the top level in 2014.

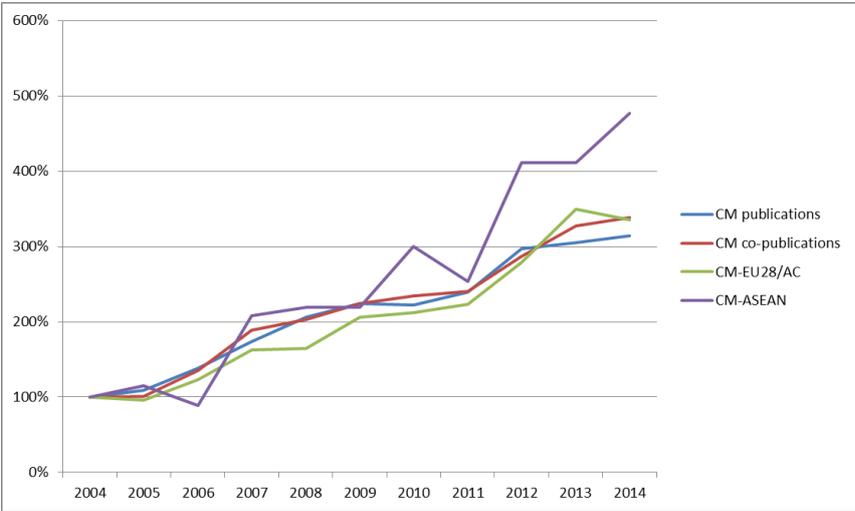


Figure 146: Overview of the growth of annual Cambodian (co-)publication output, 2004-2014

Regarding the **composition of Lao PDR's total publication number** (blue column in Figure 147), the high number of co-publications (red column) among the total publication number is evident. The green column shows the co-publications with the ASEAN region and purple column with EU28/AC.

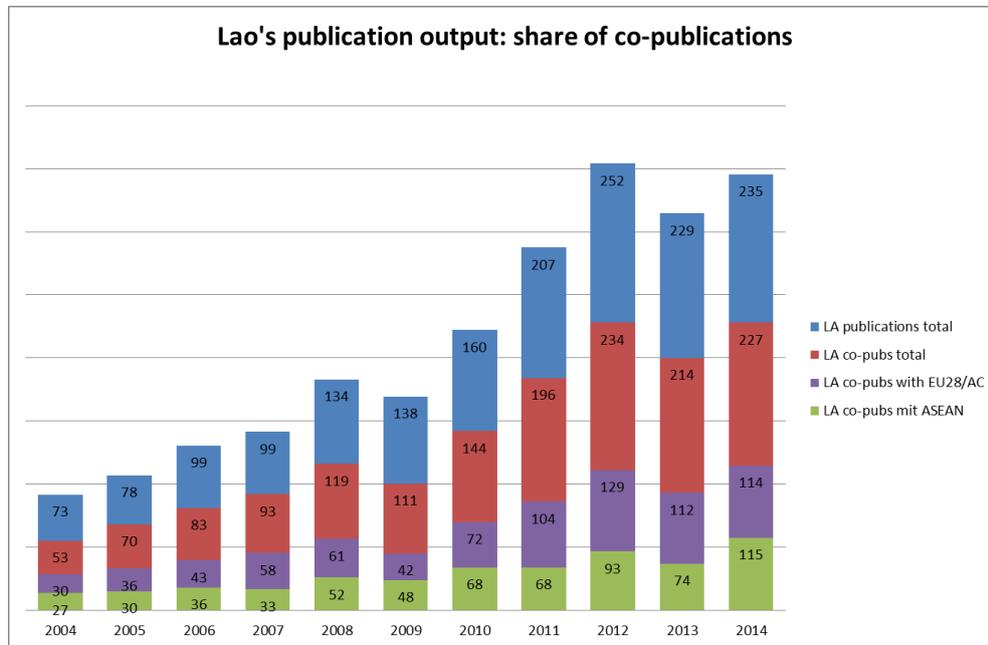


Figure 147: Overview of the annual Lao PDR's publication and co-publication output 2004-2014– overlay view, i.e. the bars are not stacked but placed "behind" each other (all start from 0)

Figure 148 shows the annual growth rate of Lao PDR's publications and co-publications. Lao PDR's total co-publications (red line) and co-publications with ASEAN (purple trend line) developed most positively. Both sectors experienced a growth rate of about 330% between 2004 and 2014. Lao PDR's co-publications with EU28/AC (green trend line) rose by about 280% and Lao PDR's total publication output (blue) around 220% in the same time period.

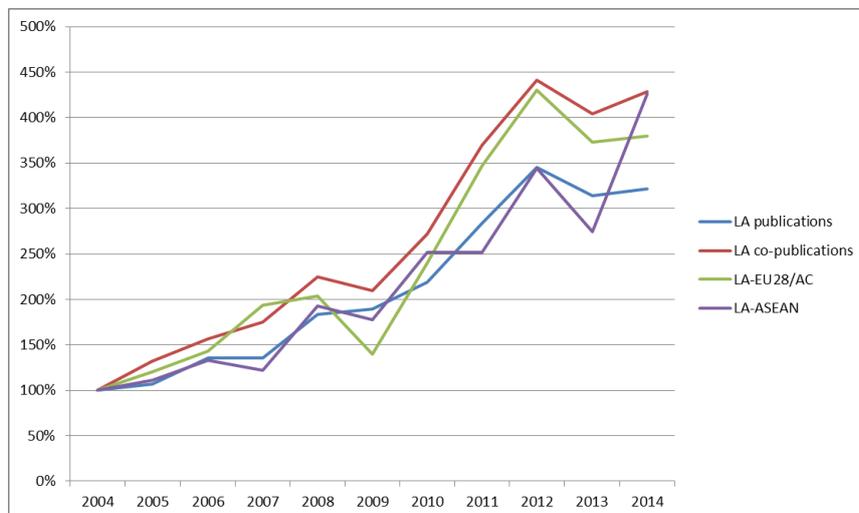


Figure 148: Overview of the growth of annual Laotian (co-)publication output, 2004-2014

Thirdly, the composition of Myanmar’s total publication number is depicted (blue column) in Figure 149. Myanmar’s co-publications in total are again shown in the red column, whereas the co-publications with the ASEAN region are in green colour and EU28/AC in purple colour.

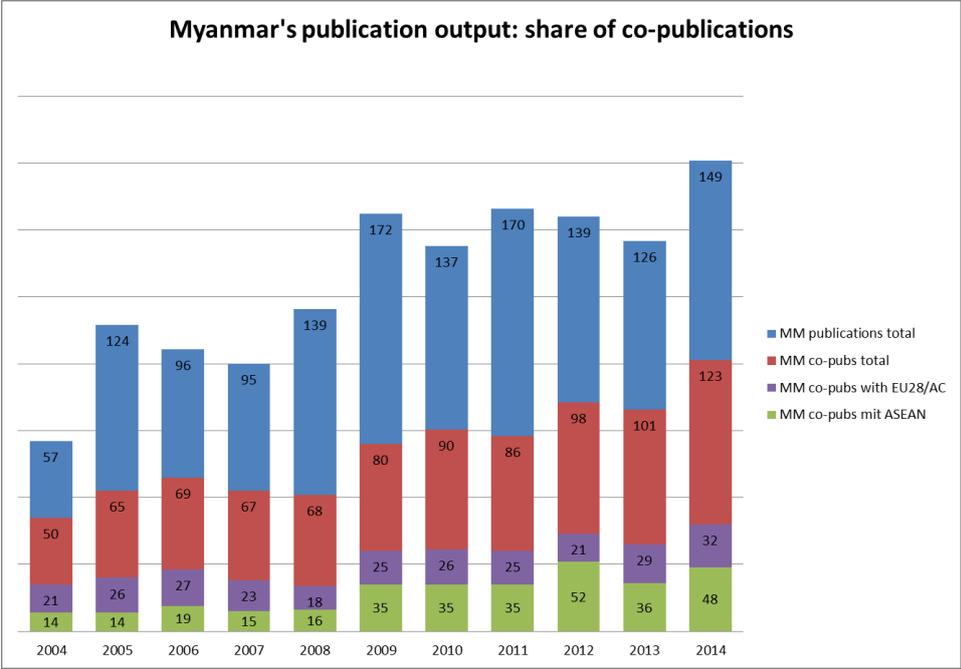


Figure 149: Overview of the annual Myanmar’s publication and co-publication output 2004-2014– overlay view, i.e. the bars are not stacked but placed “behind” each other (all start from 0)

Looking at the growth rate for Myanmar’s publications and co-publications in Figure 150, some interesting findings occur. It is Myanmar’s co-publications with ASEAN, which grew strongest from 2004-2014 (purple line). The output number rose by more than 240% until 2014 compared to the original number in 2004. Least growing were Myanmar’s co-publications with EU28/AC (green line) until 2014, namely solely by 52%. The growth of MM total publication and co-publication output was similar: In both sectors the output number rose by about 150%.

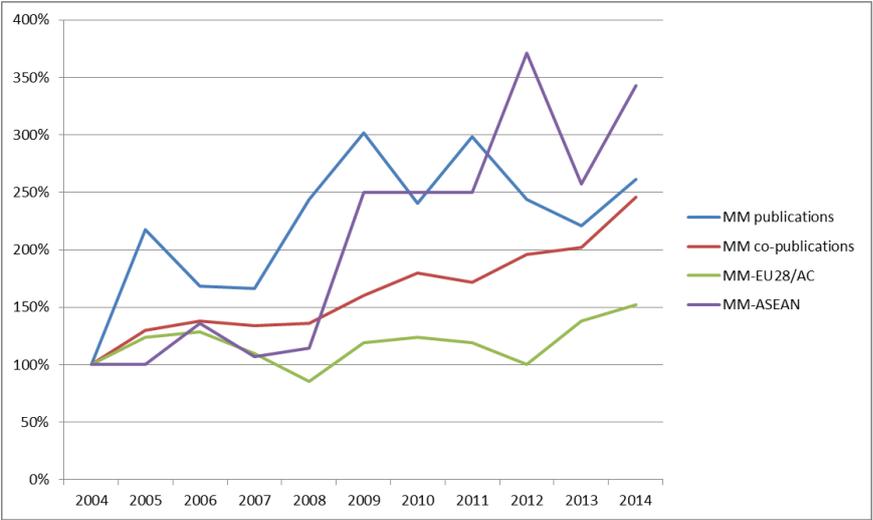


Figure 150: Overview of the growth of annual Myanmar’s (co-)publication output, 2004-2014

As a resume for the growth rate of all three countries (Cambodia, Lao PDR, Myanmar), the following highlights can be named:

1. Overall, the trends are positive: Each sector (total publications, total co-publications, co-publications with EU28/AC and with ASEAN) in all of the three cases was growing in terms of output number.
2. Co-publications with ASEAN partners were growing most from 2004 to 2014. In all three country cases, the co-publications with ASEAN show the highest growth rate (Cambodia-ASEAN co-publications: nearly 500% growth rate, Lao PDR-ASEAN: nearly 450% and Myanmar-ASEAN: nearly 350%).
3. For Lao PDR, the growth of total co-publications is quite the same as for its co-publications with ASEAN.
4. Least growth in collaboration with EU28/AC shows Myanmar, for which the co-publications with EU28/AC rose solely by around 50% (in the other two cases growth rate is close to 300%).

### Analysis of research topics in the research output of Cambodia, Lao PDR and Myanmar

On this level we look at the main research topics of Cambodia's, Lao PDR's and Myanmar's publication and co-publication output from 2004-2014.

Again, our analysis focuses on the Science Metrix research areas and the Science Metrix research fields.

Figure 151 shows the research area breakdown of the Cambodian publications from 2004-2014. Most of the Cambodian publications were published in the area of "Health Sciences", which includes 1,426 scientific publications. This makes up around 58% of all Cambodian publications in the observed period of time. The second biggest area is "Natural Sciences", which includes 332 publications (14%) of all Cambodian publications. The third biggest area belongs to the field "Applied Sciences" (319; 13% of all Cambodian publications), followed by "Economic & Social Sciences" (213; 9%), "General Sciences" (103; 4%) and "Arts and Humanities" (52; 2%).

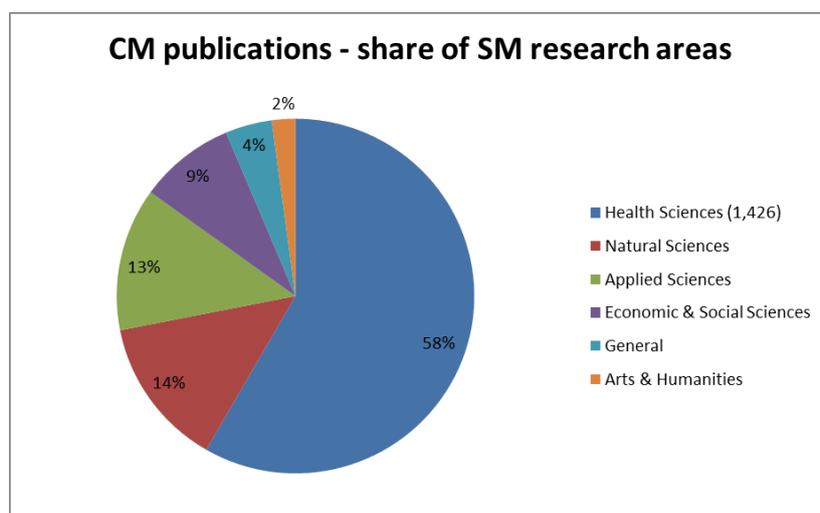


Figure 151: Research areas of Cambodian publications, 2004-2014

Concerning Lao PDR, Figure 152 gives a detailed overview of the share of research areas. Also in Lao PDR's publications, Health Sciences is the biggest research area. From 2004-2014, 719 Laotian publications in Health Sciences were published. This is 42% of all Laotian publications in this period. Second is ranked Applied Sciences with 425 publications (25%) and third Natural Sciences with 377 publications (22%). Least publications are indexed in the Arts & Humanities (19; 1%).

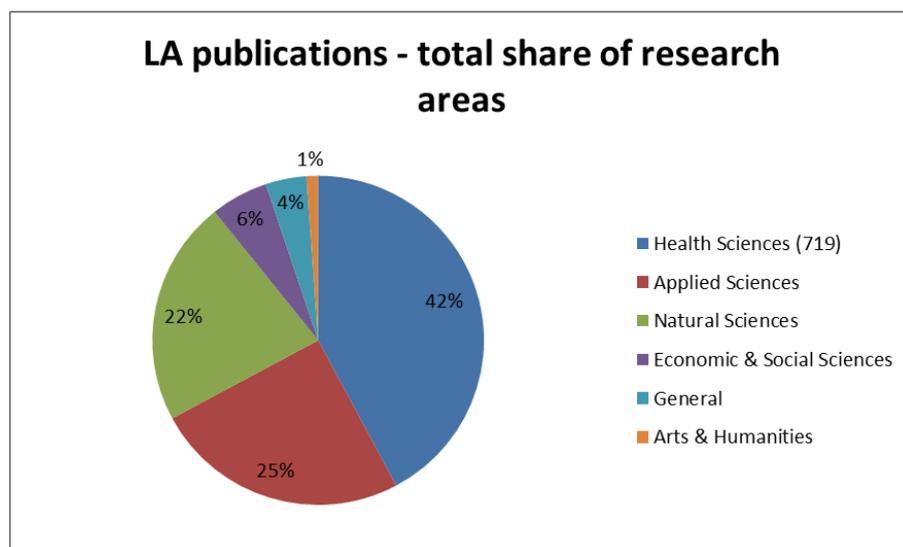


Figure 152: Research areas of Laotian publications, 2004-2014

Myanmar has the lowest publication output of the three countries (Figure 153). For the period 2004-2014 the number of 1,404 publications is indexed for Myanmar in *Web of Science* and *Scopus*. The foci of research areas are somewhat different from the ones of Cambodia and Lao PDR. Myanmar focuses more on the Applied Sciences which is the biggest research field and counts 523 (37% of all Myanmar's publications) publications. Health Sciences is ranked second (409; 29%), followed by Natural Sciences (24%). Health Sciences keep strong performance in all three cases (ranked first in both the other countries).

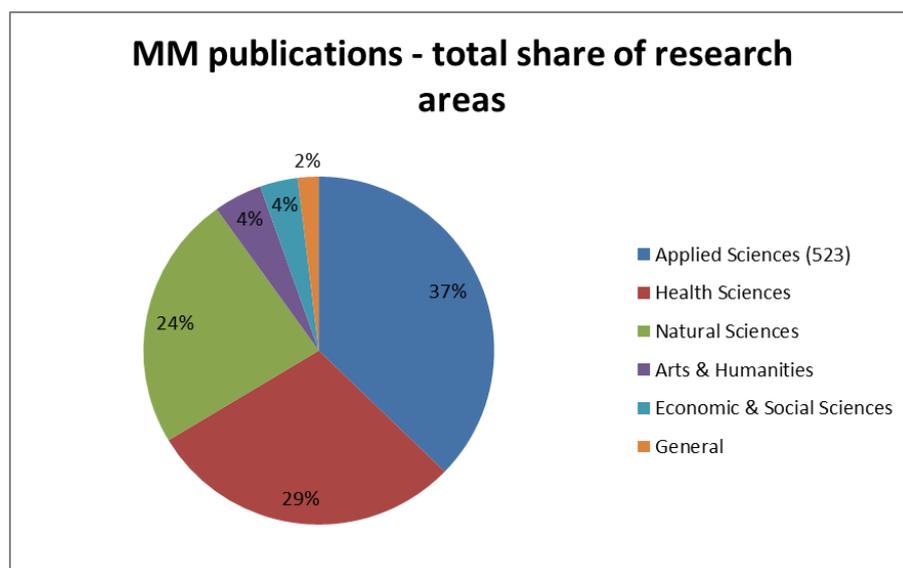


Figure 153: Research areas of Myanmar's publications, 2004-2014

After this general overview of the scientific areas of Cambodia’s, Lao PDR’s and Myanmar’s publications, our analysis now delves into a more detailed level of Science Metrix fields.

### Cambodia –Share of Science Metrix Fields

One will recognise that the distribution of Cambodia’s publications is much more diverse on the level of SM fields than on the level of the SM areas (Figure 154). On this level, most Cambodian publications were published in the field “Clinical Medicine” (685 publications, 28%), followed by “Biomedical Research” (538; 22%) and “Biology” (235; 10%). These top 3 research fields make up 60% of all Cambodian publications. Clinical Medicine and Biomedical Research are fields within Health Sciences, whereas Biology is field within the Natural Sciences. Clinical Medicine and Biomedical Research are the top 2 SM fields in Cambodian publications, as pictured below in Figure 154.

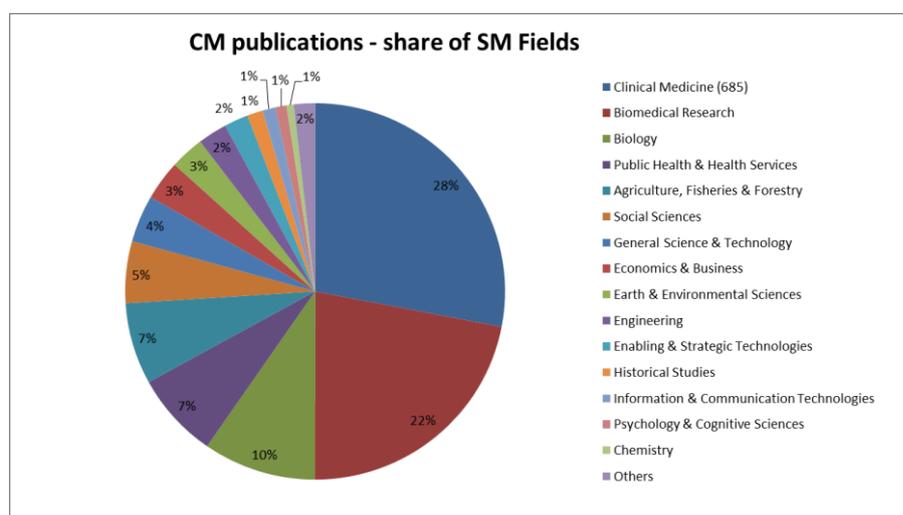


Figure 154: SM research fields of Cambodian publications, 2004-2014

### Lao PDR – Share of Science Metrix Fields

Lao PDR’s share of research fields is pictured in Figure 155. As for Cambodia, the biggest research field is Clinical Medicine (390 publications). Clinical Medicine is a field within Health Sciences (719 publications), which, as illustrated before, is the biggest research area of Laotian publications. Slightly more than half of all Laotian publications in Health Sciences are publications in Clinical Medicine. Second ranked is Biology with 246 publications (14% share of all SM fields in Lao PDR’s publications). Biology is a field within the Natural Sciences (377 publications in total). Around 65.25% of all Laotian publications in Natural Sciences belong to the field of Biology. Agriculture, Fisheries & Forestry is the third biggest research field within Lao PDR’s publications. 227 publications were made in this field. It is a sub-field of Applied Sciences.

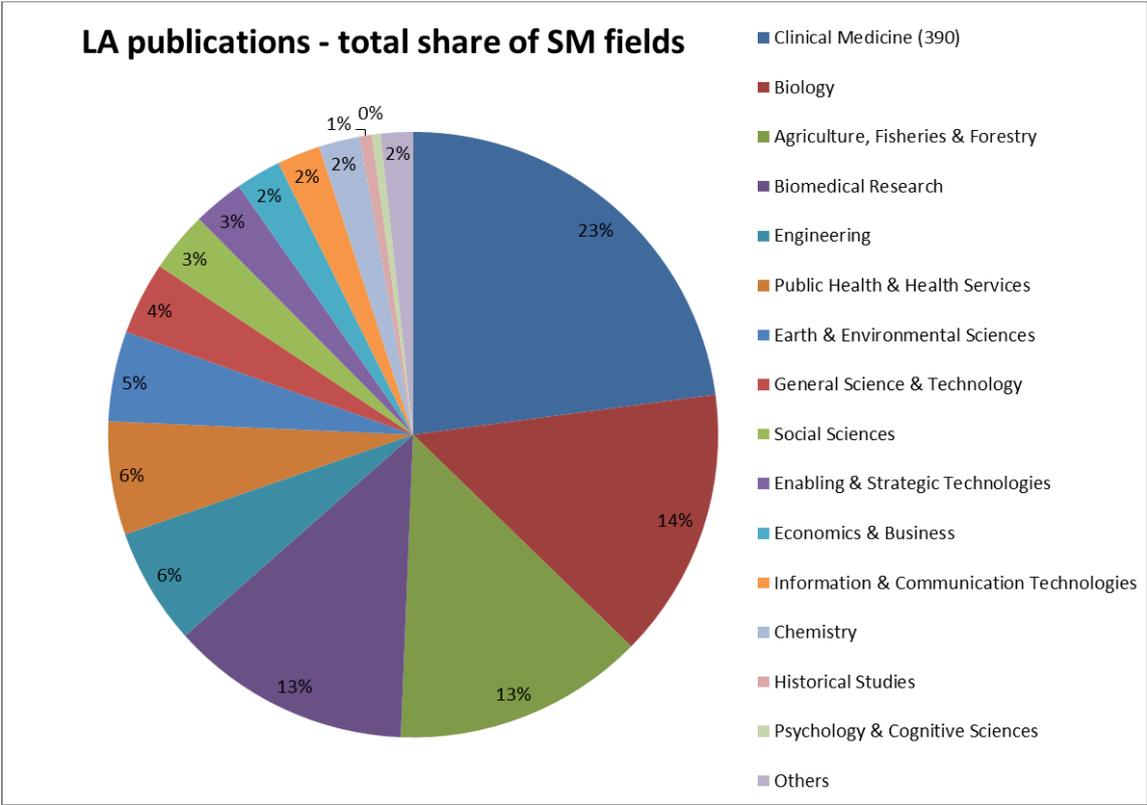


Figure 155: SM research fields of Laotian publications, 2004-2014

**Myanmar - Share of Science Metrix Fields**

Myanmar’s share of research fields is pictured in Figure 156. As in the two other countries, the biggest research field is Clinical Medicine. It comprises 267 of all 1,404 Myanmar publications. Notwithstanding, the biggest research area in Myanmar publications is Applied Sciences, to which Clinical Medicine does not belong. Clinical Medicine is part of the Health Sciences – this research area is the second biggest area in Myanmar publications. ICT (field within Applied Sciences) covers 205 publications and is ranked second after Clinical Medicine. Biology (within Natural Sciences) with 182 publications is ranked third. At the end of this list are Visual & Performing Arts, Built Environment & Design and General Arts, Humanities & Social Sciences. These fields are similarly ranked also in Cambodia’s and Lao PDR’s publication overview related to the Science Metrix fields.

