

SEA-EU-NET 2 has been set up to expand scientific collaboration between Europe and Southeast Asia (SEA) in a more strategic and coherent manner. The four-year long project involves 21 institutions from the two regions and is deepening collaboration by: Intensifying the bi-regional dialogue between EU and SEA S&T policy makers; jointly tackling societal challenges in the fields of health, food security and safety, metrology, and water management; increasing the level of SEA participation in Horizon 2020; analysing in detail the current state of EU-SEA S&T relations