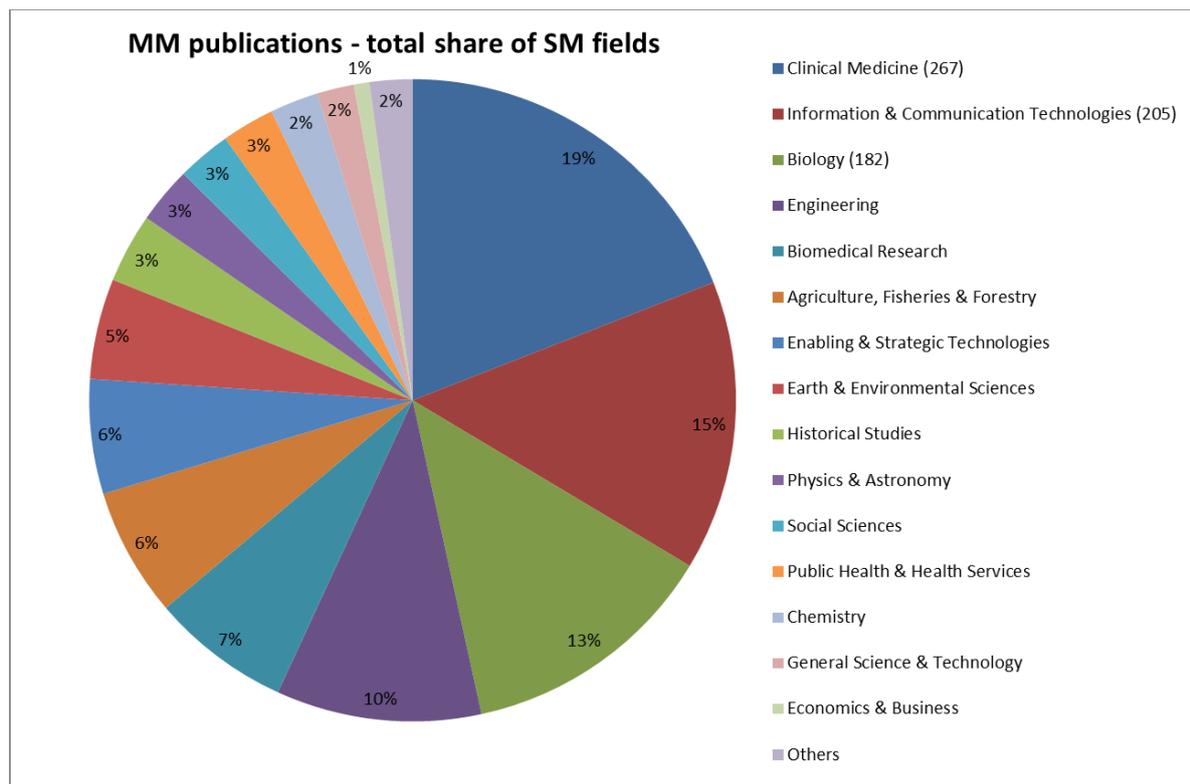


Figure 156: SM research fields of Myanmar’s publications, 2004-2014

The following overview in Table 27 compiles both the top research areas and the top research fields for Cambodia, Lao PDR and Myanmar. According to the total publication output, the share of each respective research area (number of publications and percent) and research field (SM2) is given (number of publications). In order to understand better whether the research fields within the top 3 research areas are performing as positive as their super-ordinated areas, common colours are given to the research areas and those fields, which belong to them. All in all, **Health Sciences as a research area and Clinical Medicine as one of its attributive fields are performing best in the country overview**. Apart from Myanmar, where Health Sciences is ranked 2<sup>nd</sup> in the research areas, both Health Sciences and Clinical Medicine cover first positions in their respective category.

	Cambodia	Lao PDR	Myanmar
<b>Total publications</b>	<b>2,445</b>	<b>1,704</b>	<b>1,404</b>
<b>Top Research Areas (SM1)</b>	<p><b>1. Health Sciences:</b> 1,426; 58%</p> <p><b>2. Natural Sciences:</b> 332; 14%</p> <p><b>3. Applied Sciences:</b> 319; 13%</p>	<p><b>1. Health Sciences:</b> 719; 41%</p> <p><b>2. Applied Sciences:</b> 425; 25%</p> <p><b>3. Natural Sciences:</b> 372; 22%</p>	<p><b>1. Applied Sciences:</b> 523; 37%</p> <p><b>2. Health Sciences:</b> 409; 29%</p> <p><b>3. Natural Sciences:</b> 333; 24%</p>

Top Research Fields (SM2)	1. Clinical Medicine: 685	1. Clinical Medicine: 390	1. Clinical Medicine: 267
	2. Biomedical Research: 538	2. Biology: 246	2. Information and Communication Technologies: 205
	3. Biology: 235	3. Agriculture, Fisheries and Forestry: 227	3. Biology: 182

Table 27: Comparison of top research areas and top research fields in KH, LA and MM publications

### Cambodia – Development of Research Fields over time

Figure 157 shows the development of Cambodia’s SM Fields over time. To make the figure more illustrative, only the top 10 SM fields are depicted. Due to the high number of fields (more than 20), the trend lines would not be identifiable very well otherwise. Clinical Medicine (dark blue line) and Biomedical Research (dark red) are boosting since the beginning of our analysis period in 2004. Both fields also decreased from time to time, but the development overall is positive. The drop in 2014 in both fields is unusual though. Also Biology (dark green line) could somehow break away from the rest of the fields, which is why it became the third fastest growing field in Cambodian publications.

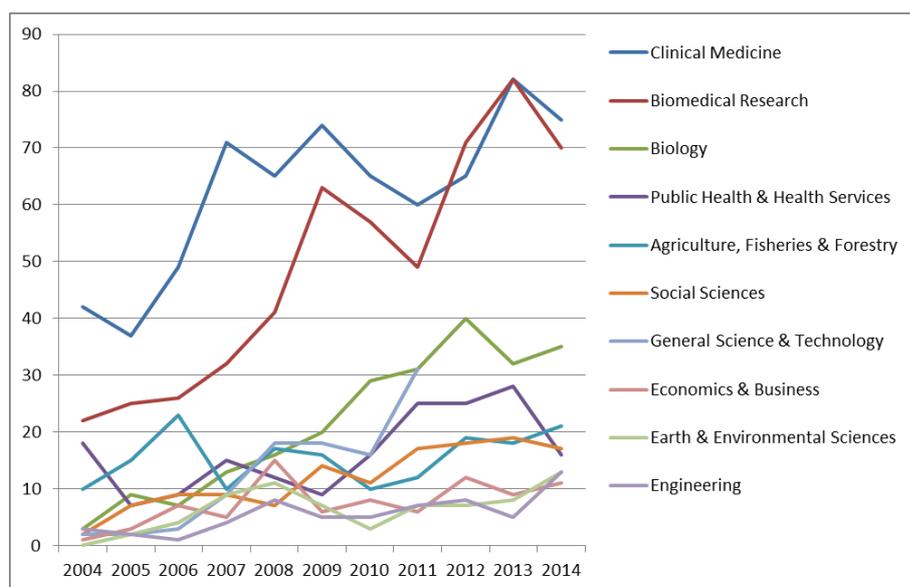


Figure 157: Annual development of the top 10 research fields of Cambodian publications, 2004-2014

### Lao PDR – Development of Research Fields over time

Figure 158 depicts the development SM2 fields in Lao PDR’s publications from 2004 and 2014. Again, only the top 10 out of more than 20 SM2 fields, in which Lao PDR’s publications in the observed time period were classified, are shown. Whereas Clinical Medicine (dark blue graph) only dropped slightly from 2013 2014, Biology (dark red) is significantly falling since 2011. Remarkable is also Engineering and General Science & Technology, both are boosting since 2013.

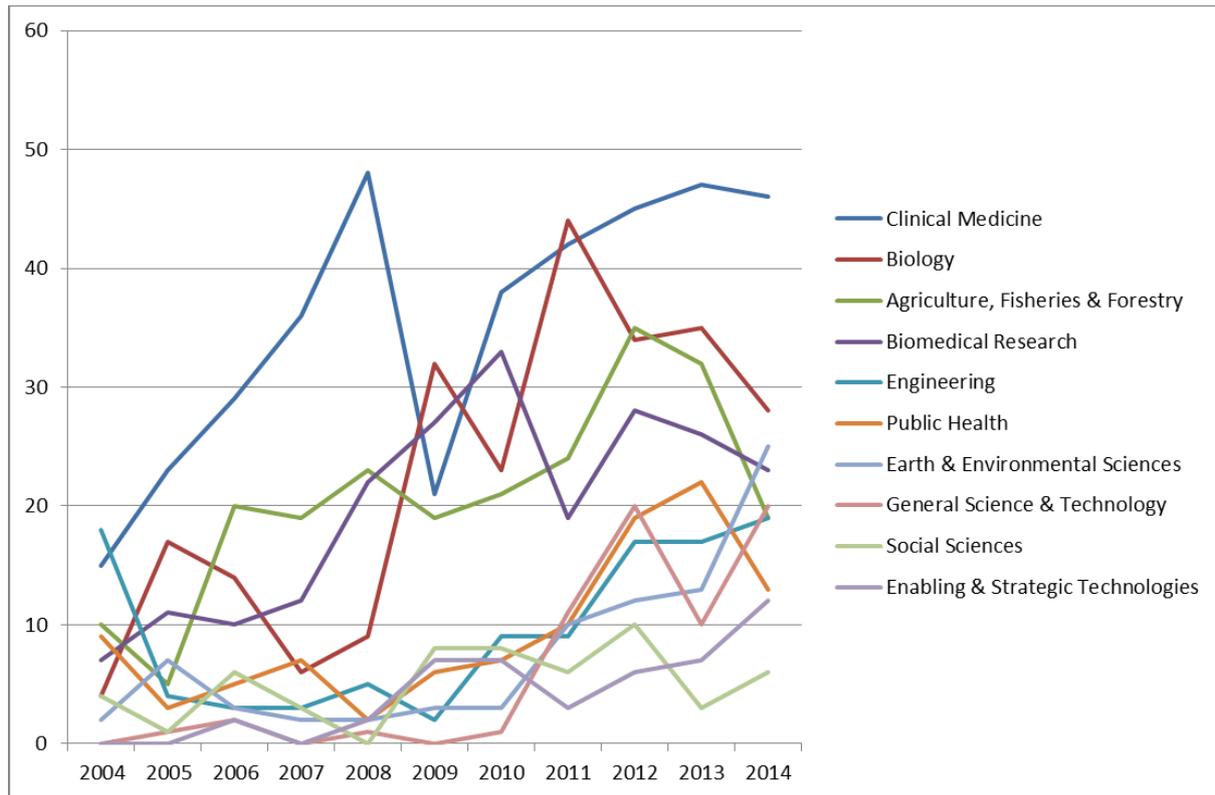


Figure 158: Annual development of the top 10 research fields of Laotian publications, 2004-2014

### Myanmar – Development of Research Fields over time

Figure 159 shows the development of Myanmar’s research fields between 2004 and 2014 based on the number of publications indexed in a particular research field. Depicted are the top 10 research fields according to the number of publications indexed in a descending order.

As we can observe in all three countries, Clinical Medicine is the strongest research field in terms of output. It is usually followed by fields from the Natural Sciences, such as Biology or Biomedical Research. However, what is interesting to mention is the performance of ICT in the current case of Myanmar (dark red line). In 2005, 56 publications were classified in ICT, which is obviously the highest of all numbers within this overview. The second position of ICT in the total publication amount is strongly linked to the performance in this year, as the field is more or less flagging since 2011 (significant drop from 2011 to 2012, only moderate recovery since 2012). Apart from that one can further notice the boost of Biology since 2012 (dark green line) and the drastic drop of Engineering from 2011 to 2012 similar to ICT (purple line).

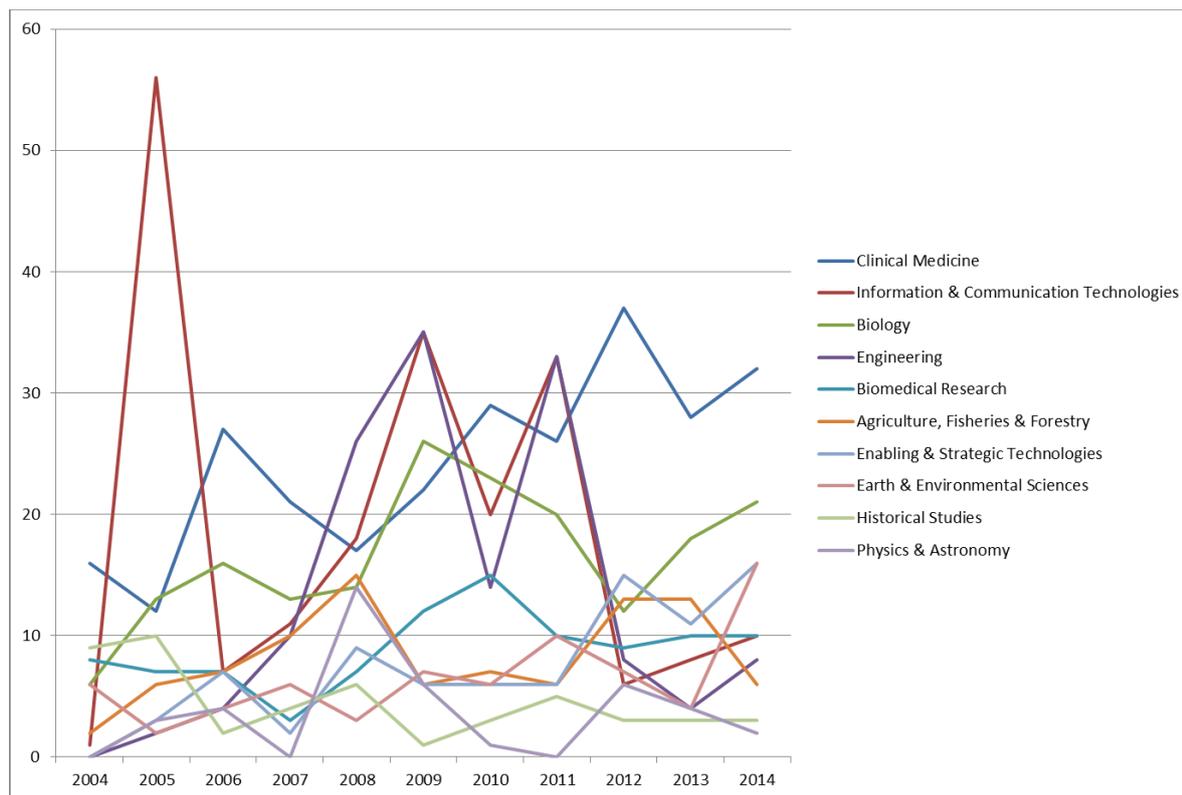


Figure 159: Annual development of the top 10 research fields of Myanmar publications, 2004-2014

### Strongest collaboration linkages – within the ASEAN region and the EU

Regarding Cambodia’s intraregional collaboration with ASEAN and EU28/AC, the most important partner countries are France (418 joint co-publications), Thailand (411), Great Britain (329), Vietnam (226) and Switzerland (161). Looking at the impact (= citation count/co-publication), Cambodia’s co-publications with Austria are leading. Whereas the average citation count for Cambodia’s co-publications with its top 20 partners is between 10 and 20, those co-publications including at least one author which is affiliated in Austria are cited 63.09 times in average. Also the co-publications with Myanmar (44.89) and Switzerland (24.91) are cited more frequently than the average. Most different countries are involved in Cambodia’s co-publications with Myanmar (in average 9.82 countries participated in such co-publications). Cambodia’s co-publications with Austria include the highest number of authors as well – 24.11 authors took part in a joint co-publication between the two countries in average.

Table 28 gives a detailed overview of all important figures in the co-publication collaboration between Cambodia and its top 20 collaboration partners (in terms of jointly published co-publications) from ASEAN and EU28/AC. Highlighted in green are the top values of each category.

	Publications	mean citation corr.	mean country count	mean author count
FR	418	13.08	4.12	11.17
TH	411	19.61	5.69	13.6
GB	329	18.90	4.87	11.62
VN	226	19.47	6.77	15.01
CH	161	24.91	6.14	13.79
BE	138	10.04	3.82	10.08
ID	132	13.91	7.48	15.41
PH	129	15.95	7.43	13.95
MY	124	14.09	7.19	13.72
LA	110	10.3	5.79	11.87
DE	74	9.72	6.20	14.31
NL	56	8.57	7.32	16.54
SG	51	18.26	9.00	21.24
SW	46	11.70	6.59	14.96
DK	42	8.80	6.17	13.60
MM	34	44.89	9.82	19.24
IT	34	15.95	7.65	18.59
NG	25	6.55	4.88	13.40
AT	19	63.09	8.79	24.11
SK	19	1.53	2.42	7.95

Table 28: Cambodia's top 20 collaboration countries within ASEAN and EU28/AC (Source: WoS + Scopus)

Regarding Lao PDR's intraregional collaboration with ASEAN and EU28/AC, the most important partner countries are Thailand (403 joint co-publications), Great Britain (317), France (262), Vietnam (154) and Cambodia (110). The highest impact shows Lao PDR's collaboration with Belgium, in which the co-publications were cited 22.07 times in average. Also Lao PDR's co-publications with Spain, Myanmar and Italy were cited quite frequently. As the following table also shows, in Lao PDR's co-publications with Myanmar the highest number of countries were involved to produce such co-publications. In average, authors from more than 10 countries (10.53) participated in these co-publications. And the same is true for the author level: From all top 20 partner countries, it is again Myanmar's collaboration with Lao PDR which includes the highest number of authors – 24.16 authors in average were involved in the co-publications between the two countries. The average number of involved authors in Lao PDR's co-publications presented below is between 10 and 12.

Table 29 gives a detailed overview of all important figures in the co-publication collaboration between Lao PDR and its top 20 collaboration partners (in terms of jointly published co-publications) from ASEAN and EU28/AC. Highlighted in green are the top values of each category.

	Publications	mean citation corr.	mean country count	mean author count
TH	403	10.14	4.24	9.78
GB	317	13.75	4.58	10.11
FR	262	11.09	3.73	8.58
VN	153	9.98	5.29	12.01
KH	110	10.30	5.79	11.87
CH	101	13.07	4.49	10.46
DE	92	7.06	5.10	10.52
SW	90	4.70	2.99	5.10
ID	64	11.14	7.11	13.52

NL	52	8.45	5.96	12.04
PH	59	17.57	6.15	12.92
MY	52	8.54	5.63	10.29
BE	36	22.07	6.31	11.86
SG	23	10.29	4.96	12.78
DK	22	7.55	5.23	9.82
MM	19	19.44	10.53	24.16
IT	15	19.97	5.93	13.33
NO	12	6.85	4.00	4.58
CZ	12	1.67	5.08	4.67
ES	12	21.26	8.00	17.42

Table 29: Lao PDR's top 20 collaboration countries within ASEAN and EU28/AC (Source: WoS + Scopus)

Regarding Myanmar's intraregional collaboration with ASEAN and EU28/AC, the top partner countries are Thailand (188 joint co-publications), Great Britain (92), Malaysia (76), Vietnam (68) and Germany (67). By far the highest impact show Myanmar's co-publications with Cambodia – co-publications between these two countries were cited 44.89 times in average. In terms of involved countries in co-publications, Myanmar's co-publications with Brunei stimulated most countries for participation. In average, 14.50 different countries were involved in an MM-BR co-publication. Also the co-publications with Lao PDR included more countries than the average (10.53). Looking at the author instead of the country level, it is Myanmar's co-publications with Lao PDR which involved the highest number of additional authors. 24.16 single authors contributed to a Lao PDR- Myanmar co-publication in average. **Table 30 gives a detailed overview of all important figures in the co-publication collaboration between Myanmar and its top 20 collaboration partners (in terms of jointly published co-publications) from ASEAN and EU28/AC.** Highlighted in green are the top values of each category.

	Publications	mean citation corr.	mean country count	mean author count
TH	188	15.74	5.27	10.92
GB	92	24.82	5.27	11.84
MY	76	8.32	5.63	10.88
VN	68	29.97	7.93	17.37
DE	67	7.89	4.15	9.24
ID	53	11.72	8.53	16.26
PH	52	9.79	7.17	11.73
FR	52	8.03	4.79	10.67
CH	43	36.31	5.35	9.88
SG	38	15.45	6.50	13.42
KH	34	44.89	9.82	19.24
BE	21	26.14	6.19	11.33
NL	21	8.08	6.48	12.43
LA	19	19.44	10.53	24.16
IS	14	8.57	5.21	7.00
IR	8	8.75	5.75	11.13
NO	7	9.00	4.00	7.71
SW	6	25.18	9.50	13.50
ES	6	12.67	9.67	20.00
BR	2	1.50	14.50	15.00

Table 30: Myanmar's top 20 collaboration countries within ASEAN and EU28/AC (Source: WoS + Scopus)

**Analysis of research fields – Cambodia with the ASEAN region and the EU28/AC respectively**

Next, we look at Cambodia’s co-publications with the other ASEAN states. By looking at Cambodia’s collaboration with ASEAN compared to the analysis of Cambodia’s co-publication activity with the EU28/AC, which is touched upon in the next chapter, we can point to differences as well as commonalities.

Both the size and the thematic strengths within this collaboration are scrutinised. The top 10 SM Fields in Cambodia-ASEAN co-publications from 2004-2014 can be found in Figure 160. Most of the co-publications between Cambodia and ASEAN were published in the field of Clinical Medicine (223; 32%), followed by Biomedical Research (187; 27%) and Biology (66; 10%). The top 10 SM Fields contain 689 of all 729 CM-ASEAN co-publications.

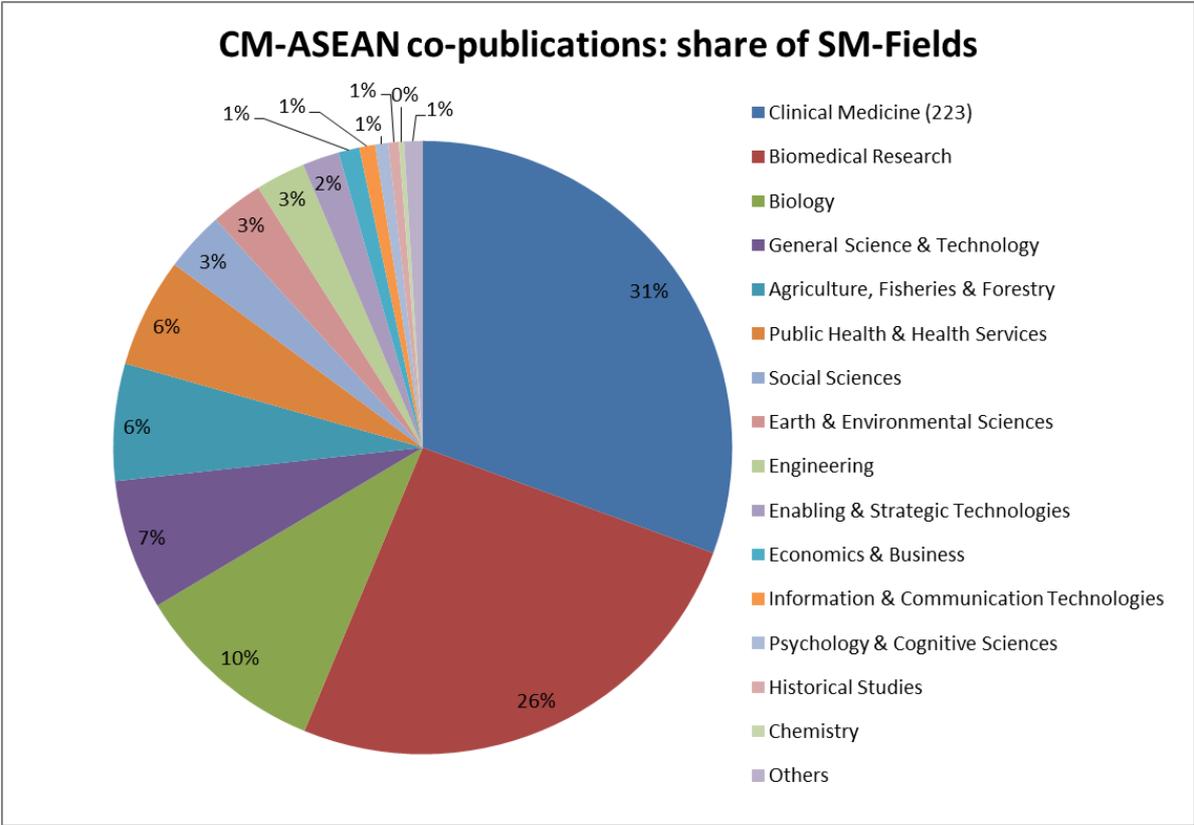


Figure 160: SM research fields of Cambodian co-publications with ASEAN countries, 2004-2014

To identify similarities and/or differences at a first glance, the same illustration is done for the collaboration between Cambodia and the EU28/AC (Figure 161). Clinical Medicine, Biomedical Research and Biology are the biggest fields also within Cambodia’s collaboration with the EU28/AC. Hence, the comparison between Cambodia’s co-publication collaboration with ASEAN and EU28/AC respectively, shows exactly the same pattern for the top 3 SM fields. Moreover, also the remaining fields within the top 10 are similar to each other in both collaborations.

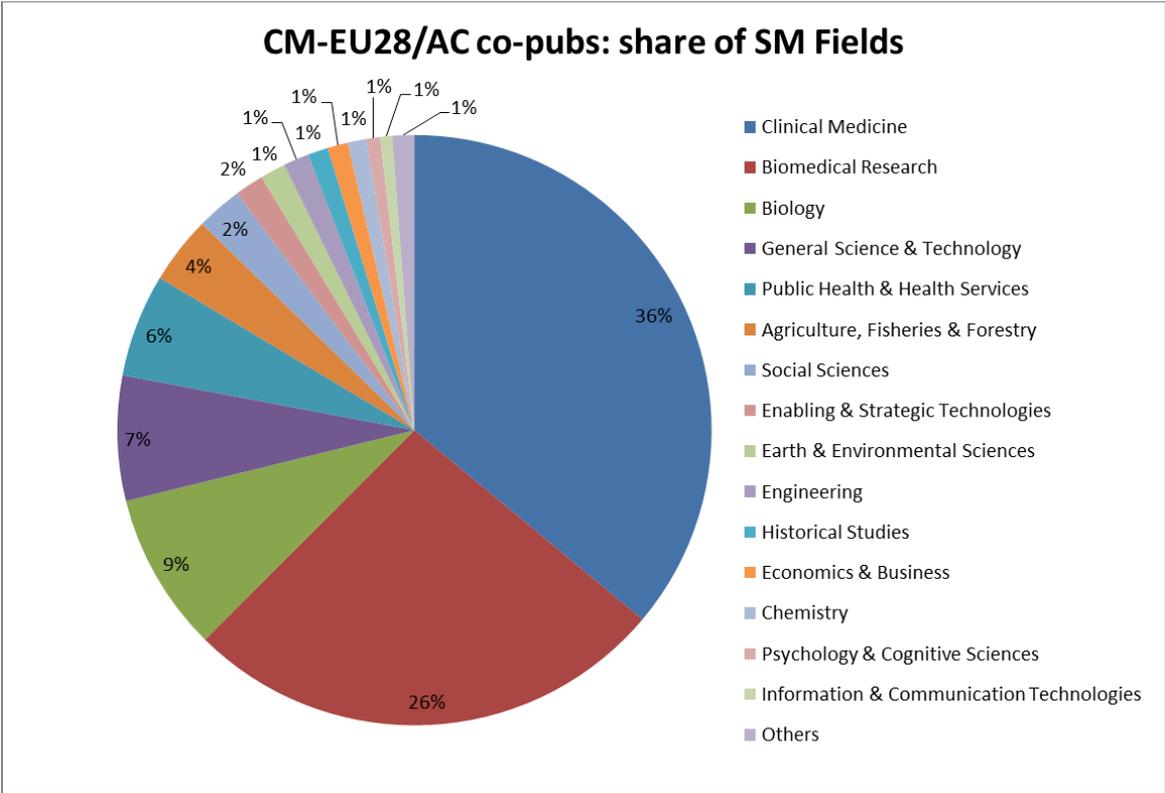


Figure 161: SM research fields of Cambodian co-publications with EU28/AC, 2004-2014

In the next chapter we look at the strongest collaboration partner countries of Cambodia. The three strongest partner countries for Cambodia both within ASEAN and within EU28/AC are presented. Interesting to us in this comparison is the development of joint co-publications with the strongest partner countries over time and their thematic trends.

**Cambodia’s collaboration linkages – within the ASEAN region in detail**

The strongest collaboration partner for Cambodia in the ASEAN region is Thailand with 411 joint co-publications (see Figure 162). Second strongest partner is Vietnam with 226 and third strongest partner is Indonesia with 132 joint co-publications. The list is completed by the Philippines (129), Malaysia (124), Lao PDR (92), Singapore (51) and Myanmar (28).

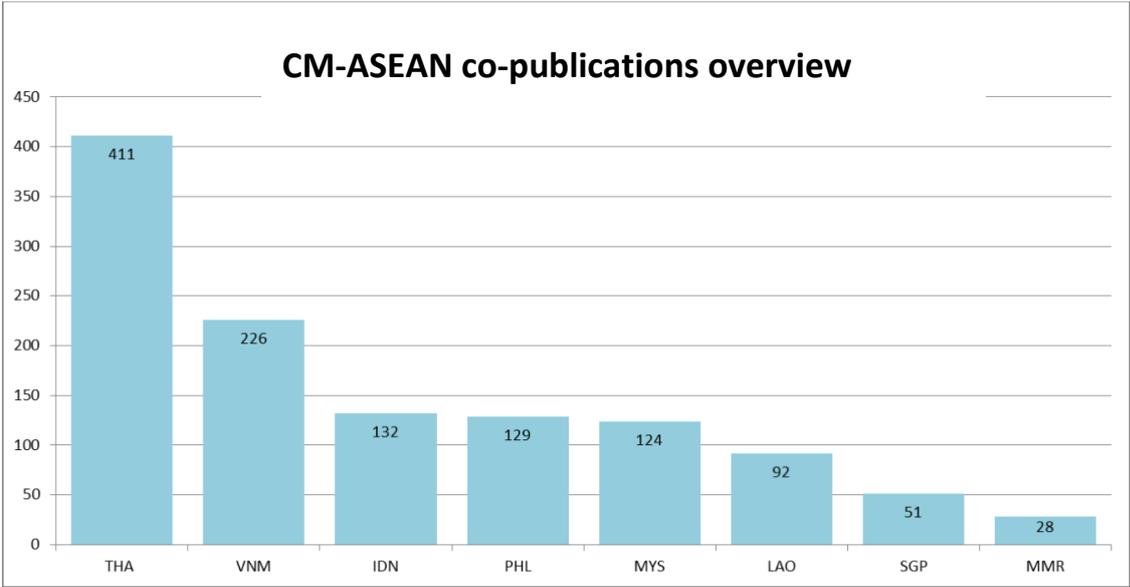


Figure 162: Cambodia’s co-publications with ASEAN countries, 2004-2014

If we look at the development over time of Cambodia’s co-publications with its three strongest collaboration partners from ASEAN, one can easily notice the leading role of Cambodia’s co-publications with Thailand (blue line in Figure 163). Whereas in 2004, in none of the three collaborations were produced more than 10 co-publications, this number raised up to a maximum of 73 co-publications (Cambodia-Thailand) in the ten year’s period.

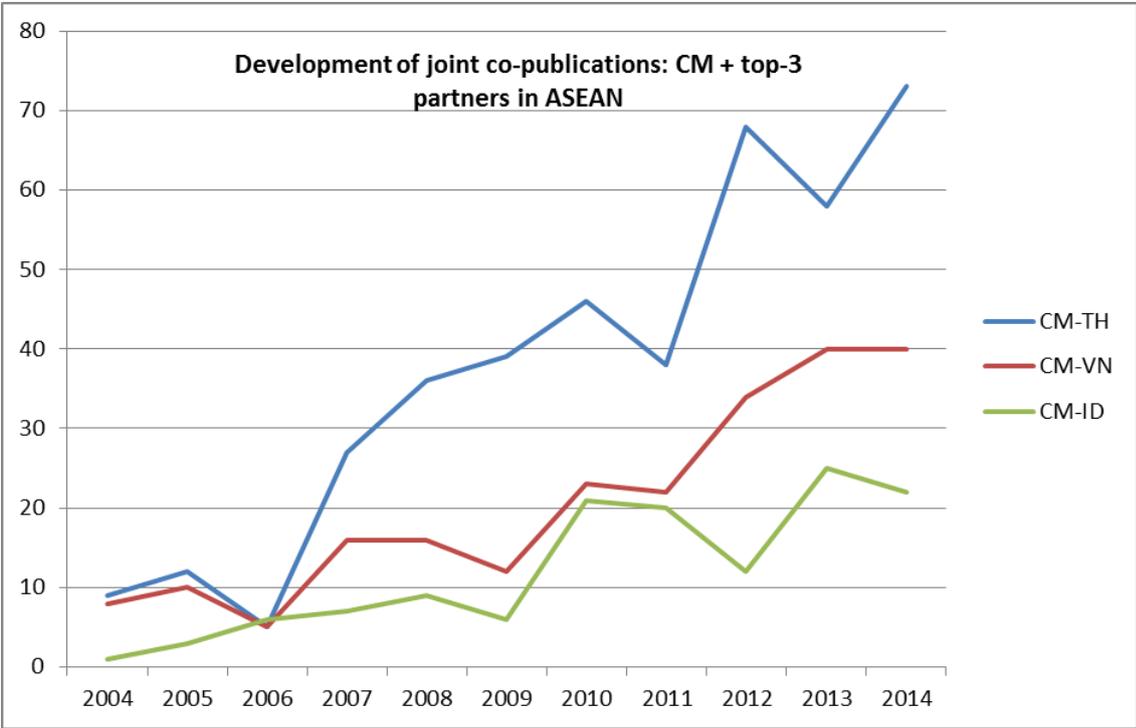


Figure 163: Cambodia's co-publications with the three strongest ASEAN collaboration countries and their development over time, 2004-2014

## **Thematic foci in Cambodia's co-operation with Thailand, Vietnam and the Philippines: Overview of the research fields**

The next step is to analyse the joint research fields in Cambodia's cooperation with Thailand, Vietnam and the Philippines. With the help of this analysis, it is possible to find out whether the single country co-operations also show common patterns and to which degree they might be similar.

### **Cambodia– Thailand: Top 3 research fields**

1. Clinical Medicine: 136 co-publications
2. Biomedical Research: 119
3. Biology: 34

### **Cambodia– Vietnam: Top 3 research fields**

1. Biomedical Research: 67 co-publications
2. Clinical Medicine: 65
3. Biology: 28

### **Cambodia – Indonesia: Top 3 research fields**

1. Clinical Medicine: 46
2. Biomedical Research: 44
3. Biology: 11

Clinical Medicine and Biomedical Research are the two leading research fields, which replace it other from case to case. The only other field in the top 3 is Biology.

The following Figure 164, Figure 165 and Figure 166 depict the total share of all SM research fields for Cambodia-Thailand, Cambodia-Vietnam and Cambodia-Indonesia. To put the different %-data provided into a context, the number of co-publications for the strongest research field (33% in Clinical Medicine) is listed in brackets. Also in the following charts the percent and number of publications for the strongest research fields is given: Cambodia-Vietnam publications: Biomedical Research (30%, 67), Cambodia-Indonesia publications: Clinical Medicine (35%, 46).

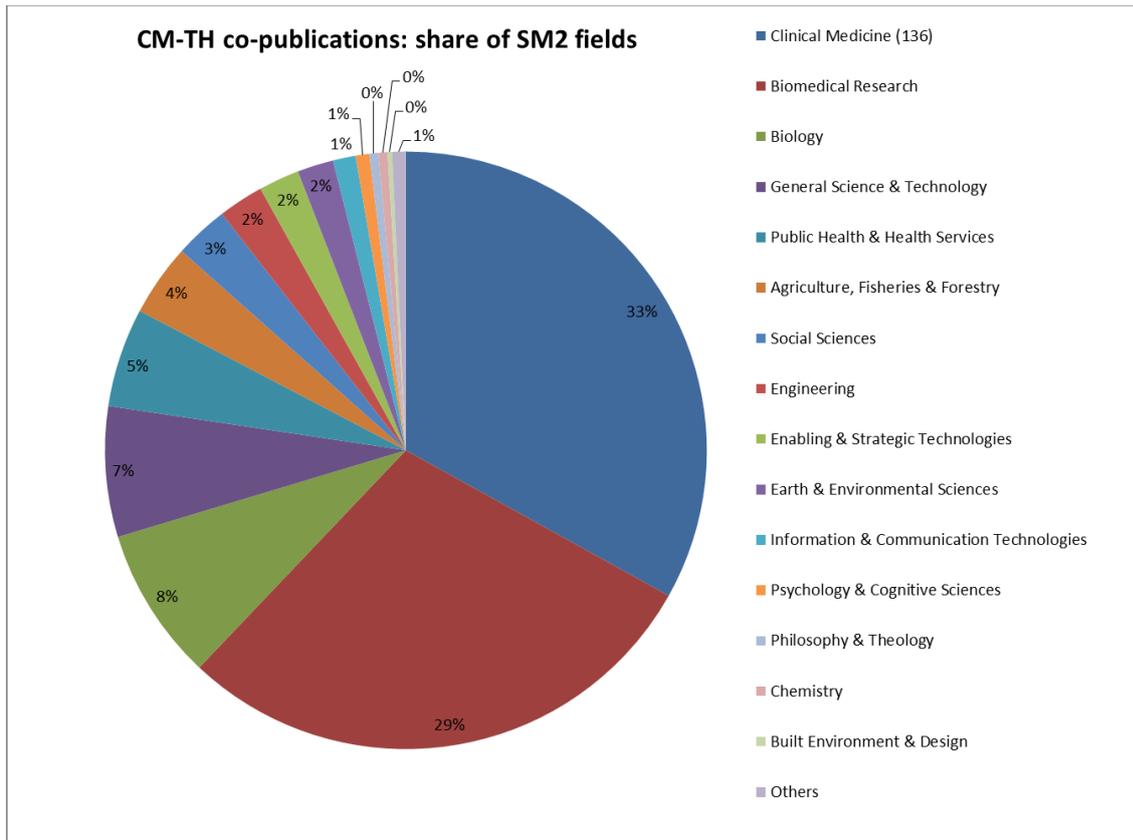


Figure 164: SM research fields of Cambodia-Thailand co-publications, 2004-2014

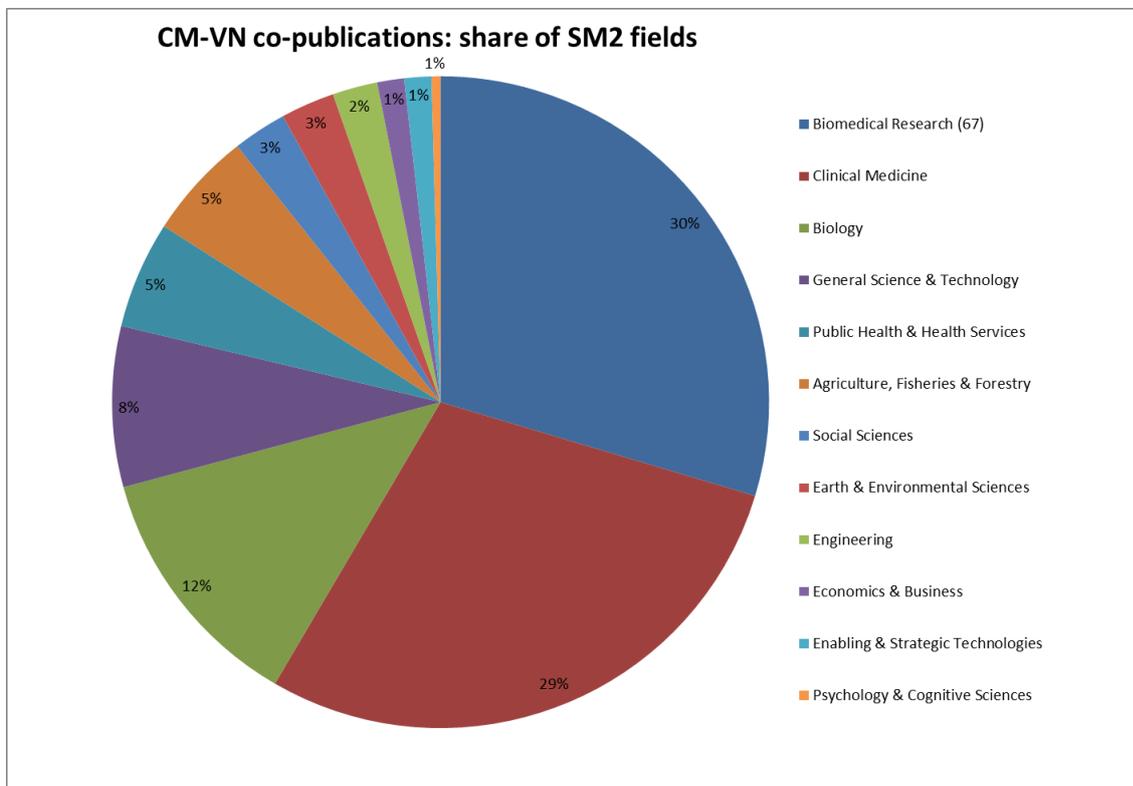


Figure 165: SM research fields of Cambodia-Vietnam co-publications, 2004-2014

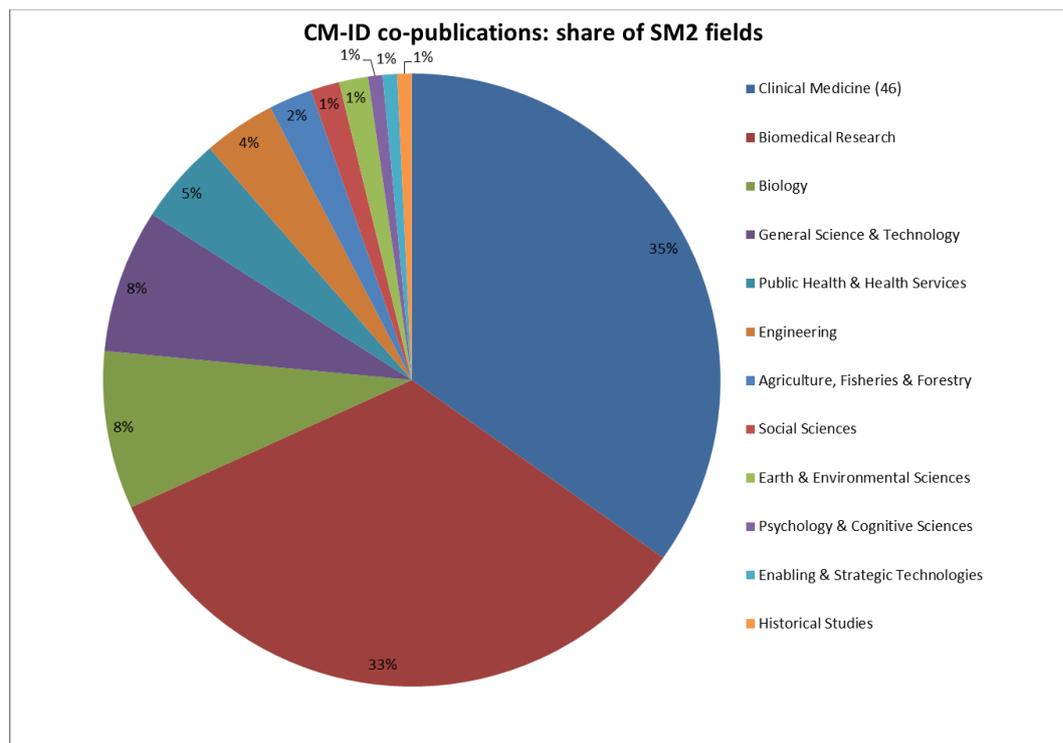


Figure 166: SM research fields of Cambodia-Indonesia co-publications, 2004-2014

### Cambodia's collaboration linkages – with the EU28/AC countries in detail

The strongest collaboration partner for Cambodia within EU28/AC is France with 418 joint co-publications (see Figure 167). Second strongest partner is Great Britain with 329 co-publications, and third is Switzerland with 161 co-publications. As one can see, there is a broad range of countries with which Cambodia had joint co-publication between 2004-2014 – in the case of Bulgaria, Albania, Lithuania and Luxembourg it is at least one.

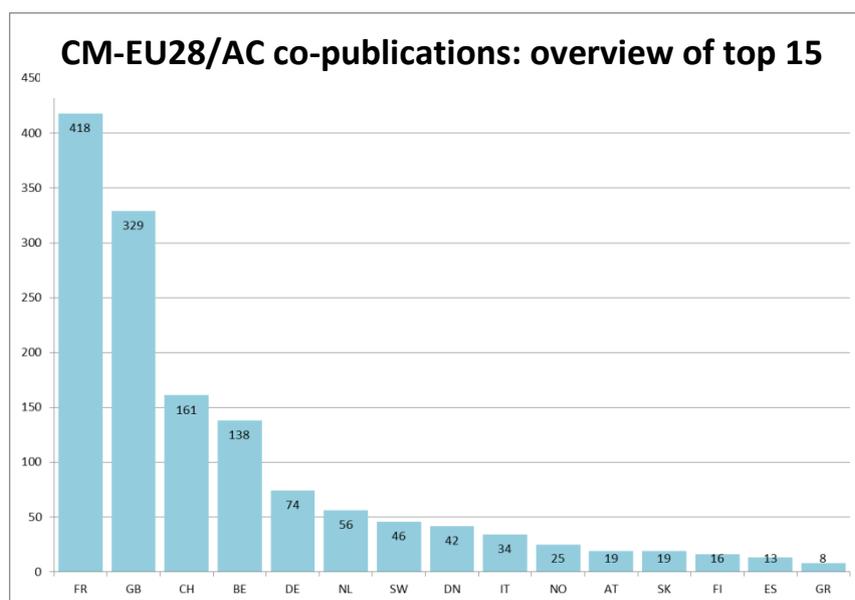


Figure 167: Cambodia's co-publications with EU28/AC countries, 2004-2014

The next step is to look again on the development over time of these co-publications. Despite France’s position as the leader in joint co-publications with Cambodia, the co-publications with Cambodia dropped in 2014, whereas the co-publications between Cambodia and Great Britain and between Cambodia and Switzerland were rising (see Figure 168).

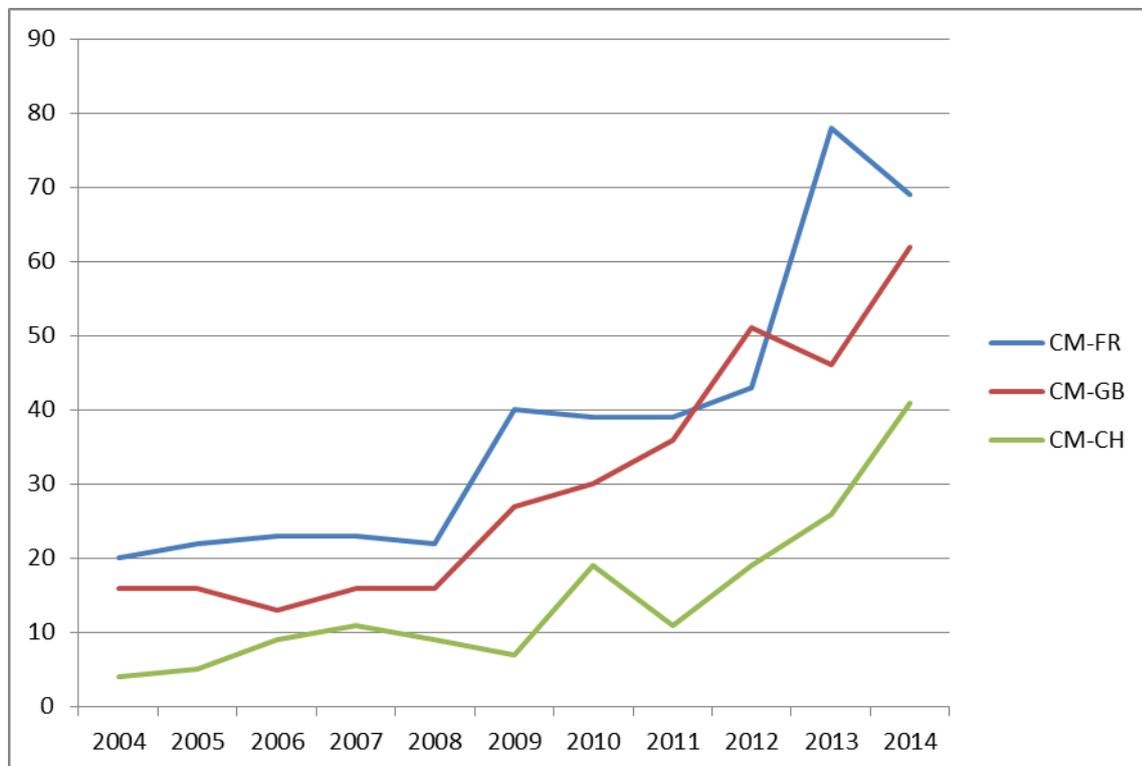


Figure 168: Cambodia’s co-publications with the three strongest collaboration countries from EU28/AC (France, Great Britain and Switzerland) and their development over time, 2004-2014

Next, we focus on the research fields of these co-publications. It is interesting to analyse on which research fields Cambodia’s co-publications with the three countries are focussing. As we have given the same overview for Cambodia’s top 3 partners in ASEAN, one can easily draw a direct comparison between them.

#### Cambodia– France: Top 3 research fields

1. Biomedical Research: 155 co-publications
2. Clinical Medicine: 142
3. General Science & Technology: 41

#### Cambodia– Great Britain: Top 3 research fields

1. Clinical Medicine: 109 co-publications
2. Biomedical Research 64
3. Biology: 58

**Cambodia – Switzerland: Top 3 research fields**

- 1. Clinical Medicine: 80
- 2. Biomedical Research: 43
- 3. General Science & Technology: 15

Clinical Medicine and Biomedical Research are the two leading research fields, which alternate on the top 2 positions. Other fields in the top 3 are Biology and General Science & Technology. That said, we observe a very similar research focus in both Cambodia’s co-publications with ASEAN and its co-publications with EU28/AC. **Clinical Medicine and Biomedical Research are in both co-operations the top 2 research fields of the three strongest country partnerships.**

Figure 169, Figure 170 and Figure 171 depict the total share of all SM research fields for Cambodia-France, Cambodia-Great Britain and Cambodia-Switzerland. We know already about the strongest research fields, but it is worth to look also on the other, smaller fields. By looking at the full picture, we get also an idea on how the ratio between the stronger and the weaker research fields looks like. For the strongest research field each time also the number of co-publications is given in the right column on the top.

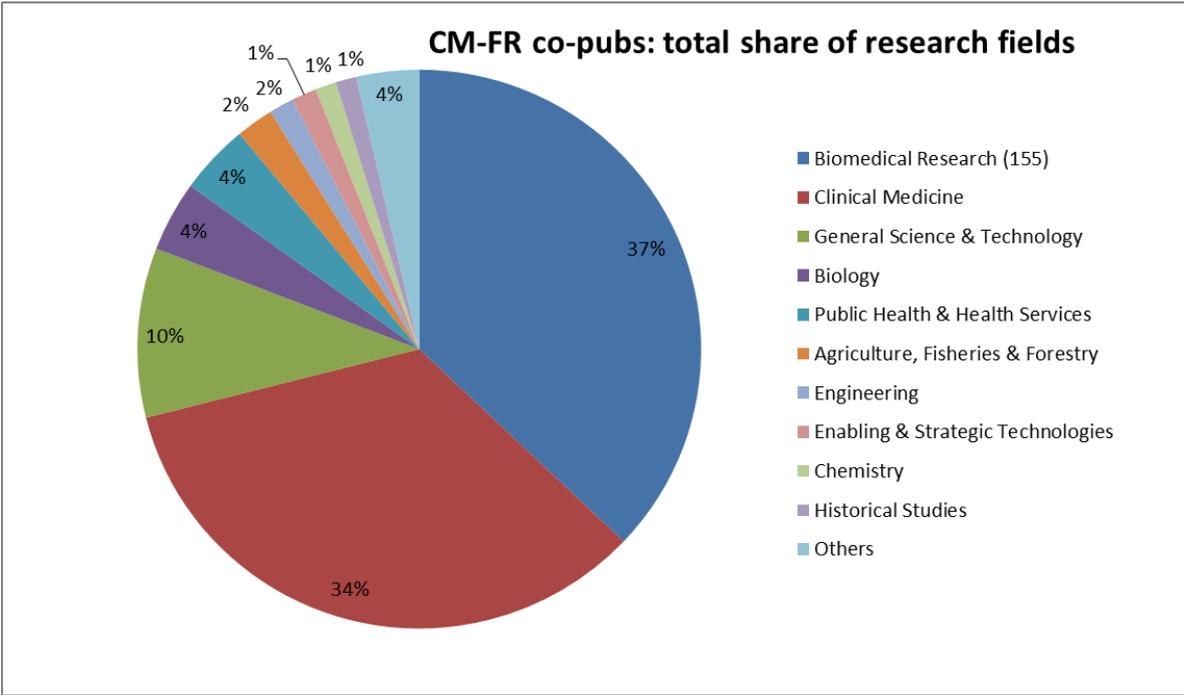


Figure 169: SM research fields of Cambodia-France co-publications, 2004-2014

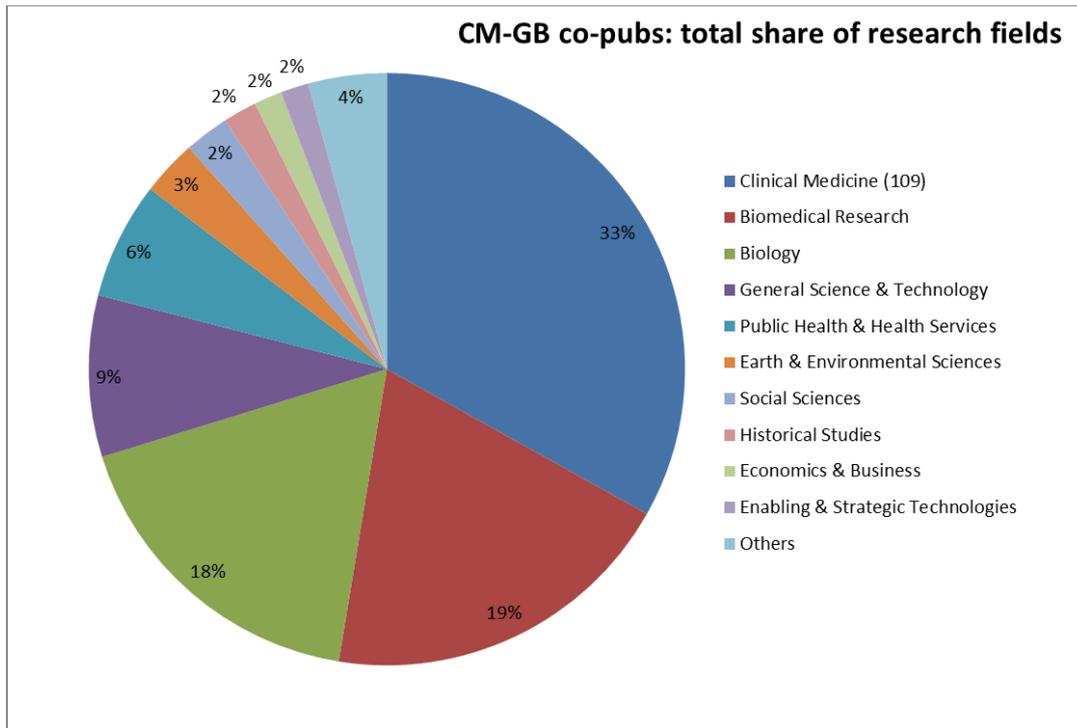


Figure 170: SM research fields of Cambodia-Great Britain co-publications, 2004-2014

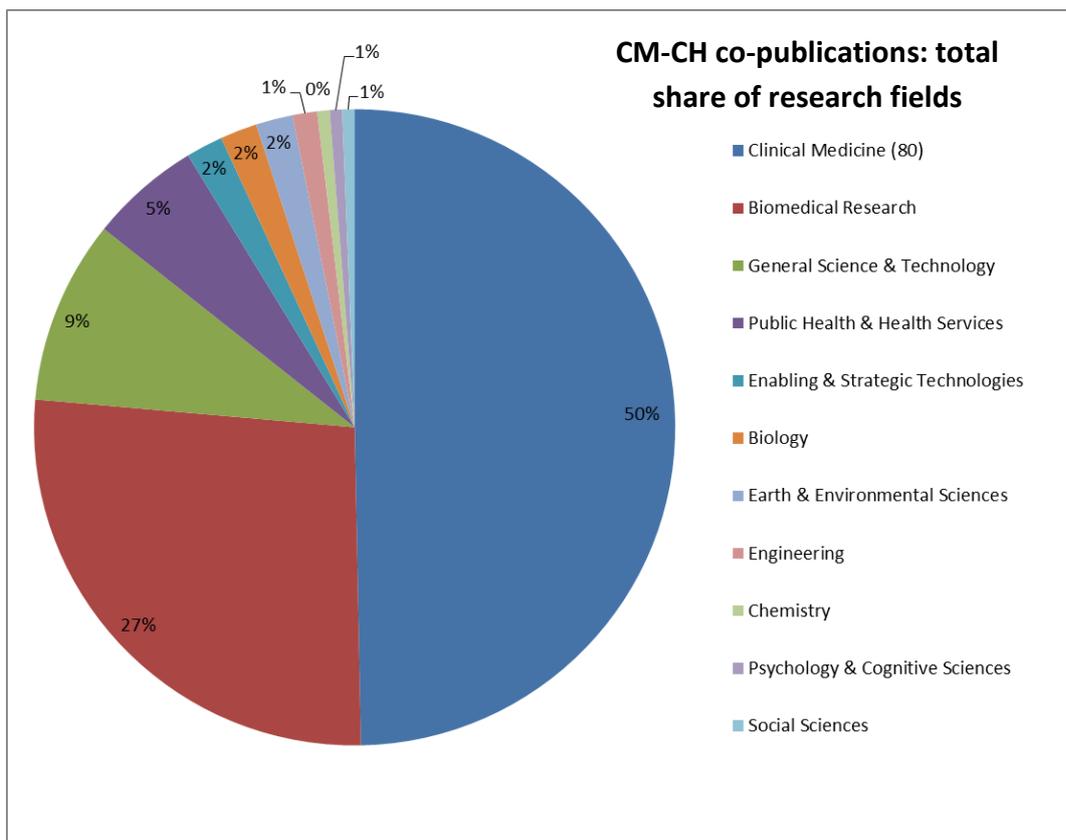


Figure 171: SM research fields of Cambodia-Switzerland co-publications, 2004-2014

**Analysis of research fields – Lao PDR with the ASEAN region**

Next, we look at Lao PDR’s co-publications with the other ASEAN states.

Both the size and the thematic strengths within this collaboration are scrutinised. The top 10 SM Fields in Lao PDR-ASEAN co-publications from 2004-2014 can be found in Figure 172. Most of the co-publications between Lao PDR and ASEAN were published in the field of Clinical Medicine, which is the biggest part in the pie chart in blue colour (190 co-publications; 32%), followed by Biology (103; 17%) and Biomedical Research (95; 16%).

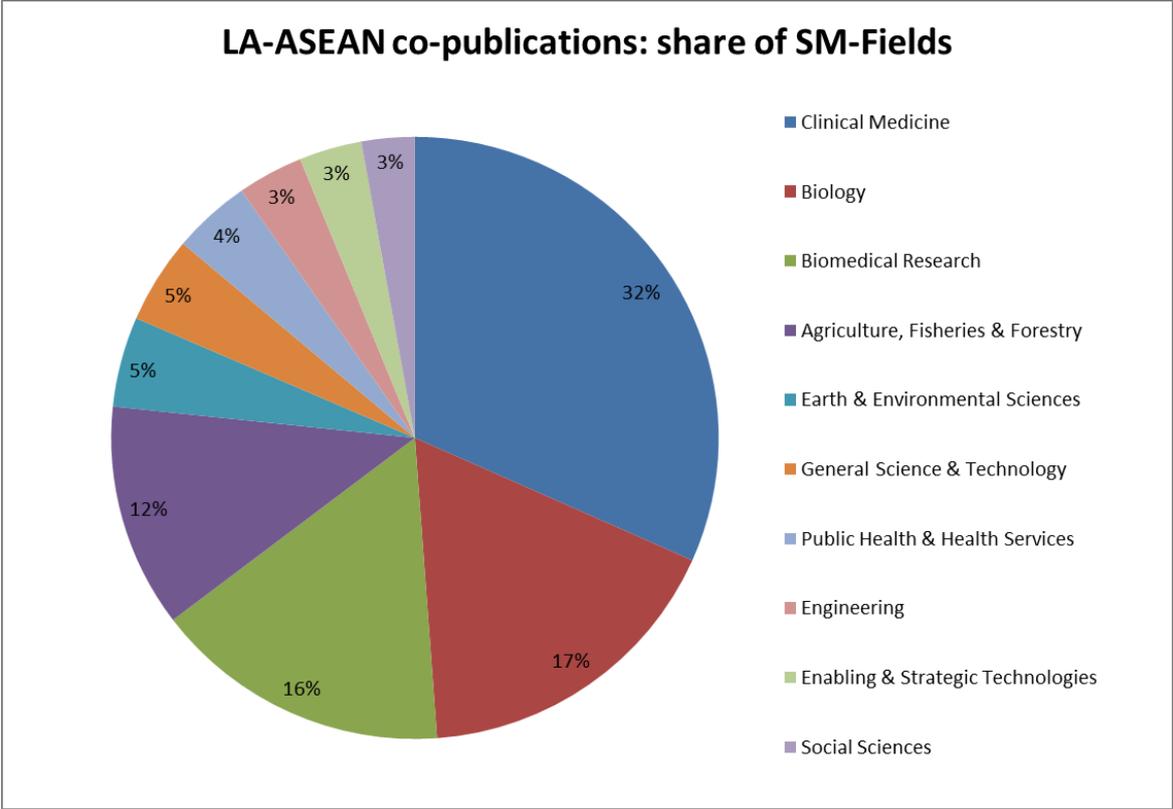


Figure 172 SM research fields of Lao PDR’s co-publications with ASEAN countries, 2004-2014

**Lao PDR’s collaboration linkages – within the ASEAN region in detail**

The strongest collaboration partners for Lao PDR in the ASEAN region don’t differ much from Cambodia’s strongest collaboration partner countries (Figure 173) - Thailand is first with 403 joint co-publications (around 46% of the total number of 883 joint co-publications between Lao PDR and the ASEAN countries). Second strongest partner is Vietnam with 153 (17%) and third strongest partner is Cambodia with 110 co-publications (12%) joint co-publications. Here’s the only difference: For Cambodia the third strongest collaboration partner is Indonesia, whereas for Lao PDR it is Cambodia. The list is completed by Indonesia (64; 7%), the Philippines (59; 7%), Malaysia (52; 6%), Singapore (23; 3%) and Myanmar (19; 2%).

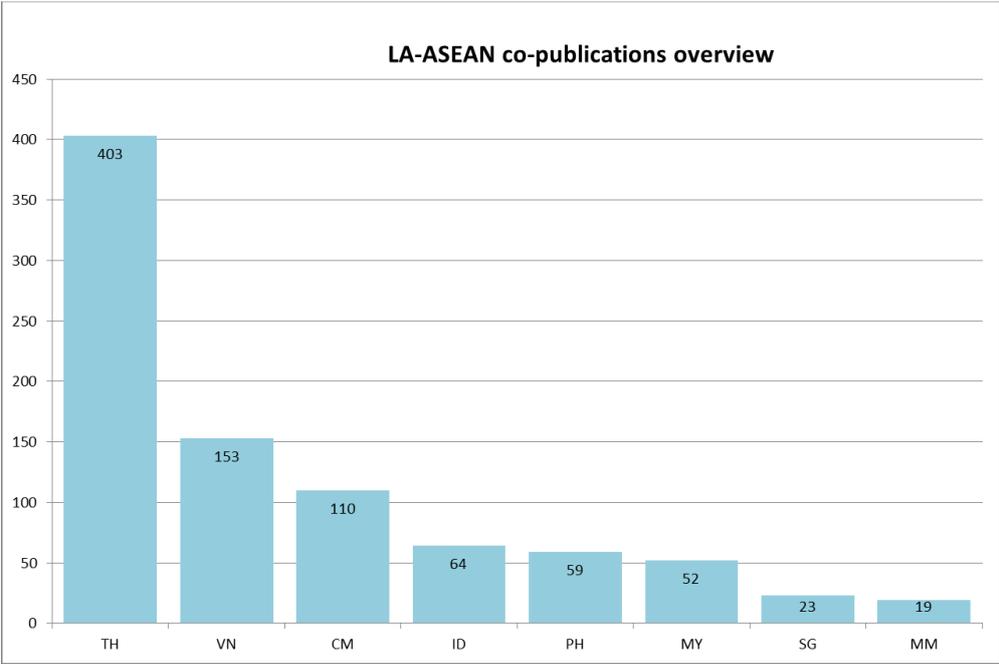


Figure 173: Lao PDR’s co-publications with ASEAN countries, 2004-2014

If we look at the **development over time of Lao PDR’s co-publications with its three strongest collaboration partners from ASEAN** (Figure 174), the Lao PDR-Thailand co-publications are performing considerably stronger over time than the Lao PDR -Vietnam and Lao PDR – Cambodia publications. The blue graph shows the development of Lao PDR -Thailand co-publications. In none of the years between 2004 and 2014 one of the other two partnerships had as much co-publications produced as Lao PDR with Thailand. Lao PDR’s co-publication output with Vietnam and its co-publication output with Cambodia on the other hand show a rather similar development over time. The two graphs (red and green) are not far from each other and some of the ups (increase of co-publication output) and downs (decrease) happened parallel in time.

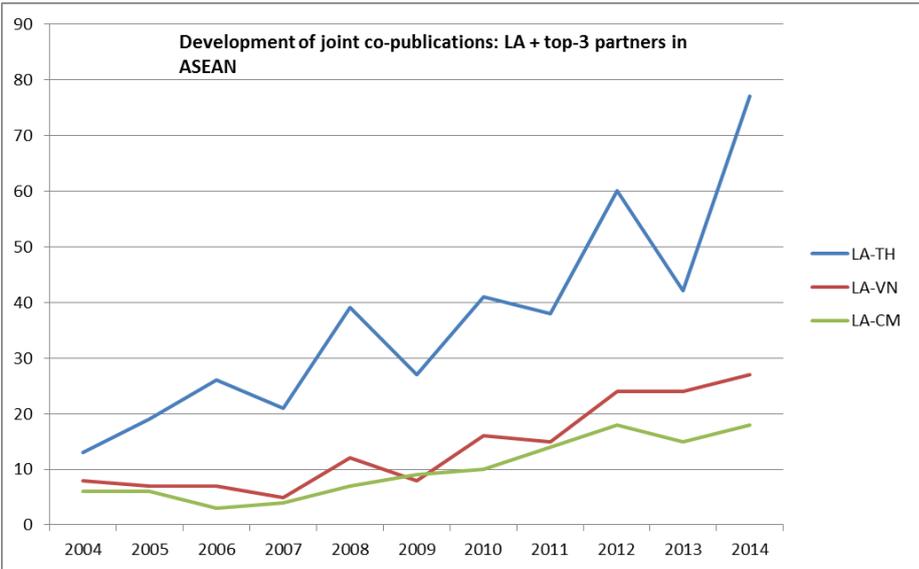


Figure 174: Lao PDR's co-publications with the three strongest ASEAN collaboration countries and their development over time, 2004-2014

Following the same steps as in the previous analysis for Cambodia-ASEAN, we look next at the level of research fields. We are interested in which research fields co-published Lao PDR with its core partners from ASEAN most often.

First a brief overview of the top 3 research fields is given. After this introduction, we offer a closer look on the total share of research fields in Lao PDR's co-publications with its strongest ASEAN partners.

#### **Lao PDR – Thailand: Top 3 research fields**

1. Clinical Medicine: 145 co-publications
2. Biomedical Research: 79
3. Biology: 44

#### **Lao PDR – Vietnam: Top 3 research fields**

1. Clinical Medicine: 37 co-publications
2. Biology: 33
3. Agriculture, Fisheries & Forestry: 22

#### **Lao PDR – Cambodia: Top 3 research fields**

1. Clinical Medicine: 36
2. Biology: 16
3. Agriculture, Fisheries & Forestry: 15

**Clinical Medicine is the top research field in all three country partnerships.** For Lao PDR's co-publications with Thailand Biomedical Research is on the second position, followed by Biology. In the co-operations between Lao PDR and Vietnam and Lao PDR and Cambodia respectively, Biology both times ranks second. In both cases it is followed by Agriculture, Fisheries & Forestry on the third position.

The following Figure 175, Figure 176 and Figure 177 depict the total share of the research fields in Lao PDR's co-publications with Thailand, Vietnam and Cambodia. The top 3 research fields were already introduced before. The overview now highlights the complete list of research fields in the three country partnerships.

To give some orientation, to the strongest research field the number of co-publications is given not only in each of the pie charts itself, but also in the right-hand column.

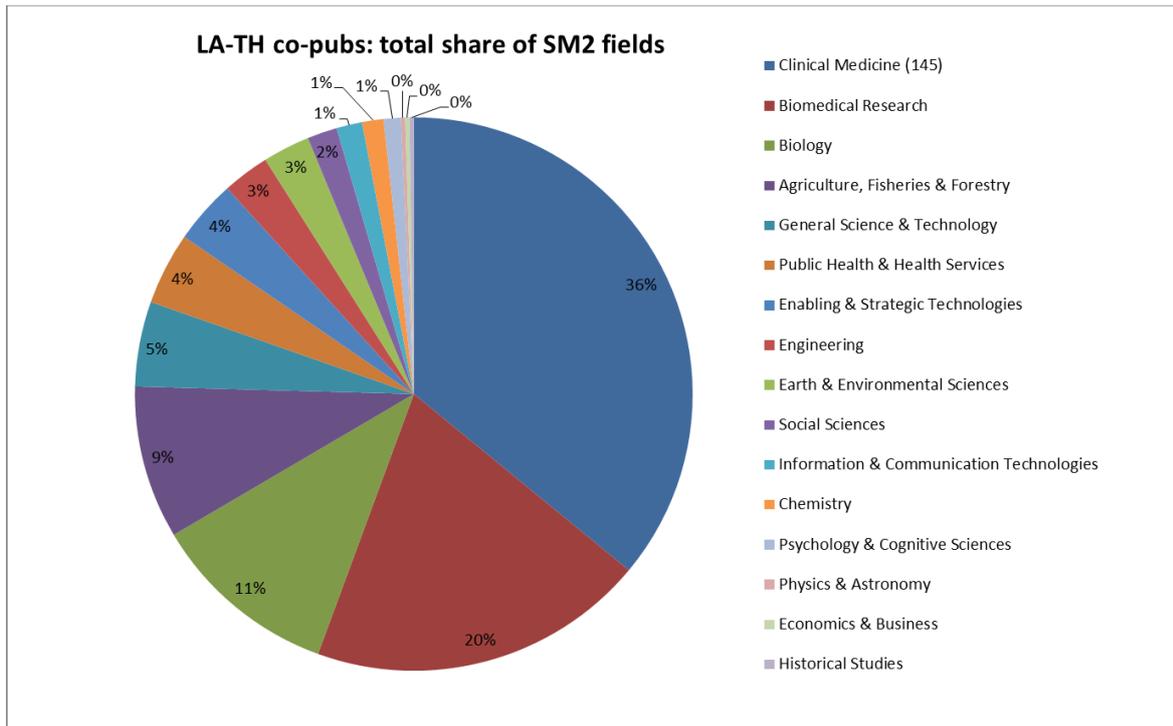


Figure 175: SM research fields of Lao PDR-Thailand co-publications, 2004-2014

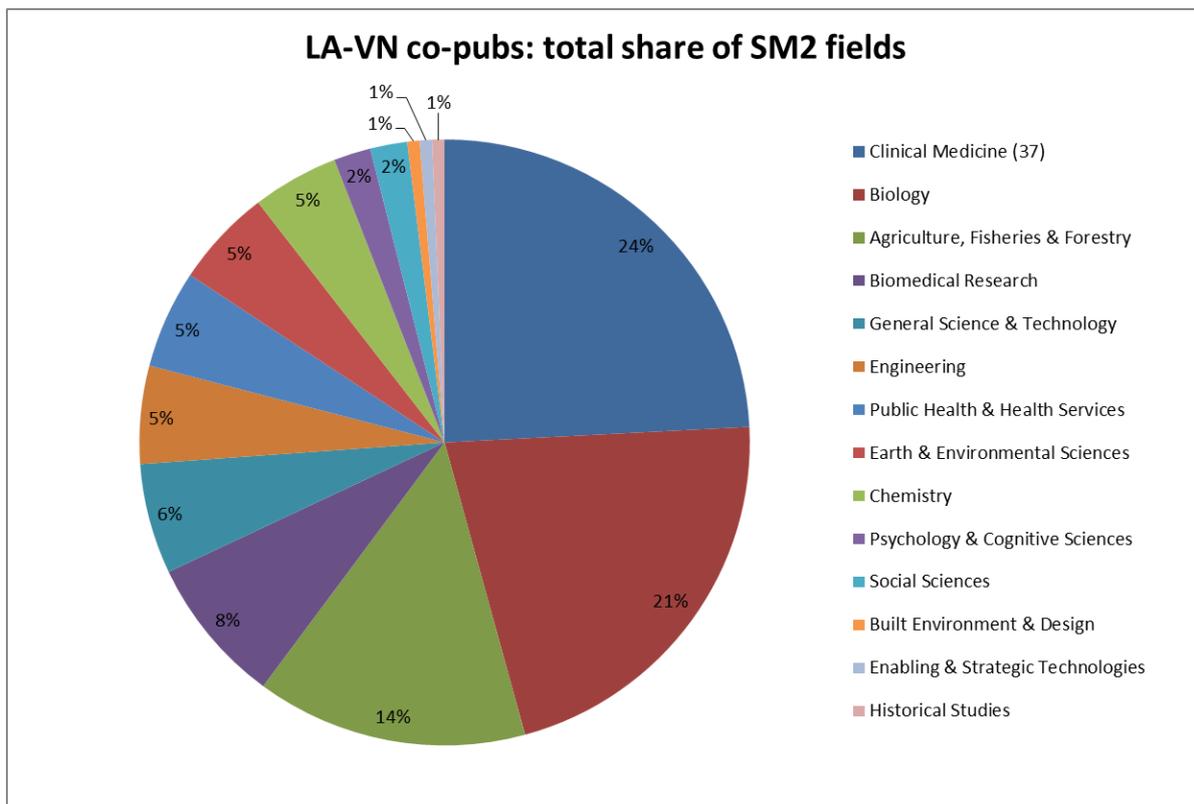


Figure 176: SM research fields of Lao PDR-Vietnam co-publications, 2004-2014

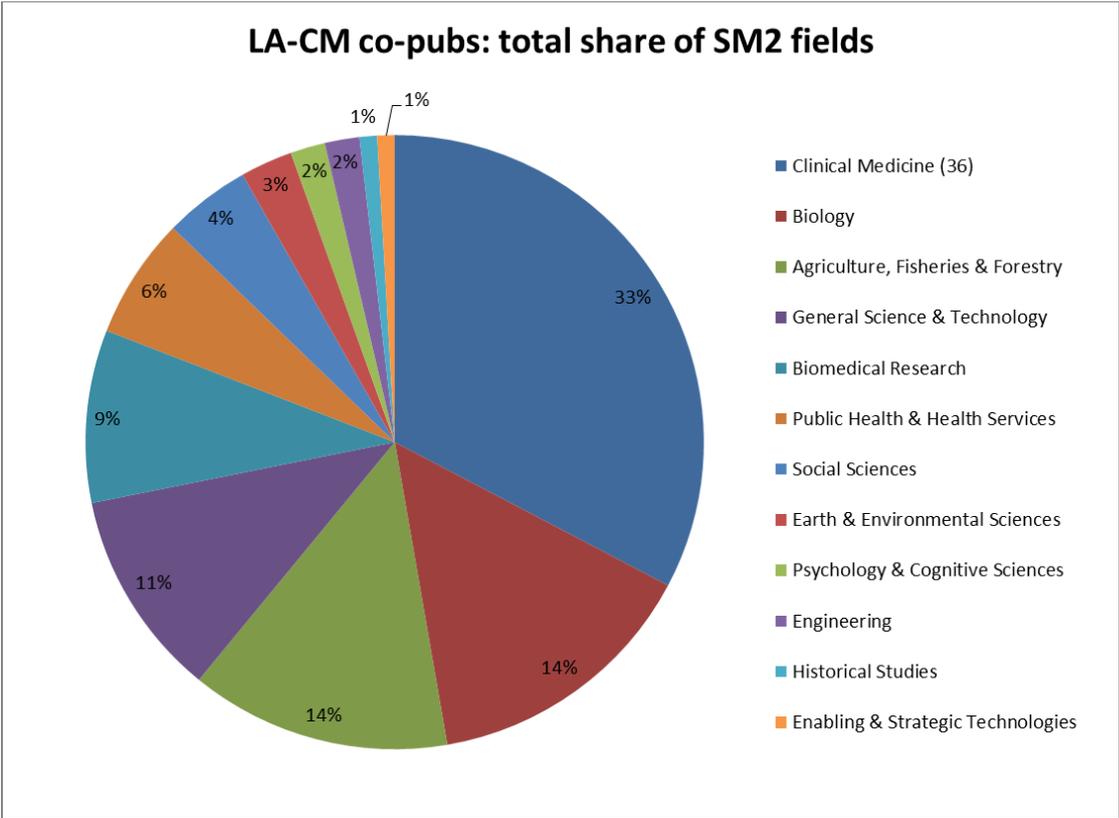


Figure 177: SM research fields of Lao PDR-Cambodia co-publications, 2004-2014

**Lao PDR’s Collaboration linkages – with the EU28/AC countries in detail**

In Lao PDR’s co-operation with EU28/AC, Great Britain, France and Switzerland turn out to be the strongest collaboration partners with highest joint co-publication numbers (see Figure 178). All in all, Lao PDR (or better said: one or more Laotian researcher(s)) has conducted 801 joint co-publications with EU28/AC in the period 2004-2014. With Great Britain, Lao PDR co-published 317, with France 262 and with Switzerland 101 times in this period.

If we compare these results again with those from the collaboration between Cambodia and EU28/AC, the findings are remarkable: Cambodia’s strongest partner countries in EU28/AC are also France, Great Britain and Switzerland. In Lao PDR’s case now only France and Great Britain switched places.

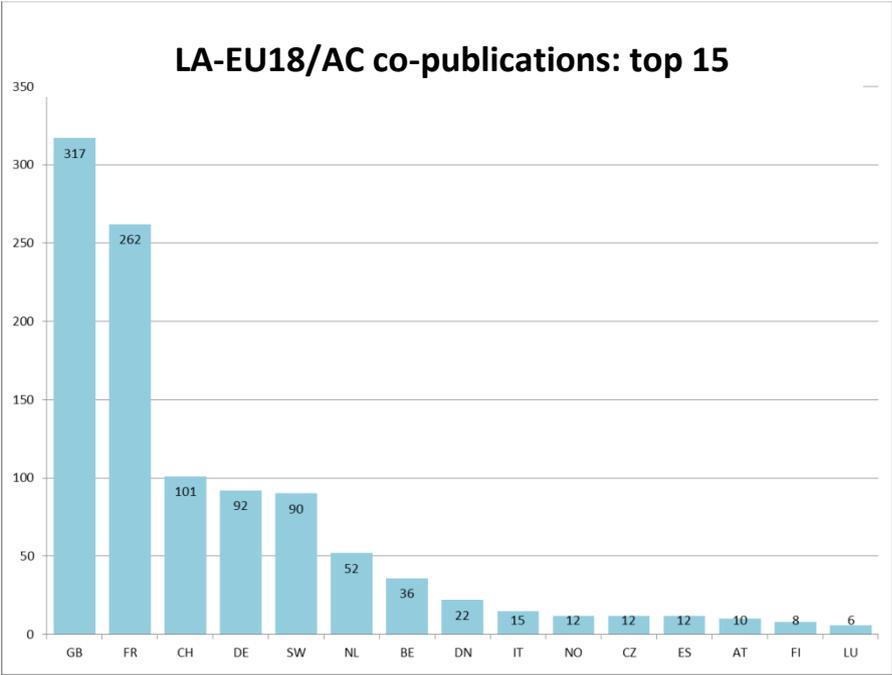


Figure 178: Lao PDR’s co-publications with EU28/AC countries, 2004-2014

Regarding the ten year’s period, the course over time in Lao PDR’s co-publications with Great Britain, France and Switzerland is illustrated in Figure 179. The drop in Lao PDR’s co-publication output with Switzerland from 2012 to 2014 seems drastic; however, when looking closer at the numbers, the relation is clearer. The co-publication output fell from 18 to 4 co-publications. Since the output numbers in this case are generally small, the drop is not as decisive as the green graph may indicate. Lao PDR’s co-publication output with France overtook the one with Great Britain from 2013 to 2014, after being nearly on the same level already in 2012 (blue graph for Great Britain and red graph for France). France had 39 joint co-publications with Lao PDR at that time, Great Britain 38.

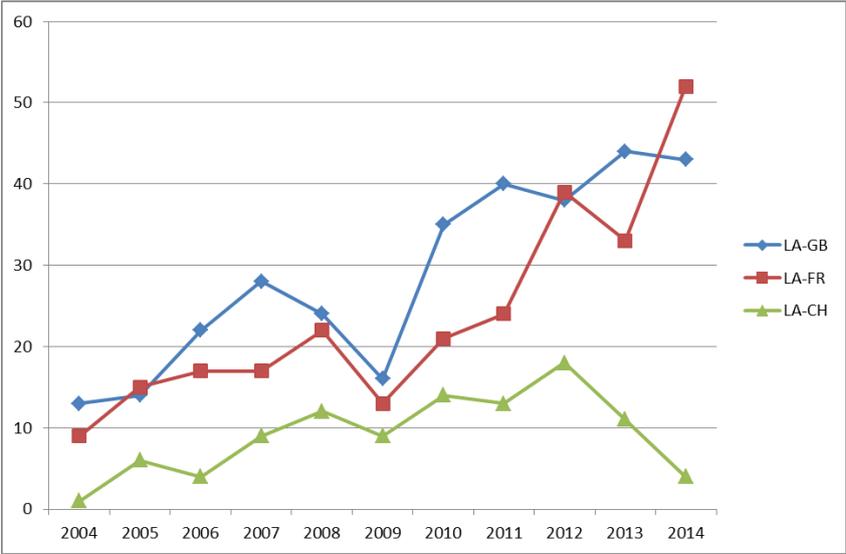


Figure 179: Cambodia’s co-publications with the three strongest collaboration countries from EU28/AC (France, Great Britain and Switzerland) and their development over time, 2004-2014

Regarding both the overall split of research fields and the top performing research fields in Lao PDR's co-operation with EU28/AC, the next charts give relevant information. The structure of the data given is the same as for Lao PDR's co-publications with the top 3 partners from ASEAN. This allows a quick and comprehensible comparison between Lao PDR's top collaboration partners from both regions.

#### **Lao PDR – Great Britain: Top 3 research fields**

1. Clinical Medicine: 126 co-publications
2. Biomedical Research: 67
3. Biology: 31

#### **Lao PDR- France: Top 3 research fields**

1. Clinical Medicine: 69 co-publications
2. Agriculture, Forestry & Fisheries: 38
3. Biomedical Research: 36

#### **Lao PDR - Switzerland: Top 3 research fields**

1. Clinical Medicine: 50
2. Biomedical Research: 20
3. Biology: 10

**Clinical Medicine is ranked on the first position in all three cases.** The other fields in the list of top 3 research fields are Biomedical Research, Biology and Agriculture, Forestry & Fisheries. Reflecting on the strongest research fields in Lao PDR's co-operation with ASEAN, we can draw the following comparison: **Clinical Medicine is the strongest performing research field in all of Lao PDR's six strongest country partnerships** (Lao PDR – Thailand, Lao PDR – Vietnam, Lao PDR – Cambodia, Lao PDR – Great Britain, Lao PDR– France and Lao PDR – Switzerland). Also the **remaining research fields in the top 3 are exactly the same through all six cases: Biology, Biomedical Research and Agriculture, Fisheries & Forestry.** They just change their positioning between the second and third place from country to country.

#### **As a resume:**

Lao PDR performs best in some typical research fields when it comes to collaboration with the two major world regions EU28/AC and ASEAN. It is a set of four research fields in which Lao PDR shows highest international co-publication numbers. Among these four research fields, Clinical Medicine is the top performing field with the highest co-publication numbers in all six analysed country partnerships.

Figure 180, Figure 181 and Figure 182 depict the total share of all SM research fields for Lao PDR-Great Britain, Lao PDR-France and Lao PDR-Switzerland. The previously mentioned top 3 research fields cover the three biggest pieces of the cake. As becomes obvious, Clinical Medicine is the

strongest research field in all three collaborations (dark blue part of the pie chart). Second in the collaboration between Lao PDR and Great Britain as well as with Switzerland is Biomedical Research (dark red). In the collaboration with France it is Agriculture, Fisheries and Forestry. Biology ranks third in the collaboration with Switzerland and Great Britain again, whereas with France it is Biomedical Research (light green).

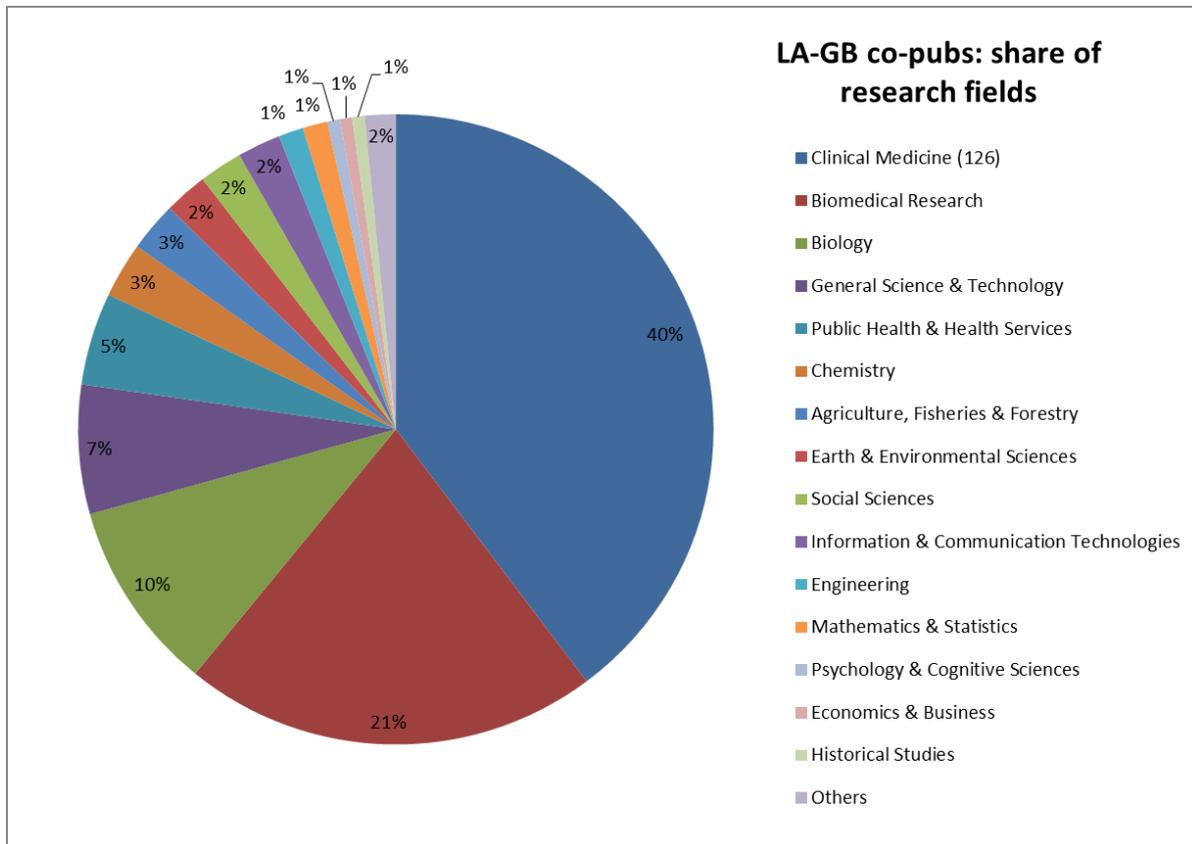


Figure 180: SM research fields of Lao PDR-Great Britain co-publications, 2004-2014

Figure 181 covers the research fields in Lao PDR’s co-publications with France. The three biggest fields are again highlighted in dark blue (Clinical Medicine), dark red (Agriculture, Fisheries & Forestry) and dark green (Biomedical Research). For the remaining fields please see the illustration below.

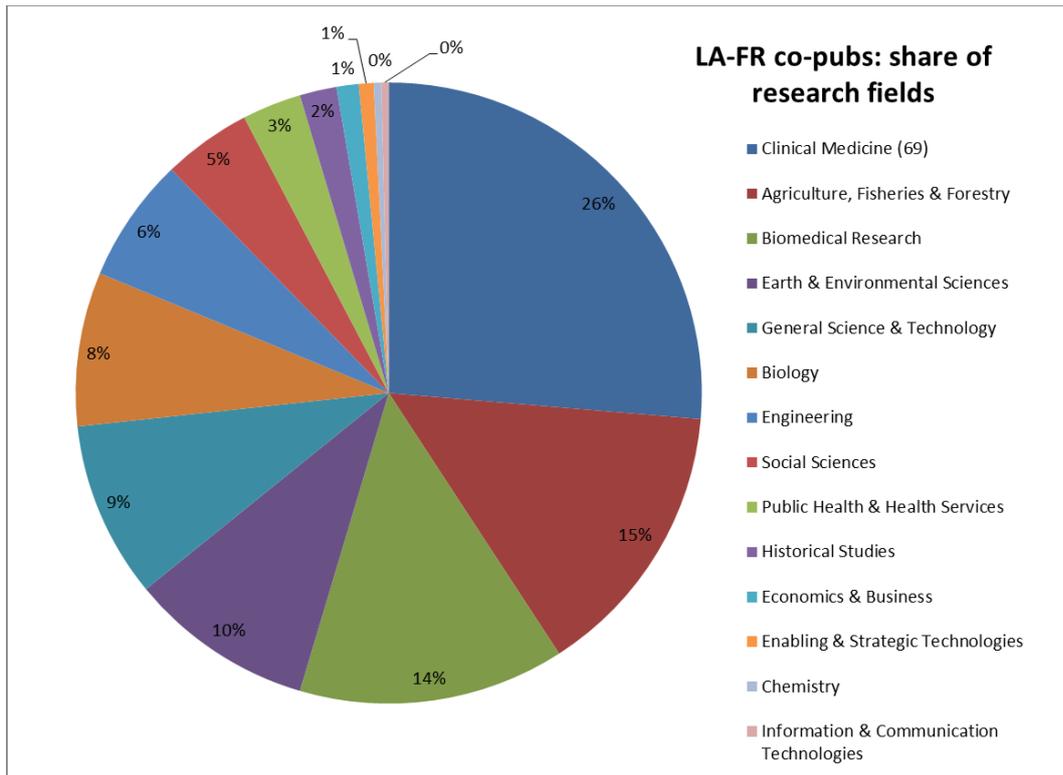


Figure 181: SM research fields of Lao PDR-France co-publications, 2004-2014

The last pie chart covers the total split of research fields for Lao PDR’s co-publications with Switzerland. Please see also here the data below for more information.

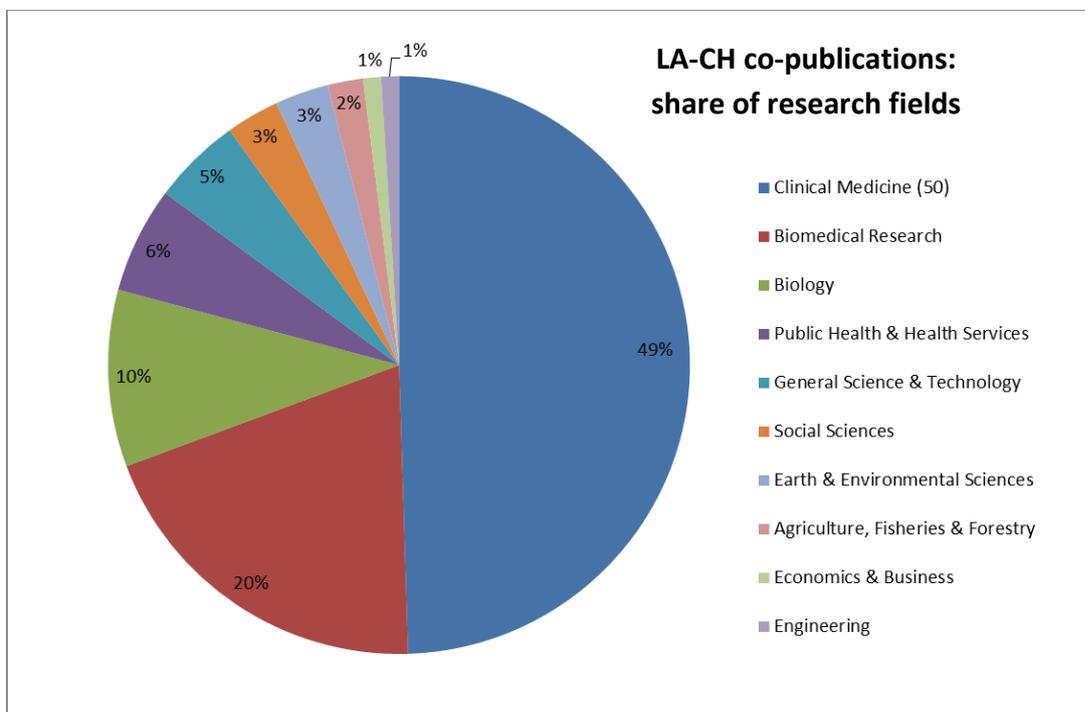


Figure 182: SM research fields of Lao PDR-Switzerland co-publications, 2004-2014

### Analysis of research fields – Myanmar with the ASEAN region

Next, we look at Myanmar’s co-publications with the other ASEAN states.

Both the size and the thematic strengths within this collaboration are scrutinised. The top 10 SM Fields in Myanmar-ASEAN co-publications from 2004-2014 can be found in Figure 183 on the following page. Most of the co-publications between Myanmar and ASEAN were published in the field of Clinical Medicine (89 co-publications; 30%), again displayed in blue colour in the pie chart. This field is followed by Biology (67; 22%) and Biomedical Research (35; 12%).

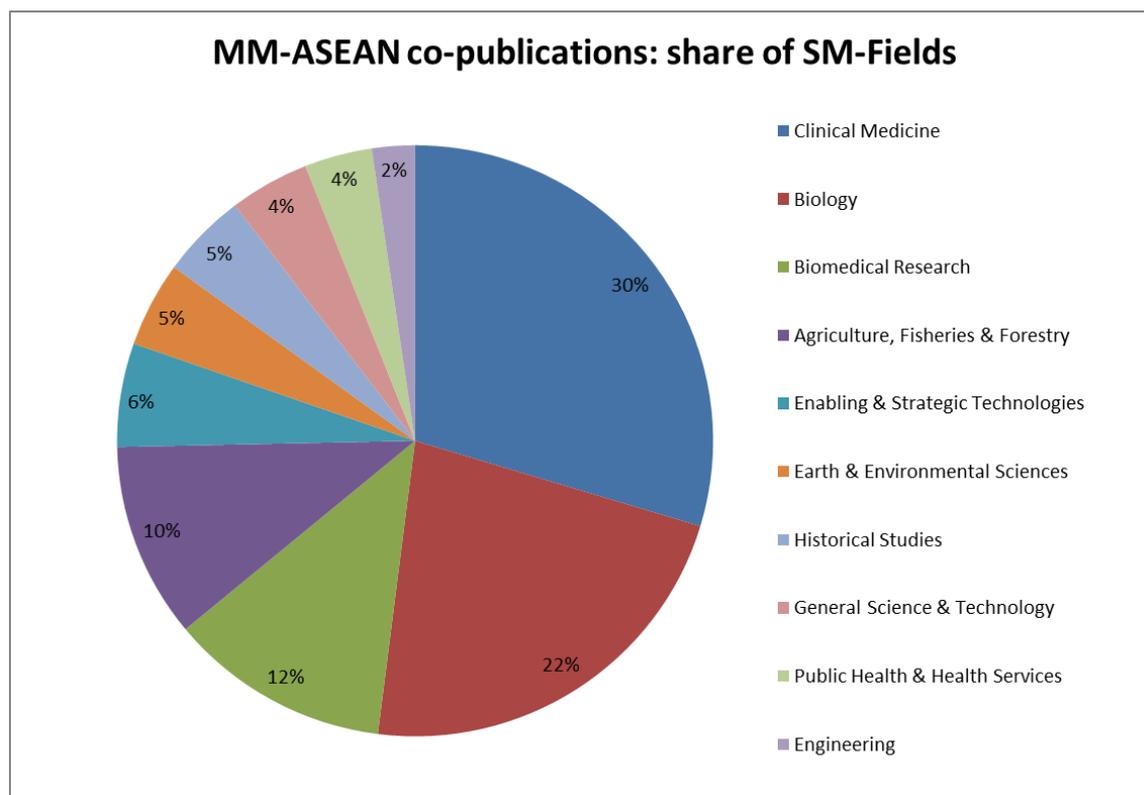


Figure 183 SM research fields of Myanmar’s co-publications with ASEAN countries, 2004-2014

### Myanmar’s collaboration linkages – within the ASEAN region in detail

Figure 184 depicts the strongest co-publication partners from ASEAN region. **The strongest collaboration partners for Myanmar in the ASEAN region are Thailand with 188 joint co-publications.** Second strongest partner is Malaysia with 76 and third strongest partner is Vietnam with 68 co-publications. The list is completed by Indonesia (53), the Philippines (52), Singapore (38), Cambodia (34) Lao PDR (19) and Brunei (2).

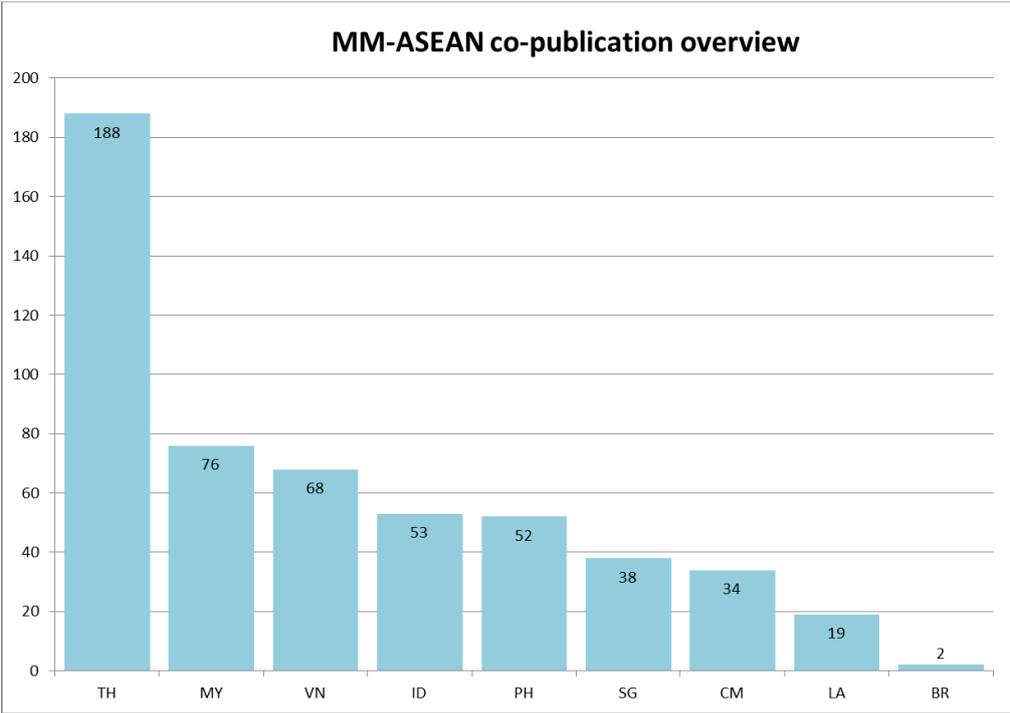


Figure 184: Myanmar’s co-publications with ASEAN countries, 2004-2014

In Figure 185, we focus on the **development over time of Myanmar’s co-publications with its three strongest collaboration partners from ASEAN**. Myanmar’s co-publications with Thailand are highlighted in blue, the co-publications with Malaysia are in red and the co-publications with Vietnam in green.

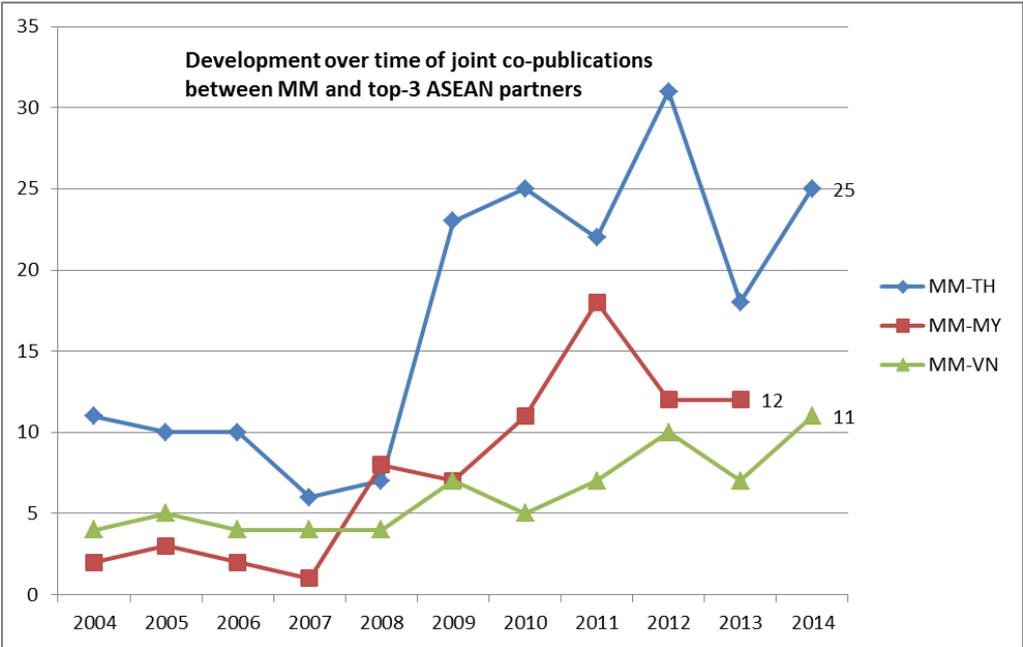


Figure 185: Myanmar’s co-publications with the three strongest ASEAN collaboration countries and their development over time, 2004-2014

The following analysis provides information on in which research fields published Myanmar with its top 3 partners from ASEAN most often. First a brief overview of the top 3 research fields in the single partnerships is given, before we look at the split of research fields in total.

#### **Myanmar– Thailand: Top 3 research fields**

1. Clinical Medicine: 57 co-publications
2. Biology: 39
3. Biomedical Research: 22

#### **Myanmar– Malaysia: Top 3 research fields**

1. Clinical Medicine: 26 co-publications
2. Biology: 12
3. Agriculture, Fisheries & Forestry: 10

#### **Myanmar – Vietnam: Top 3 research fields**

1. Biology: 21
2. Clinical Medicine: 19
3. Biomedical Research: 6

**Clinical Medicine, Biology, Biomedical Research and Agriculture, Fisheries & Forestry are the strongest research fields in Myanmar’s co-publication co-operation with ASEAN core partners.** The top research fields are similar to our previous findings. Also in Cambodia’s and Lao PDR’s collaboration with their top 3 ASEAN partner countries these research fields appeared to be on the top.

The following Figure 186 to Figure 188 depict the total share of the research fields in Myanmar’s co-publications with Thailand, Malaysia and Vietnam. After introducing the top 3 research fields, this overview highlights now the complete list of all research fields (including those, in which at least one co-publication was made).

To give some orientation, in each of the three pie charts to the strongest research field the number of co-publications is always given (right-hand column).

First, we offer a complete overview of the research fields in Myanmar’s co-publications with Thailand in the period 2004-2014. The biggest pieces of the cake go to the already mentioned fields of Clinical Medicine (dark blue), Biology (dark red) and Biomedical Research (dark green). The research fields thereafter are covered in various other colours, as you can see below.

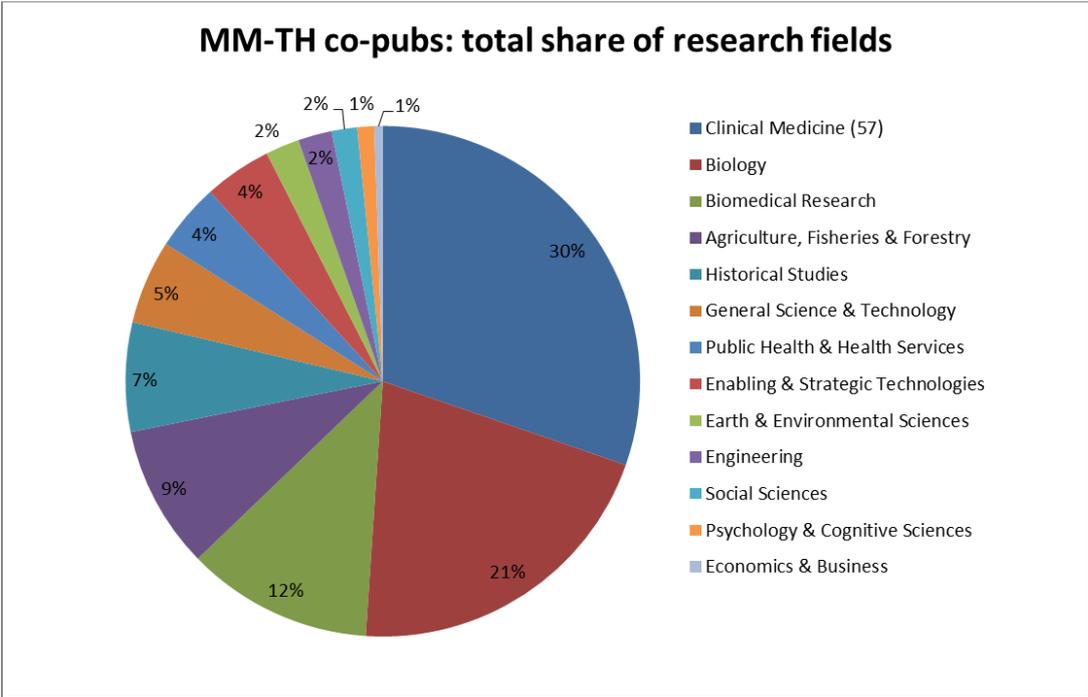


Figure 186: SM research fields of Myanmar-Thailand co-publications, 2004-2014

Second follows an overview of the research fields for Myanmar’s collaboration with Malaysia. The top 3 fields are covered in the same colours as in the previous example. Here the list of research fields is less exhaustive as the previous one. In some fields like Social Sciences, Historical Studies or Engineering no publication was produced between Myanmar and Malaysia.

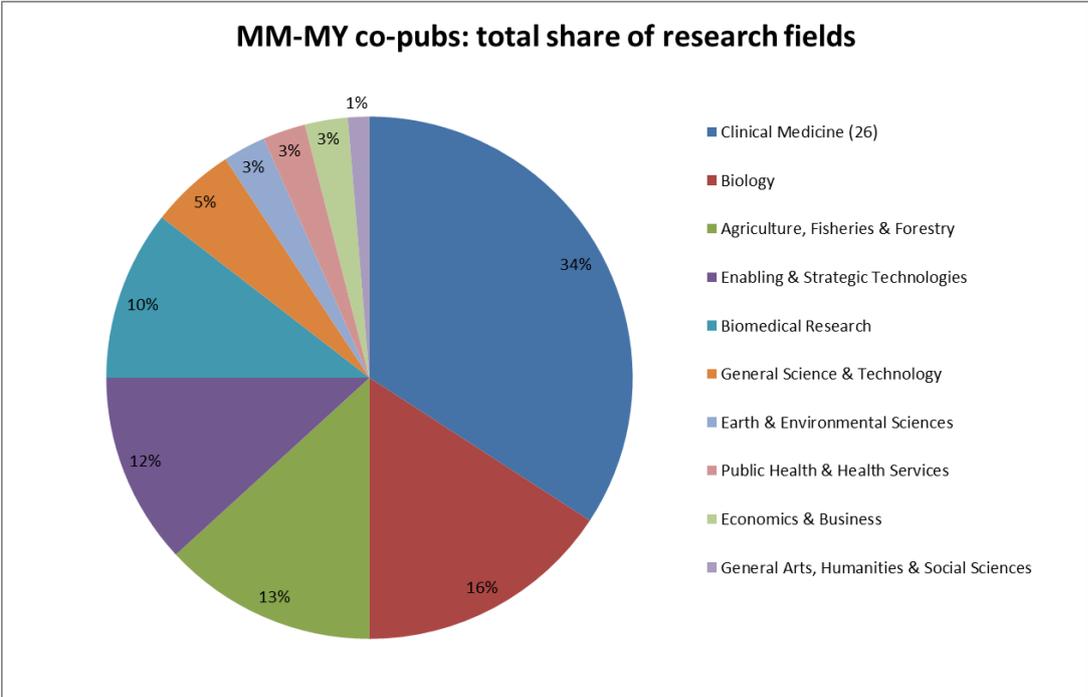


Figure 187: SM research fields of Myanmar-Malaysia co-publications, 2004-2014

Thirdly, the share of research fields for Myanmar’s co-publications with Vietnam is given. As in the other two charts, please find all information directly in the pie chart below.

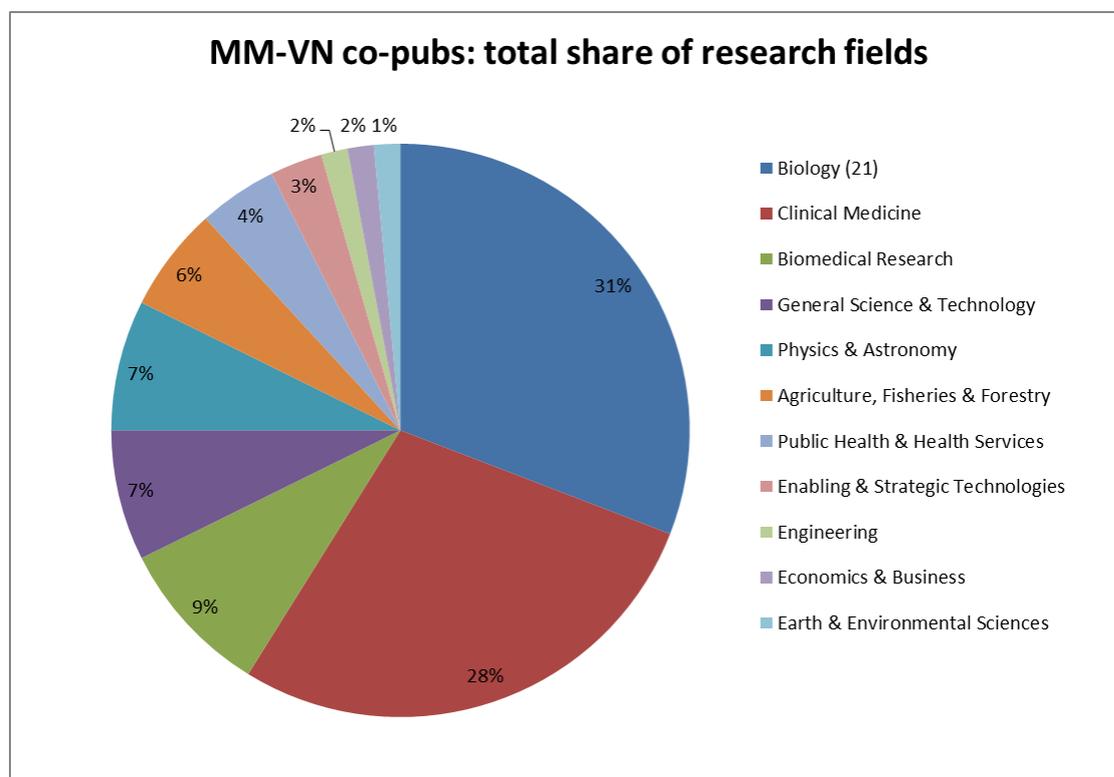


Figure 188: SM research fields of Myanmar-Vietnam co-publications, 2004-2014

### Myanmar’s Collaboration linkages – with the EU28/AC countries in detail

Compared to Cambodia’s and Lao PDR’s collaboration with EU28/AC, Myanmar has the smallest co-publication output with this region. In total numbers, Myanmar and the EU28/AC have jointly published 273 co-publications in the period 2004 -2014. Cambodia, at the same time, has 1,081 joint co-publications with EU28/AC, Lao PDR has 801 (please compare on page 164 and 172).

On a country level the picture looks as it follows: **Great Britain is the major collaboration partner for Myanmar** (Figure 189). **The countries together produced 92 co-publications (dark red color). Germany is second with 67 joint co-publications (dark green) and France (purple) is third with 52 co-publications.** Only one co-publication from 2004 – 2014 is recorded between Myanmar and Luxembourg, Portugal and Slovakia.

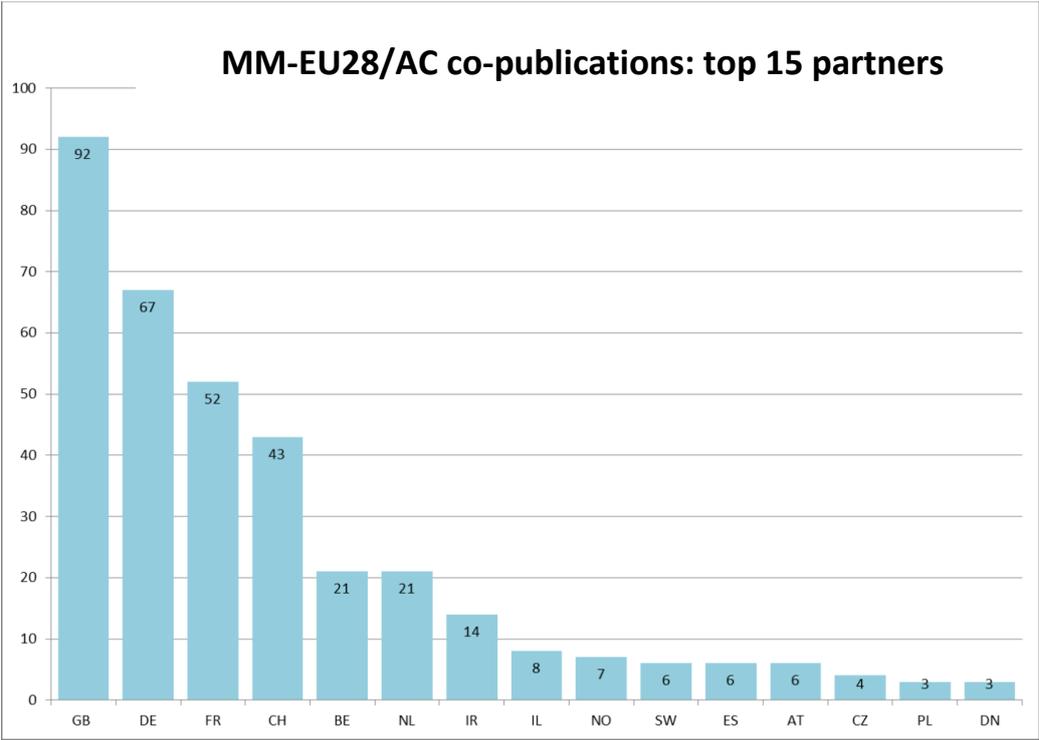


Figure 189: Myanmar’s co-publications with EU28/AC countries, 2004-2014

Figure 190 looks at the development over time for Myanmar’s co-publications with GB, DE and FR. Whereas Myanmar’s co-publication output with Great Britain and France is boosting since 2012, the output numbers with Germany were decreasing from 2012-2014. The red graph illustrates this trend. As Myanmar’s co-publication numbers are generally small, the difference between the highest (Myanmar-Great Britain with 15) and the lowest (Myanmar-Grmany with 6) number in 2014 is nevertheless minor.

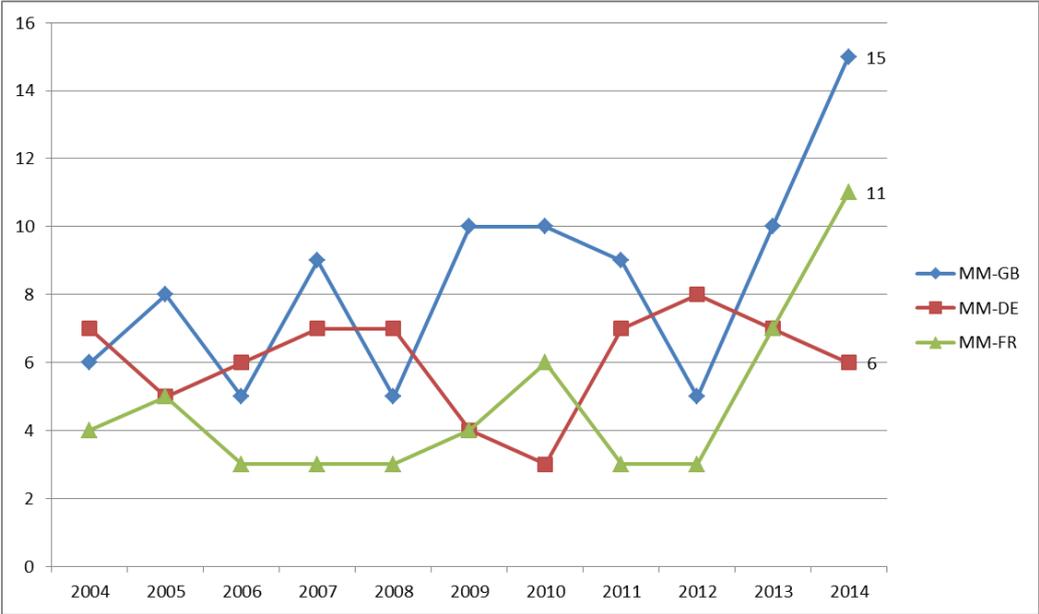


Figure 190: Myanmar’s co-publications with the three strongest collaboration countries from EU28/AC (France, Great Britain and Switzerland) and their development over time, 2004-2014

Regarding both the overall split of and the top performing research fields in Myanmar's co-operation with EU28/AC, this chapter now provides some answers.

The structure in this chapter follows the same pattern as for the two countries earlier: First the top 3 research fields within the three country partnerships are introduced. Then the total list of research fields in which Myanmar co-published with its three partners from EU28/AC follows.

#### **Myanmar – Great Britain: Top 3 research fields**

1. Biology: 27 co-publications
2. Clinical Medicine: 25
3. Biomedical Research: 16

#### **Myanmar - Germany: Top 3 research fields**

1. Biology: 16 co-publications
2. Chemistry: 11
3. Clinical Medicine: 9

#### **Myanmar - France: Top 3 research fields**

1. Historical Studies: 17
2. Clinical Medicine: 7
3. Earth & Environmental Sciences: 6

**Compared to Cambodia and Lao PDR earlier, Myanmar has a somewhat different thematic focus in its co-publications with the top 3 partners from EU28/AC. Biology and Historical Studies are the strongest research fields with most co-publications, whereas this has been Clinical Medicine most often in the other two cases. Still, Clinical Medicine is among the top 3 fields in all of the three cases here.** Historical Studies is worth to mention in another regard too: As we have shown, the top 3 fields in all cases are usually from the Health, Natural or Applied Sciences. Historical Studies as the first ranked field in Myanmar's collaboration with France, is the **only field from the Arts & Humanities.**

#### **As a resume:**

Myanmar shows a different pattern of research fields in its co-operation with EU28/AC than Cambodia and Lao PDR. Whereas the research fields in Myanmar's co-publication co-operation with the top 3 ASEAN states follow the "logic" of those of the other two countries regarding their co-operation with ASEAN (please see previous subchapters), the research fields in the co-operation with EU28/AC are, as said, somewhat different. Please compare with the previous subchapters again for the top 3 research fields in all of the analysed co-operations.

In the second part the total overview of the research fields for Myanmar and its core partners from EU28/AC is given now. The pie chart illustrations allow observing the share between the single research fields within all co-publications in the respective country collaboration.

Figure 191 covers the research fields in Myanmar’s co-publications with Great Britain. The three biggest fields, as introduced before, are highlighted in dark blue (Biology), dark red (Clinical Medicine) and dark green (Biomedical Research). For the remaining fields please see the illustration below.

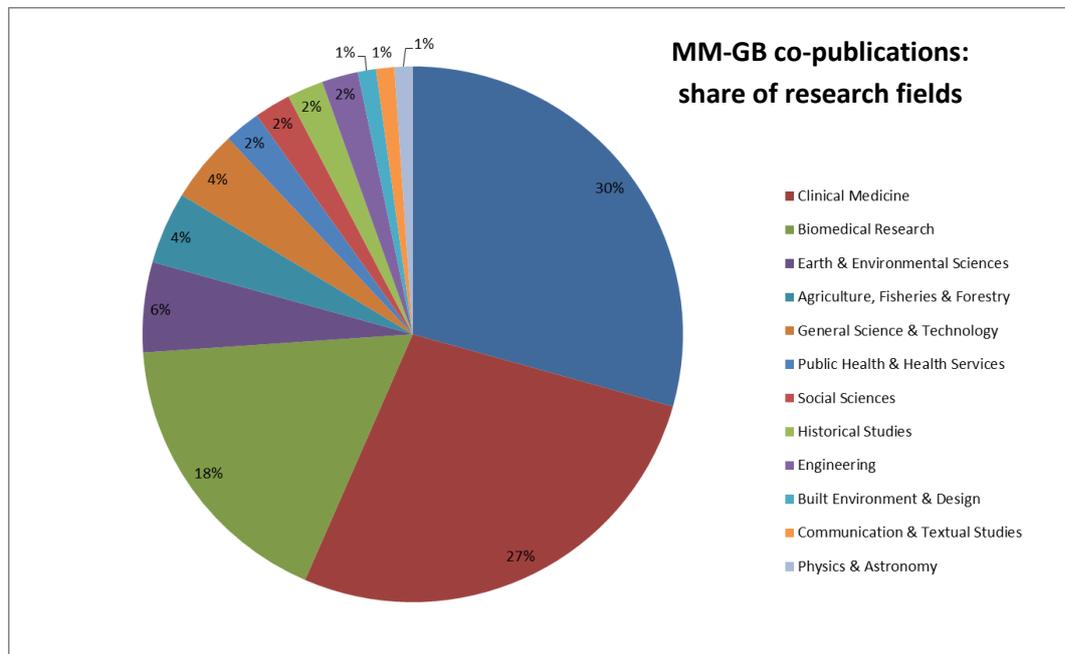


Figure 191: SM research fields of Myanmar-Great Britain co-publications, 2004-2014

Figure 192 depicts the share of research fields in Myanmar’s collaboration with Germany. Here the top 3 fields are Biology (dark blue; 16 joint co-publications), Chemistry (dark red; 11) and Clinical Medicine (dark green; 9).

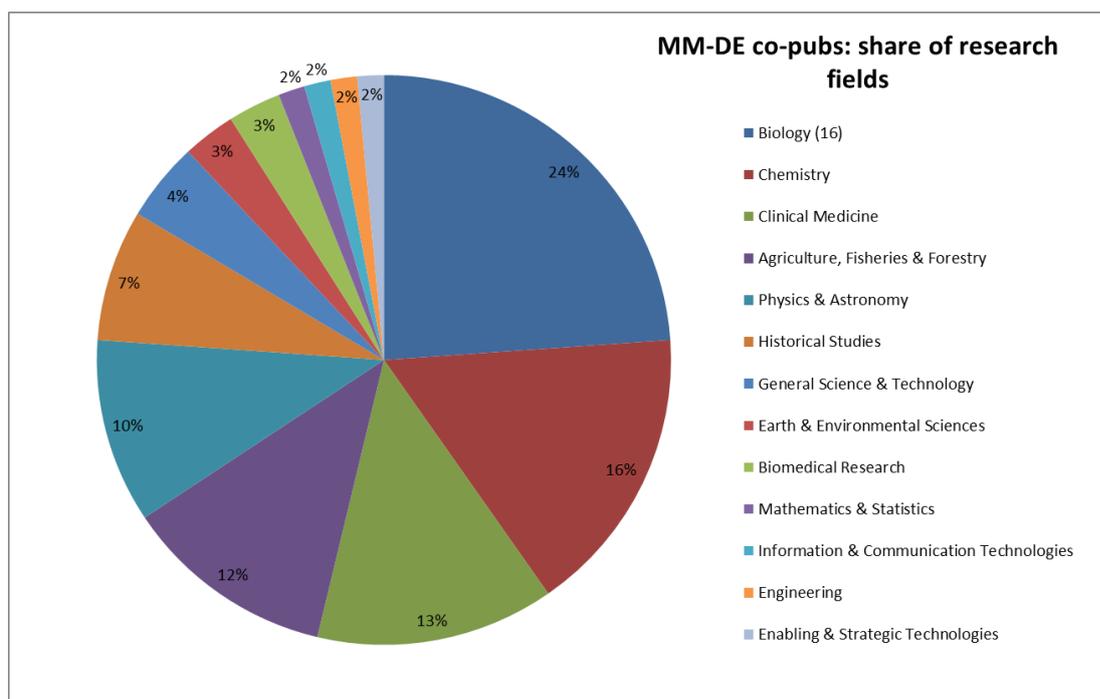


Figure 192: SM research fields of Myanmar-Germany co-publications, 2004-2014

Figure 193 covers the total split of research fields for Myanmar’s co-publications with France. Historical Studies leads the list (dark blue; 17 joint co-publications between Myanmar and France in this field), followed by Clinical Medicine (dark red; 7) and Earth & Environmental Sciences (dark green; 6).

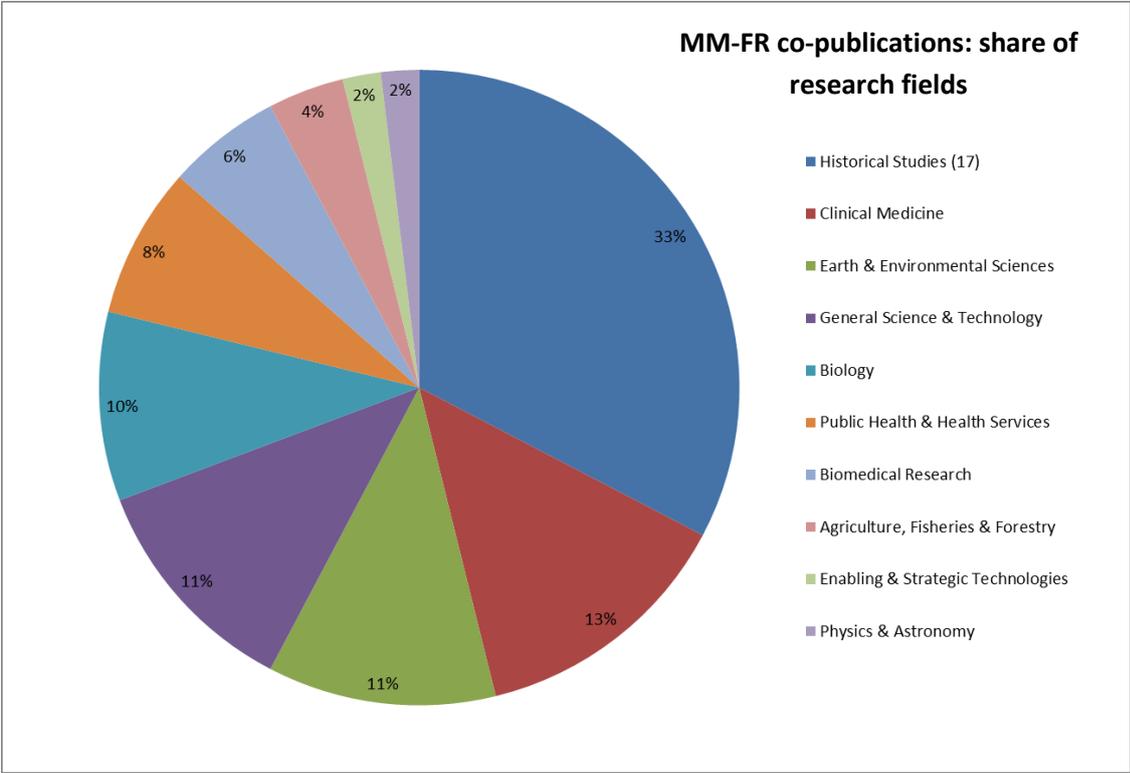


Figure 193: SM research fields of Myanmar-France co-publications, 2004-2014

**Impact Analysis**

Within this chapter, we present findings on the impact of Cambodia’s, Lao PDR’s and Myanmar’s co-publications with ASEAN and EU28/AC. First we look at some general figures related to citation count in co-publications. After that, national citation count is compared generally on the level of macro-regional co-operation, before looking at the same figures on the country level.

Within the analysed time span of 2004 to 2014, the average citation of a publication involving at least one author from Cambodia amounts to 10.25, i.e. each publication has been cited on average 10.25 times. Works co-authored with at least one author from a foreign country are cited more often: 11.42 is the number of average citations for internationally co-authored works. Works co-authored with at least one author from EU28/AC are cited 14.89 times on average and co-publications with at least one author from an ASEAN country are cited 16.44 times on average.

The average citation of a publication involving at least one author from Lao PDR amounts to 7.30, i.e. each publication has been cited on average 7.30 times. Works co-authored with at least one author from a foreign country are cited more often: 11.42 is the number of average citations for internationally co-authored works. Works co-authored with at least one author from EU28/AC are

cited 10.37 times on average and co-publications with at least one author from an ASEAN country are cited 9.2 times on average.

The average citation of a publication involving at least one author from Myanmar amounts to 5.61, i.e. each publication has been cited on average 5.61 times. Works co-authored with at least one author from a foreign country are cited more often: 8.30 is the number of average citations for internationally co-authored works. Works co-authored with at least one author from EU28/AC are cited 14.65 times on average and co-publications with at least one author from an ASEAN country are cited 12.16 times on average.

The table below elaborates on this data more in detail. In a direct comparison and based on the citation count (= impact) in the respective research field, national publications, international co-publications, co-publications with ASEAN and co-publications with EU28/AC are listed. The figures highlighted in green mark the top citation count in the respective category.

*Overview of average citations per SM research field: Comparison of Cambodia's, Lao PDR's and Myanmar's publications, co-publications, co-publications with ASEAN and with EU28/AC*

Cambodia's co-publications are compared to Cambodia's publications, Cambodia's co-publications with ASEAN and its co-publications with EU28/AC – as seen in the Table 31. **Remarkable is the overall performance between Cambodia and the ASEAN partners** – in the majority of the listed research fields this partnership proves the highest average citation counts. Among these are Communication & Textual Studies (distinctively higher citation count than the rest – 28.04) or Psychology & Cognitive Sciences (also clearly ahead with 14.28 citations/ co-publication). General Arts, Humanities & Social Sciences and Visual & Performing Arts are the only two fields in which neither any Cambodian publication, nor any co-publication was produced between 2004-2014.

	CM publications	CM co-publications	CM-ASEAN co-pubs	CM-EU28/AC co-pubs
<b>Agriculture, Fisheries &amp; Forestry</b>	5.61	5.87	7.78	10.55
<b>Biology</b>	5.94	6.26	6.68	6.27
<b>Biomedical Research</b>	13.1	13.74	16.95	15.97
<b>Built Environment &amp; Design</b>	2.93	4.04	7	3
<b>Chemistry</b>	5.88	5.88	12	5.84
<b>Clinical Medicine</b>	15.33	16.96	28.04	20.52
<b>Communication &amp; Textual Studies</b>	0.79	0.86	0	1
<b>Earth &amp; Environmental Sciences</b>	16.87	17.77	20.9	34.87
<b>Economics &amp; Business</b>	1.64	2.64	0.88	6
<b>Enabling &amp; Strategic Technologies</b>	4.06	4.61	3.8	6.92
<b>Engineering</b>	2.96	3.17	4.05	2.6
<b>General Arts, Humanities &amp; Social Sciences</b>	0	0	0	no co-pubs
<b>General Science &amp; Technology</b>	14.45	14.56	15.45	14.67
<b>Historical Studies</b>	4.82	5.78	3.9	5.41
<b>Information &amp; Communication</b>	3.71	4.1	2.33	1.3

Technologies				
Mathematics & Statistics	1	1	no copubs	1
Philosophy & Theology	1	1.2	1.5	1
Physics & Astronomy	3.75	4	3	2
Psychology & Cognitive Sciences	5.93	6.5	14.28	10.69
Public Health & Health Services	6.85	7.18	5.01	6.25
Social Sciences	1.59	1.96	1.3	2.64
Visual & Performing Arts	0	no co-pubs	no co-pubs	no co-pubs

Table 31: Overview of average citations of different SM research fields: Cambodia’s publications, co-publications, ASEAN co-publications and EU28/AC co-publications (all SM fields are included, irrespective of the number of publications or co-publications published in the respective field – “no co-publications” means no co-publications are indexed, “0” means no citations to indexed co-publications were made)

In most of the research fields, Lao PDR’s co-publications with EU28/AC perform best (most right-hand column in Table 32). Only in small number of fields Lao PDR’s co-publications with ASEAN perform better. Whereas in some fields no co-publication was produced at all or, if any was produced, it wasn’t cited (citation count is 0).

	LA pubs	LA co-publications	LA-ASEAN copubs	LA-EU28/AC copubs
Agriculture, Fisheries & Forestry	6.45	6.6	7.37	7.92
Biology	6.02	6.03	5.84	6.75
Biomedical Research	13	13.38	14.95	16.12
Built Environment & Design	6.57	6.83	7.5	9.5
Chemistry	16.36	16.36	15.46	16.14
Clinical Medicine	8.68	9.04	12.08	11.91
Communication & Textual Studies	0	0	no co-pubs	no co-pubs
Earth & Environmental Sciences	8.69	9.22	3.69	12.98
Economics & Business	3.37	5.04	1.5	5.77
Enabling & Strategic Technologies	2.33	2.87	4.01	7.29
Engineering	2.11	2.58	1.58	4.9
General Arts, Humanities & Social Sciences	0	0	no co-pubs	0
General Science & Technology	7.38	7.85	10.18	7.94
Historical Studies	3.91	4.3	6.33	4.88
Information & Communication Technologies	1.1	1.15	1.2	2.45
Mathematics & Statistics	2	2	0.67	2
Philosophy & Theology	no pubs	no co-pubs	no co-pubs	no co-pubs
Physics & Astronomy	5.67	5.67	94	11.33
Psychology & Cognitive Sciences	2.51	2.51	2.87	4
Public Health & Health Services	4.67	4.64	7.14	5.74
Social Sciences	5.95	6.23	2.59	11.04

<b>Visual &amp; Performing Arts</b>	0	0	no co-pubs	no co-pubs
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**Table 32: Overview of average citations of different SM research fields: Lao PDR’s publications, co-publications, ASEAN co-publications and EU28/AC co-publications publications (all SM fields are included, irrespective of the number of publications or co-publications published in the respective field – “no co-publications” means no co-publications are indexed, “0” means no citations to indexed co-publications were made)**

**Myanmar’s co-publications with EU28/AC are in general performing best (Table 33).** Most of the highest citation counts in the respective research fields can be found in this collaboration. In some research fields like Biomedical Research, Enabling & Strategic Technologies, ICT etc; Myanmar’s co-publications with the ASEAN countries show the highest impact. And again in some other fields like Engineering, General Science & Technology or Social Sciences Myanmar’s international co-publications induced the highest citation counts.

At the other end, there are some research fields with no co-publications or, if any, with no citations. This is the case for fields such as General Arts, Humanities & Social Sciences or Visual & Performing Arts. Compared to the other countries, this is no surprising pattern, as these fields were weak also in the other collaborations.

Especially interesting is **Clinical Medicine in Myanmar’s collaboration with EU28/AC** – it shows by far the highest citation count (36.24 citations/co-pub). The same is true for **Earth & Environmental Sciences (12.73)** and **Economics & Business (25)**. Distinctively strong is also Myanmar’s partnership with ASEAN in **Physics & Astronomy (9.58)**.

	MM publications	MM co-publications	MM-ASEAN co-pubs	MM-EU28/AC co-pubs
<b>Agriculture, Fisheries &amp; Forestry</b>	2.97	3.16	3.18	3.31
<b>Biology</b>	4.88	5.14	4.32	7.55
<b>Biomedical Research</b>	14.01	15.48	21.51	21.17
<b>Built Environment &amp; Design</b>	0	0	no co-pubs	0
<b>Chemistry</b>	6.44	6.44	no co-pubs	8.06
<b>Clinical Medicine</b>	12.33	15.87	24.77	36.24
<b>Communication &amp; Textual Studies</b>	0.14	1	no co-pubs	1
<b>Earth &amp; Environmental Sciences</b>	7.72	7.8	5.51	12.73
<b>Economics &amp; Business</b>	5.36	8.14	12.5	25
<b>Enabling &amp; Strategic Technologies</b>	1.71	2.41	4.35	0.37
<b>Engineering</b>	0.91	2.69	0.29	1.6
<b>General Arts, Humanities &amp; Social Sciences</b>	0	0	0	0
<b>General Science &amp; Technology</b>	10.67	12.61	8.08	9.33
<b>Historical Studies</b>	4.48	4.77	7.67	5.2
<b>Information &amp; Communication Technologies</b>	0.87	0.88	7	0
<b>Mathematics &amp; Statistics</b>	0.67	0.75	no co-pubs	1
<b>Philosophy &amp; Theology</b>	0.2	0.5	no co-pubs	no co-pubs
<b>Physics &amp; Astronomy</b>	2.92	5.08	9.58	6.28

<b>Psychology &amp; Cognitive Sciences</b>	4.14	4.14	5	5
<b>Public Health &amp; Health Services</b>	2.38	2.51	0.93	4.32
<b>Social Sciences</b>	1.05	1.41	0.4	2
<b>Visual &amp; Performing Arts</b>	0	0	no co-pubs	no co-pubs

Table 33: Overview of average citations of different SM research fields: Myanmar’s publications, co-publications, ASEAN co-publications and EU28/AC co-publications publications (all SM fields are included, irrespective of the number of publications)

*Impact of SM research fields of Cambodia’s, Lao PDR’s and Myanmar’s co-publications with ASEAN countries*

Table 34 shows the average number of citations each Cambodian co-publication involving at least one author from at least one ASEAN country in the different Science-Metrix research fields. Values marked with red are below 50% (slightly higher and lower numbers incorporated) of the average citation the overall Cambodian co-publications received in the same research field and time frame; values marked in green are more than 50% higher than the average value of citations of the Cambodian co-publications.

The overall picture is quite heterogeneous. Cambodia has nearly with all of the ASEAN partner countries at least one research field, which is performing far better than the average Cambodian international co-publication. Only with Brunei Cambodia has no co-publication at all. And Cambodia’s co-publications with Indonesia are in none of the joint research fields explicitly better performing than Cambodia’s co-publications with the other ASEAN partners (no impact value marked in green).

	CM co-publications	CM-ID co-pubs	CM-SG co-pubs	CM-PH co-pubs	CM-TH co-pubs	CM-VN co-pubs	CM-BR co-pubs	CM-MY co-pubs	CM-MM co-pubs	CM-LA co-pubs
Agriculture, Fisheries & Forestry	5,87	--	--	--	--	--	--	--	--	--
Biology	6,26	--	--	--	10.49	10.66	--	--	--	--
Biomedical Research	13,74	11	34.55	17.86	17.23	18.49	--	16.12	--	--
Built Environment & Design	4,04	--	--	--	--	--	--	--	--	--
Chemistry	5,88	--	--	--	--	--	--	--	--	--
Clinical Medicine	16,96	24.02	--	24.29	33.61	36.86	--	14.09	--	16.81
Communication & Textual Studies	0,86	--	--	--	--	--	--	--	--	--
Earth & Environmental Sciences	17,77	--	--	--	--	--	--	--	--	--
Economics & Business	2,64	--	--	--	--	--	--	--	--	--
Enabling & Strategic Technologies	4,61	--	--	--	--	--	--	--	--	--
Engineering	3,17	--	--	--	--	--	--	--	--	--
General Arts, Humanities & Social Sciences	0	--	--	--	--	--	--	--	--	--
General Science & Technology	14,56	--	--	--	21.59	--	--	--	--	--
Historical Studies	5,78	--	--	--	--	--	--	--	--	--
Information & Communication Technologies	4,1	--	--	--	--	--	--	--	--	--
Mathematics & Statistics	1	--	--	--	--	--	--	--	--	--
Philosophy & Theology	1,2	--	--	--	--	--	--	--	--	--
Physics & Astronomy	4	--	--	--	--	--	--	--	--	--
Psychology & Cognitive Sciences	6,5	--	--	--	--	--	--	--	--	--
Public Health & Health Services	7,18	--	--	--	5.23	--	--	--	--	--
Social Sciences	1,96	--	--	--	--	--	--	--	--	--
Visual & Performing Arts	0	--	--	--	--	--	--	--	--	--

Table 34: Impact of Cambodia's co-publications per SM research field with Indonesia, Singapore, the Philippines, Thailand, Vietnam, Brunei, Malaysia, Myanmar and Lao PDR (threshold: only SM fields with over 20 co-publications in the time frame 2004-2014. Green table cells indicate the impact is 50 % or higher than the impact of the CA co-publications, red cells indicate the impact is at least 50 % below.

Table 35 shows the average number of citations each Laotian co-publication involving at least one author from at least one ASEAN country in the different Science-Metrix research fields. Again, also in this overview the threshold of at least 20 co-publications per research field is kept. This automatically

produces a table with little numbers like the one below. This is not surprising, since the countries within this overview chapter, namely Cambodia, Lao PDR and Myanmar, are among the weakest in the ASEAN region concerning the co-publication output.

The things worthwhile mentioning from the table below: Agriculture, Biology, Biomedical Research, Clinical Medicine and General Science & Technology are the only fields with enough “activity” (at least or more than 20 co-publications) to start assessing the impact. At least for Biology, Biomedical Research and Clinical Medicine this confirms the fact about their overall strong performance (both in numbers of jointly produced co-publications in these fields and in their citation impact) among all of the analysed countries within this chapter.

	LA co-publications	LA-ID co-pubs	LA-SG co-pubs	LA-PH co-pubs	LA-TH co-pubs	LA-VN co-pubs	LA-BR co-pubs	LA-MY co-pubs	LA-MM co-pubs	LA-CM co-pubs
Agriculture, Fisheries & Forestry	6,6	-	-	-	6,93	6,14	-	-	-	-
Biology	6,03	-	-	-	6,84	7,03	-	-	-	-
Biomedical Research	13,38	-	-	-	15,86	-	-	-	-	-
Built Environment & Design	6,83	-	-	-	-	-	-	-	-	-
Chemistry	16,36	-	-	-	-	-	-	-	-	-
Clinical Medicine	9,04	-	-	-	11,16	18,33	-	-	-	16,81
Communication & Textual Studies	0	-	-	-	-	-	-	-	-	-
Earth & Environmental Sciences	9,22	-	-	-	-	-	-	-	-	-
Economics & Business	5,04	-	-	-	-	-	-	-	-	-
Enabling & Strategic Technologies	2,87	-	-	-	-	-	-	-	-	-
Engineering	2,58	-	-	-	-	-	-	-	-	-
General Arts, Humanities & Social Sciences	0	-	-	-	-	-	-	-	-	-
General Science & Technology	7,85	-	-	-	11,81	-	-	-	-	-
Historical Studies	4,3	-	-	-	-	-	-	-	-	-
Information & Communication Technologies	1,15	-	-	-	-	-	-	-	-	-
Mathematics & Statistics	2	-	-	-	-	-	-	-	-	-
Philosophy & Theology	no co-pubs	-	-	-	-	-	-	-	-	-
Physics & Astronomy	5,67	-	-	-	-	-	-	-	-	-
Psychology & Cognitive Sciences	2,51	-	-	-	-	-	-	-	-	-
Public Health & Health Services	4,64	-	-	-	-	-	-	-	-	-
Social Sciences	6,23	-	-	-	-	-	-	-	-	-
Visual & Performing Arts	0	-	-	-	-	-	-	-	-	-

Table 35: Impact of Lao PDR's co-publications per SM research field with ASEAN countries (Indonesia, Singapore, the Philippines, Thailand, Vietnam, Brunei, Malaysia, Myanmar and Cambodia (threshold: only SM fields with over 20 co-publications in the time frame are considered) in the time frame 2004-2014. Green table cells indicate the impact is 50 % or higher than the impact of the LA co-publications, red cells indicate the impact is at least 50 % below.

Table 36 shows the average number of citations each Myanmar co-publication involving at least one author from at least one ASEAN country in the different Science-Metrix research fields. **Values marked in green are more than around 50% higher than the average value of citations of the overall Myanmar co-publications in the respective field.**

To start off, one fact is obvious first and foremost: **Most of Myanmar’s collaborations with ASEAN partners do not exceed the threshold of 20 co-publications.** This is why most of the categories listed in the table below don’t show any numbers. The rationale behind this is simple: Each research field needs a certain amount of co-publications, in order to allow an objective assessment of the impact of its co-publications. The introduced threshold of 20 co-publications is the minimum number for starting the comparative work in citations. If a research field contains fewer co-publications, any citation could easily distract the overall picture by raising the impact disproportionately. Just in some

cases the number of co-publications is high enough – Myanmar’s co-publications with Thailand in Biology, Biomedical Research and Clinical Medicine (the latter two actually also perform best compared to Myanmar international co-publications and Myanmar co-publications with Malaysia), Myanmar’s co-publications with Vietnam in Biology and Myanmar’s co-publications with Malaysia in Clinical Medicine are examples for this.

	MM co-publications	MM-ID co-pubs	MM-SG co-pubs	MM-PH co-pubs	MM-TH co-pubs	MM-VN co-pubs	MM-BR co-pubs	MM-MYS co-pubs	MM-LA co-pubs	MM-KH co-pubs
Agriculture, Fisheries & Forestry	3,16	-	-	-	-	-	-	-	-	-
Biology	5,14	-	-	-	3,72	6,19	-	-	-	-
Biomedical Research	15,48	-	-	-	29,33	-	-	-	-	-
Built Environment & Design	0	-	-	-	-	-	-	-	-	-
Chemistry	6,44	-	-	-	-	-	-	-	-	-
Clinical Medicine	15,87	-	-	-	31,22	-	-	8,31	-	-
Communication & Textual Studies	1	-	-	-	-	-	-	-	-	-
Earth & Environmental Sciences	7,8	-	-	-	-	-	-	-	-	-
Economics & Business	8,14	-	-	-	-	-	-	-	-	-
Enabling & Strategic Technologies	2,41	-	-	-	-	-	-	-	-	-
Engineering	2,69	-	-	-	-	-	-	-	-	-
General Arts, Humanities & Social Sciences	0	-	-	-	-	-	-	-	-	-
General Science & Technology	12,61	-	-	-	-	-	-	-	-	-
Historical Studies	4,77	-	-	-	-	-	-	-	-	-
Information & Communication Technologies	0,88	-	-	-	-	-	-	-	-	-
Mathematics & Statistics	0,75	-	-	-	-	-	-	-	-	-
Philosophy & Theology	0,5	-	-	-	-	-	-	-	-	-
Physics & Astronomy	5,08	-	-	-	-	-	-	-	-	-
Psychology & Cognitive Sciences	4,14	-	-	-	-	-	-	-	-	-
Public Health & Health Services	2,51	-	-	-	-	-	-	-	-	-
Social Sciences	1,41	-	-	-	-	-	-	-	-	-
Visual & Performing Arts	0	-	-	-	-	-	-	-	-	-

**Table 36: Impact of Myanmar's co-publications per SM research field with ASEAN countries (Indonesia, Singapore, the Philippines, Thailand, Vietnam, Brunei, Malaysia, Lao PDR and Cambodia (threshold: only SM fields with over > 20 co-publications in the time frame are considered). Green table cells indicate the impact is 50 % or higher than the impact of the MM co-publications, red cells indicate the impact is at least 50 % below.**

***Impact of SM research fields of Cambodia’s, Lao PDR’s and Myanmar’s co-publications with top 5 partner countries from EU28/AC countries***

Table 37 shows the average number of citations each Cambodian co-publication involving at least one author from the five strongest partner countries in EU28/AC (France, Great Britain, Switzerland, Belgium and Germany). No values are marked in green since none of the country collaborations shows a 50% or higher citation count than the overall Cambodian co-publications. The Cambodian co-publications with Great Britain (27.66) and with Switzerland (30.14) in Clinical Medicine are close to it though.

We can conclude that Cambodia’s partnership with Great Britain is relatively strong. The highest citation counts for Cambodia-Great Britain co-publications in Agriculture, Chemistry or Enabling & Strategic Technologies prove that fact. Extraordinary strong are the fields Earth & Environmental Sciences (overall citation count of 103.33) and Psychology & Cognitive Sciences (70.4) in Cambodia’s co-publications with Switzerland.

	CM co-publications	CM-FR co-pubs	CM-GB co-pubs	CM-CH co-pubs	CM-BE co-pubs	CM-DE co-pubs
Agriculture, Fisheries & Forestry	5.87	–	–	–	–	–
Biology	6.26	–	8.54	–	–	–
Biomedical Research	13.74	15.92	19.05	18.6	7.05	–
Built Environment & Design	4.04	–	–	–	–	–
Chemistry	5.88	–	–	–	–	–
Clinical Medicine	16.96	15.39	27.66	30.14	13.71	6.67
Communication & Textual Studies	0.86	–	–	–	–	–
Earth & Environmental Sciences	17.77	–	–	–	–	–
Economics & Business	2.64	–	–	–	–	–
Enabling & Strategic Technologies	4.61	–	–	–	–	–
Engineering	3.17	–	–	–	–	–
General Arts, Humanities & Social Sciences	0	–	–	–	–	–
General Science & Technology	14.56	13.45	23.26	–	–	–
Historical Studies	5.78	–	–	–	–	–
Information & Communication Technologies	4.1	–	–	–	–	–
Mathematics & Statistics	1	–	–	–	–	–
Philosophy & Theology	1.2	–	–	–	–	–
Physics & Astronomy	4	–	–	–	–	–
Psychology & Cognitive Sciences	6.5	–	–	–	–	–
Public Health & Health Services	7.18	–	–	–	–	–
Social Sciences	1.96	–	–	–	–	–
Visual & Performing Arts	0	–	–	–	–	–

Table 37: Impact of Cambodia’s co-publications per SM research field with top 5 partner countries from EU28/AC (France, Great Britain, Switzerland, Belgium and Germany) (threshold: only SM fields with over 20 co-publications in the time frame 2004-2014 are considered).

Table 38 shows the average number of citations Lao PDR’s co-publications with the top 5 partner countries (according to their jointly produced co-publications) Great Britain, France, Switzerland, Germany and Sweden. As most of the collaborations in the respective fields don’t exceed the threshold of 20 co-publications, not so many citation counts are to be found in the table.

Lao PDR’s co-publications with France in the field of Agriculture are the only ones highlighted in green – they are more than 50% above the average citation count of Lao PDR’s international co-publications in the same field. Clinical Medicine is the only field in which Lao PDR’s collaboration with all of the five partner countries exceeds the threshold. The usual strong research fields, as assessed also in the other country’s collaborations, are again confirmed here: Biology, Biomedical Research and Clinical Medicine in most cases exceed 20 co-publications and show high citation counts.

	LA co-pubs	LA-GB co-pubs	LA-FR co-pubs	LA-CHE co-pubs	LA-DE co-pubs	LA-SW co-pubs
Agriculture, Fisheries & Forestry	6.6	-	12.22	-	-	4.25
Biology	6.03	10.2	4.71	-	7.19	-
Biomedical Research	13.38	18.5	18.57	12.03	-	-
Built Environment & Design	6.83	-	-	-	-	-
Chemistry	16.36	-	-	-	-	-
Clinical Medicine	9.04	13.3	11.71	13.22	10.52	6.69
Communication & Textual Studies	0	-	-	-	-	-
Earth & Environmental Sciences	9.22	-	8.48	-	-	-
Economics & Business	5.04	-	-	-	-	-
Enabling & Strategic Technologies	2.87	-	-	-	-	-
Engineering	2.58	-	-	-	-	-
General Arts, Humanities & Social Sciences	0	-	-	-	-	-
General Science & Technology	7.85	12.06	6.25	-	-	-
Historical Studies	4.3	-	-	-	-	-
Information & Communication Technologies	1.15	-	-	-	-	-
Mathematics & Statistics	2	-	-	-	-	-
Philosophy & Theology	no co-pubs	-	-	-	-	-
Physics & Astronomy	5.67	-	-	-	-	-
Psychology & Cognitive Sciences	2.51	-	-	-	-	-
Public Health & Health Services	4.64	-	-	-	-	4.26
Social Sciences	6.23	-	-	-	-	-
Visual & Performing Arts	0	-	-	-	-	-

Table 38: Impact of Lao PDR’s co-publications per SM research field with top 5 partner countries from EU28/AC (Great Britain, France, Switzerland, Germany and Sweden) (threshold: only SM fields with over > 20 co-publications are considered) in the time frame 2004-2014. Green table cells indicate the impact is 50 % or higher than the impact of the LA overall co-publications, red cells indicate the impact is at least 50 % below.

Table 39 shows the average number of citations of Myanmar’s co-publications with the top 5 partner countries from EU28/AC (countries with most jointly produced co-publications). These are Great Britain, Germany, France, Switzerland and Belgium. But also in this overview not much data is listed, as the threshold of 20 co-publications is only exceeded by Myanmar’s co-publications in the field of Biology and Clinical Medicine. At the same time the co-publications with Great Britain in these two fields are cited around (for Biology) and more than (for Clinical Medicine) 50% more often than the same in the same fields of Myanmar’s total international co-publications.

	MM co-publications	MM-GB co-pubs	MM-DE co-pubs	MM-FR co-pubs	MM-CH co-pubs	MM-BE co-pubs
Agriculture, Fisheries & Forestry	3.16	-	-	-	-	-
Biology	5.14	9.06	-	-	-	-
Biomedical Research	15.48	-	-	-	-	-
Built Environment & Design	0	-	-	-	-	-
Chemistry	6.44	-	-	-	-	-
Clinical Medicine	15.87	59.93	-	-	-	-
Communication & Textual Studies	1	-	-	-	-	-
Earth & Environmental Sciences	7.8	-	-	-	-	-
Economics & Business	8.14	-	-	-	-	-
Enabling & Strategic Technologies	2.41	-	-	-	-	-
Engineering	2.69	-	-	-	-	-
General Arts, Humanities & Social Sciences	0	-	-	-	-	-
General Science & Technology	12.61	-	-	-	-	-
Historical Studies	4.77	-	-	-	-	-
Information & Communication Technologies	0.88	-	-	-	-	-
Mathematics & Statistics	0.75	-	-	-	-	-
Philosophy & Theology	0.5	-	-	-	-	-
Physics & Astronomy	5.08	-	-	-	-	-
Psychology & Cognitive Sciences	4.14	-	-	-	-	-
Public Health & Health Services	2.51	-	-	-	-	-
Social Sciences	1.41	-	-	-	-	-
Visual & Performing Arts	0	-	-	-	-	-

Table 39: Impact of Myanmar's co-publications per SM research field with top 5 partner countries from EU28/AC (Great Britain, Germany, France, Switzerland, Belgium) (threshold: only SM fields with over > 20 co-publications in the time frame 2004-2014 are considered). Green table cells indicate the impact is 50 % or higher than the impact of the CA co-publications, red cells indicate the impact is at least 50 % below.

## 7 Concluding considerations

This report provides in-depth view on the results of the analysis of collaborations patterns within ASEAN and of ASEAN with the EU28/AC. Although the key results are presented in the executive summary at the beginning of this document, the individual country chapters above contain many more details that are too numerous to summarise such that all interests are satisfied. Nevertheless, the sections below highlight further results along three dimensions, i.e. in terms of the strongest linkages in the ASEAN region, in terms of the most prominent research fields, and in terms of the most noteworthy insights on impact.

### 7.1 Strongest co-publication linkages in the ASEAN region

In general, those ASEAN countries with the biggest publication output (Singapore, Malaysia, and Thailand) are the strongest partner countries for the respective ASEAN countries. Singapore has the strongest co-publication links with Malaysia and Thailand. The same is true for Indonesia and the Philippines (Singapore as third strongest ASEAN cooperation partner country for both countries). Vietnam has the most ASEAN-co-publications with Thailand and Singapore. Malaysia's strongest ASEAN link is with Indonesia, followed by Singapore and Thailand. For Thailand, Malaysia is the ASEAN partner country with the most joint publications, followed by Singapore and Vietnam. Also for the Philippines, Malaysia is the most important ASEAN cooperation partner country, followed by Thailand and Singapore. For the three smaller countries, Malaysia is not the most important partner ASEAN country: for Lao PDR and Myanmar Thailand, Vietnam and Cambodia are the three most important ASEAN partner countries, for Cambodia its Thailand, Vietnam and Indonesia.

It is worth noting that Singapore, even though it is the ASEAN country with the highest publication output, is not the most visible co-publication partner for any of the other ASEAN country (second for Malaysia, Thailand, and Vietnam; third for Indonesia and the Philippines; for the smaller countries Cambodia, Lao PDR, and Myanmar, Singapore is even less visible). Malaysia has a comparatively strong link to Indonesia, which is a rather recent development as their common annual publications are boosting since 2008 and were rather stagnant in the years before. For Thailand, Malaysia is by far the most important co-publication partner from an ASEAN country.

### 7.2 Scientific research fields

The most important scientific research field for the ASEAN publications is Clinical Medicine – 15% of all ASEAN publications are dealing with topics of this research field. Clinical Medicine is followed by ICT, Engineering – with 13% of all ASEAN publications each – and Enabling and Strategic Technologies with 12%. Enabling and Strategic Technologies is growing stronger than the other three fields from 2009 onwards.

These four research fields are – in sometimes quite different formation – consequently the most important research fields for most of the ASEAN countries:

For Singapore, Information & Communication Technologies (18% of all Singaporean publications) is the research field with the most publications, closely followed by Clinical Medicine (17%). Clinical

Medicine is the field with the most Singaporean co-publications, especially co-publications with other ASEAN countries (33% of all Singapore-ASEAN co-publications deal with the research field Clinical Medicine), for which Information & Communication Technologies is by far not as important as for the Singapore overall publications. For co-publications with the EU28/AC Clinical Medicine is slightly less important (22% of all Singapore-EU28/AC co-publications and still the field with the most publications), but still has a higher share than the overall Clinical Medicine Singapore publications. Information & Communication Technologies is the research field with the second most co-publications, thus is more relevant for Singapore-EU28/AC than for Singapore-ASEAN co-publications. Whereas Physics & Astronomy has not a big role for Singapore-ASEAN co-publications, it is important for co-publications with the EU28/AC.

This situation is similar to Indonesia – Clinical Medicine is most prominent in co-publication with other ASEAN countries (20% of all Indonesia-ASEAN co-publications are published in this field), and 16% of all Indonesia-EU28/AC co-publications are dealing with this research field. Engineering, Enabling and Strategic Technology, Biomedical Research and Biology are research fields with importance for Indonesia-ASEAN as well as for Indonesia-EU28/AC co-publications.

Vietnamese co-publications with other ASEAN countries are published the most in Clinical Medicine as well (23% of all Vietnam-ASEAN co-publications are published in this field), followed by the research fields Biomedical Research and Biology. Physics & Astronomy is not a big thematic field for Vietnam-ASEAN co-publications.

For Malaysia, Clinical Medicine is rather prominent for ASEAN- and EU-co-publications as well (20% of all Malaysia-ASEAN co-publications and 15% of all Malaysia-EU28/AC co-publications are dealing with this research field), at least compared to the Malaysia overall publications (11% of all Malaysian publications deal with Clinical Medicine). Regarding the overall Malaysian publications, Engineering, Enabling & Strategic Technologies and ICT are the three research fields with the most publications in the time frame 2004 to 2014, followed by Clinical Medicine.

For Thailand, Clinical Medicine is the most important research field not only for the co-publication output but for the overall publications as well – 23% of all Thai publications are dealing with topics related to Clinical Medicine. Engineering and Enabling & Strategic Technologies are the second and third most important research field for Thai publications with 11% and 10% of all Thai publications. Biomedical Research is more important for Thai co-publications (15% of all Thai co-publications), especially for co-publications with EU28/AC, than for the overall Thai publications (9%).

For the Philippines, Clinical Medicine is the most important research field, followed by Biology and Agriculture, Fisheries and Forestry. Engineering, ICT and Enabling & Strategic Technologies have by far less publications (4 to 5% of all Philippine publications each). This is quite the same situation for the overall Philippine co-publications, the ASEAN co-publications and the EU28/AC co-publications, but especially for the latter two groups, Engineering is slightly more important.

In general, Physics & Astronomy is not a very prominent research field for the ASEAN countries, but plays a somewhat bigger role for co-publications with the EU28/AC (especially for co-publications with Germany and France – e.g. most important research field for co-publications between Vietnam-Germany, Vietnam-France, second most important research field for co-publications between

Singapore-Germany, Malaysia-Germany or Thailand-Germany, third most important research field for co-publications between Thailand-Great Britain, Thailand-France or Malaysia-France).

Chemistry is a research field, which features strongly in the co-publications of a number of ASEAN countries. For Malaysia and Thailand, it is a field that is particularly visible in both overall co-publications and inner-ASEAN co-publications. In Malaysia's co-publications, Chemistry is the most important field (13% of all co-publications). In Malaysia's inner-ASEAN co-publications, it is the second most important field (11.3% of all Malaysia-ASEAN co-publications). In the case of Thailand, Chemistry is the fourth most important field when it comes to co-publications in general and the second most important field in inner-ASEAN co-publications (10% of Thailand-ASEAN co-publications).

### 7.3 Impact highlights

In general, co-publications tend to have more citations than purely "national" publications which typically involve few authors from only one country. This is true for the ASEAN countries as well – here, the co-publications with EU28/AC or other ASEAN countries are, overall, cited even more frequently than the *international* co-publications (worldwide). Malaysian co-publications, for example, are cited 4.63 times on average, whereas Malaysian-EU28/AC co-publications are cited 6.81 and Malaysian-ASEAN co-publications are cited 6.75 times, on average.

In the following paragraphs, some impact highlights are presented for intra-ASEAN and ASEAN-EU28/AC co-publications, in general and also for some interesting country pairings<sup>16</sup>:

Singapore's ASEAN co-publications have comparatively many citations on average in *Built Environment & Design*, *Historical Studies* (both fields with generally rather few publications, which means they may be prone to fluctuation) and *Mathematics & Statistics*, the co-publications with EU28/AC are cited comparatively frequently in *Biomedical Research* and *Clinical Medicine*. Co-publications between Singapore and Malaysia as well as Singapore and Great Britain have a high number of citations in *Historical Studies*; Singaporean-Philippine and Singaporean-French co-publications in *Clinical Medicine*; Singaporean-Dutch co-publications in *Biology*; and Singaporean-German co-publications in *General Science & Technology*.

Malaysia's ASEAN co-publications have, similar to Singapore, received many citations in *Built Environment & Design*, but also in Communication & Textual Studies, Philosophy & Theology and Psychology & Cognitive Sciences. Co-publications between Malaysia and the EU28/AC have a rather high impact in the research fields Chemistry, Earth & Environmental Sciences, General Arts and Humanities and Mathematics & Statistics. Co-publications between Malaysia and Singapore are cited comparatively frequent in Biology and Agriculture, Fisheries & Forestry, Malayan-Philippine co-publications in Clinical Medicine, Chemistry and Engineering. Malayan-German co-publications have high citation counts in the fields Chemistry and Psychology & Cognitive Sciences, Malayan-Italian co-publications in Agriculture, Fisheries & Forestry and General Science & Technology.

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<sup>16</sup> Results should be interpreted with the overall quantitative relevance of the fields in mind (see the respective chapters on publication output)

For Thailand's ASEAN co-publications, Clinical Medicine and Earth & Environmental Sciences are the two research fields with comparatively high citation counts. Co-publications with the EU28/AC are highly cited in the fields Chemistry and General Science & Technology. Especially co-publications involving Thai and Swiss authors are highly cited in the field of *Agriculture, Fisheries & Forestry* and *Chemistry*; the same is true for Thai-Singaporean co-publications in *Clinical Medicine* and *Engineering*, for Thai-Dutch co-publications in *Clinical Medicine*, and for Thai-Philippine co-publications in *Biology, Earth & Environmental Sciences*, and *Enabling & Strategic Technologies*.

Indonesia's ASEAN co-publications are highly cited in Built Environment & Design and Psychology & Cognitive Sciences. Indonesia's EU28/AC co-publications are especially highly cited in Clinical Medicine, Engineering and Physics & Astronomy. Indonesian-Thai co-publications have comparatively many citations on average in General Science & Technologies, Indonesian-Vietnamese co-publications in Biomedical Research and Clinical Medicine. Indonesian-British co-publications are comparatively highly cited in Clinical Medicine, co-publications with Germany in Engineering and Psychology & Cognitive Sciences and co-publications with France in Physics & Astronomy.

Vietnam's co-publications involving at least one author from another ASEAN country are comparatively highly cited in Physics & Astronomy, Historical Studies and Enabling & Strategic Technologies, whereas co-publications involving at least one author affiliated in EU28/AC have especially high citation counts on average in General Science & Technology, Biomedical Research, Information & Communication Technologies and Mathematics & Statistics. Vietnamese-Thai co-publication have a rather high average citation count in Clinical Medicine and Engineering, Vietnamese-Singaporean co-publications in Information & Communication Technologies and Mathematics & Statistics and Vietnamese-Malayan co-publications in Biomedical Research. Co-publications with Germany have a high impact in General Science & Technology, and co-publications with Great Britain in Mathematics & Statistics.

Co-publications involving at least one author from the Philippines and one from another ASEAN country have comparatively many citations on average in the research fields Engineering, Historical Sciences and Chemistry, Philippine-EU28/AC co-publications in Clinical Medicine, Earth & Environmental Sciences and Enabling & Strategic Technologies. Philippine-British co-publications have a high average citation count in Historical Studies, Philippine-French in General Science & Technology and Enabling & Strategic Technologies and Philippine-Dutch co-publications in Biomedical Research and Clinical Medicine.

## 8 Discussion and outlook

The goal of the present study has been to shed light on current thematic and regional patterns of the growing Southeast Asian research output. We have been particularly interested in intra-ASEAN collaboration, an issue no prior study has explicitly looked at. We have adopted an inclusive and policy-oriented approach, which is reflected in the report structure featuring country chapters instead of thematic chapters.

The analyses above have the character of a descriptive stocktaking, firstly, of ASEAN publication output and, secondly, intra-ASEAN as well as extra-ASEAN co-publication linkages. A number of more sophisticated statistical analyses beyond the scope of the present study could be envisaged as additional, future steps in the bibliometric analysis of the data (e.g. analyses of open access pervasion, first authored papers<sup>17</sup>, high-impact journals, etc.).

A second but separate part of this SEA-EU-NET project deliverable focuses on patent application output in ASEAN. Our work is one of the first attempts to bring together publication and patent data as a means to understanding the growing and changing knowledge production activity in Southeast Asia. Please refer to our project website <http://www.sea-eu.net/> for that parallel report and a comparative discussion of the findings on publication and patent application data.

We look forward to offering our results in the form of a data compendium to research policy makers in the Southeast Asian region as well as in Europe. The SEA-EU-NET project also has offered and continues to offer opportunities to discuss the data with regional stakeholders, therefore adding to their usefulness and enriching their qualitative interpretation. We wish to end on this point: Context knowledge and qualitative enriching is crucial in order to properly use the data presented in this report

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<sup>17</sup> Such an analysis would have to be highly contextualised, though, as a number of research fields exhibit different publication and citation conventions. Conclusions would be of particular rather than universal validity.

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## 10 Annexes

### Annex I – Key definitions for co-publication analysis

#### **Affiliation**

By affiliation we refer to a unique author-institution combination related to one record. The same author can be affiliated with several institutions within one single record. If this is the case, we consequently count several affiliations. Therefore, publications with one author, but two affiliations, one e.g. in Singapore and one in another country, are included in the analysis and considered a co-publication. The number of affiliations in Singaporean co-publications therefore shall not be confused with the number of authors.

#### **BibTeX**

BibTeX on the one hand is a software package for creating literature references and indices in TeX or LaTeX documents (TeX is a typesetting system with integrated macro language, LaTeX is a variant of TeX). On the other hand we use the term in context of BibTeX exports from our data sources. In this case we refer to the BibTeX format which makes literature database entries available, coded in a particular way. The BibTeX format was the common denominator present to receive data from both different source databases with the same format, though slightly different in detail features.

#### **Categories and main categories**

The two scientific literature databases used in this study assign the recorded books or periodicals to one or more thematic key words based on a classification system. In Elsevier's Scopus we have 334 of these thematic keywords and 53 in the case of Thomson Reuter's Web of Science. Only a small percentage of the scientific works is classified independently of the general classification of the periodical. To remove potential ambiguities, this study has used the Science Metrix Ontology that classifies journals on three levels of granularity: the domain, the field, and the sub-field.

#### **Co-publication**

In the context of this study we refer to international scientific publications, indexed in literature databases, with the participation of at least two institutions/organisations in at least two different countries. For this study the term co-publication therefore is only used for international co-publications, unless explicitly stated otherwise.

#### **EU28/AC**

In this co-publication analysis we included all co-publications with at least one author affiliated with an institution in an ASEAN country and one affiliated with an institution in another ASEAN country or in a EU Member State and/or that country which are/were associated to the EU's Framework Programme 7: Austria, Belgium, Bulgaria, Czech Republic, Cyprus, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Portugal, Poland, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom, Switzerland, Norway, Turkey, Serbia, Croatia, Israel, Iceland, Liechtenstein, Macedonia, Albania, Montenegro, Bosnia, Faroe Islands, Moldova.

#### **Document types**

Each of the data sources used assigns a certain document type to the tracked publications to better describe them. These types reach from articles over abstracts and conference papers to editorials,

errata and even music, movie or software reviews. To have comparable document types available we consolidated the two document type sets of our data sources to the following list: article, conference paper, meeting abstract, review, editorial, letter, other.

### **Impact**

Talking about impact in the framework of this study, we refer to the passive citations per record, i.e., the number of cases in which the respective publication was cited by a different younger publication. The data can only be punctual snapshots. Citation counts for publications from very recent years are to be treated differently from the ones of very old publications and therefore, of course, comparison only makes sense for citation data from 3 or more years in the past. Publications that are tracked in both data sources tend to be assigned with different passive citation counts. Internally, we work with various algorithms to level this bias (e.g. the weight factor for citation counts from Web of Science or the preferential usage of the higher citation count).

### **Record**

With record we refer to an entry in our database containing the meta data of a uniquely identified publication. In case the same publication appears in both data sources (Scopus and Web of Science), it is still dealt with as one record.

### **Science Metrix classification**

Science Metrix, a Canada-based company, developed a multi-lingual three-level journal subject classification system: the Science Metrix Ontology of Science. It builds on comprehensive work on standardisation and classification of journals, partly financed by the European Commission. The main difference between the Science Metrix Ontology and classification systems used by Scopus and Web of Science is the disjunct classification, i.e. each journal is attributed to one (not one or more) subject category.

## Annex II – Data cleaning, consolidation of data sources and thematic areas

The results of the processes of data cleaning and consolidation of data at first are database-specific tables, into which parsed BibTeX data are inserted. The resulting tables contain records and affiliations for Scopus and WoS separately; they are subsequently unified into one record table and an affiliation table.

On the basis of these raw data tables, we created a unified data set using a series of processing steps:

- **Import of raw data:** After importing the data-chunks in our data base, they are imported in a SQL-data base (PostgreSQL) with specifically adjusted Parsers. At first the BibTEX-Data are imported in a raw data table as key-value-pairs, where every record has an Import-ID, a specific Import-Date (which is important e.g. for analysing Impact and citation counts), information of data source (Scopus or WoS), an identifier, the key-value-pairs and a marker, if data is manually corrected or not. Simultaneously the key characteristics (normed fields as DOI, author, title, journal, year, volume, number, pages, document type) are written in a separate table for the search of duplicates.
- **Unification of journal names:** the number and set of journals that are registered by Scopus and Web of Science are different. Many records appear in both databases, but with different spelling, institution or author notation, etc. The first unification step normalises syntax and spelling of journal names detected as identical (e.g. with differing apitalisation). In a next step we use Document Object Identifiers (DOIs) of all records in our database, which are unique (disregarding typing errors in the original databases, whose rate of occurrence lies at roughly 1%) for any registered publication worldwide (but unfortunately often are missing), to identify identical journals (in different notations). If one record is available with the same DOI in both databases, the journals linked to this record must as well be identical. Remaining journal names are examined for their similarity and are suggested as merging candidates, which then are controlled and manually assigned.
- **Removal of duplicates in both record tables:** Of course, publications that are registered in both databases must not appear twice in our unified data set. The identification of records from both sources describing the same publication is led through by searching for conformities in the following variables:
  - DOI
  - title, year, begin page
  - ISBN and begin page
  - journal ID or ISSN and begin page, year and author , title or volume
  - begin page and author-keywords
  - Unification of journal names, second round: the results of the record unification can now be used to run through another round of journal name unification; a procedure to enhance data quality once more.
- **Raw data correction:** After the automatic check of raw data, possible raw data errors have to be corrected manually as well. Fields like year, volume, DOI, ISSN, etc. were corrected entirely and every manual correction was registered in our database.

Based on the previous steps, a unified record-table can be established and filled according to the queries of interest.

After having done this data cleaning process, it can be shown which benefits the consultation of both data sources can offer for the present analysis: of the 556,215 observed ASEAN publications, 446,948 are listed by Scopus and 349,688 are listed by Web of Science.

Each cleaned record not only contains keywords given by the author(s) but has also been assigned with the journal subject categories of the respective source database(s). Unfortunately, the two thematic classification systems of Web of Science and of Scopus not only distinguish themselves in the way of assignment, but also in the set of the used categories. Each database classifies each listed journal with one or more journal subject categories (253 in Web of Science) or with the help of All Science Journal Classification numbers (ASJC; 334 categories in Scopus). A third classification scheme, the Science Metrix Ontology, offers the advantage of a clear attribution of a journal to a single category called sub-field. Sub-fields are aggregated into fields which again are aggregated into domains. The ZSI developed a semi-automatic system to connect the different category systems. Web of Science categories and Scopus ASJC categories are compared and rated for their overlap via the especially designed web-interface.

### Annex III – Country comparison in terms of co-publications

In the table below, all ASEAN countries and their absolute figures in co-publication collaboration activities with the other ASEAN partner countries as well as the 25 most active partner countries outside the ASEAN region of the ASEAN countries over the time period of 2004-2014 are presented. Green fields mark the top three country links with the most co-publications respectively.

n of co-pub	ASEAN	BN	ID	KH	LA	MM	MY	PH	SG	TH	YN
<b>ASEAN</b>		1,922	34,985	2,445	1,704	1,404	173,652	20,343	188,291	118,155	28,210
<b>BN</b>	1,922		18	0	0	2	163	12	100	27	11
<b>ID</b>	34,985	18		132	64	53	2,829	551	699	990	363
<b>KH</b>	2,445	0	132		110	34	124	129	51	411	226
<b>LA</b>	1,704	0	64	110		19	52	59	23	403	153
<b>MM</b>	1,404	2	53	34	19		76	52	38	188	68
<b>MY</b>	173,652	163	2,829	124	52	76		886	2,321	1,914	412
<b>PH</b>	20,343	12	551	129	59	52	886		680	841	379
<b>SG</b>	188,291	100	699	51	23	38	2,321	680		1,259	589
<b>TH</b>	118,155	27	990	411	403	188	1,914	841	1,259		1,003
<b>YN</b>	28,210	11	363	226	153	68	412	379	589	1,003	
<b>EU28+AC</b>	69,851	329	6,048	1,081	801	273	13,345	3,746	24,682	15,092	8,468
<b>US</b>	56,942	144	3,199	607	324	171	6,524	3,610	26,863	15,527	3,098
<b>CN</b>	30,355	61	776	101	77	69	2,916	1,010	22,551	3,413	1,489
<b>JP</b>	26,813	40	4,555	271	232	267	4,735	2,206	4,595	9,100	3,078
<b>GB</b>	25,681	137	1,508	329	317	92	7,220	1,135	9,334	5,779	1,779
<b>AU</b>	24,026	180	2,890	290	215	85	5,548	1,307	9,287	4,504	1,817
<b>DE</b>	12,119	75	1,299	74	92	67	1,569	787	4,585	2,856	1,526
<b>FR</b>	11,382	32	878	418	262	52	1,438	663	3,460	2,875	2,437
<b>KR</b>	8,983	18	918	76	35	52	1,442	797	3,031	1,914	2,368
<b>CA</b>	8,784	32	499	62	40	5	1,569	480	4,143	1,994	518
<b>NL</b>	7,651	33	1,807	56	52	21	1,010	472	2,258	1,479	1,064
<b>HK</b>	5,874	33	235	49	10	10	852	403	4,382	1,003	210
<b>IR</b>	5,447	2	73	5	6	5	4,598	90	421	414	69
<b>TV</b>	5,410	27	522	26	7	13	980	719	2,480	1,497	666
<b>IT</b>	5,100	23	356	34	15	3	935	332	2,014	1,245	644
<b>CH</b>	4,999	12	423	161	101	43	662	416	1,902	1,360	670
<b>SE</b>	3,978	17	247	46	90	6	504	198	1,570	957	679
<b>SA</b>	3,721	24	112	1	10	0	2,767	64	560	430	52
<b>ES</b>	3,651	38	195	13	12	6	756	324	1,426	873	384
<b>NZ</b>	3,551	25	283	31	21	10	968	235	1,435	865	139
<b>BE</b>	3,492	6	233	138	36	21	548	291	858	868	905
<b>BR</b>	2,786	17	246	36	18	7	699	317	703	836	398
<b>PK</b>	2,772	29	149	13	10	9	1,864	149	347	552	99
<b>DK</b>	2,643	6	198	42	22	3	358	185	1,025	649	409
<b>AT</b>	2,423	8	176	19	10	6	400	194	746	918	220
n of co-pub	ASEAN	BN	ID	KH	LA	MM	MY	PH	SG	TH	YN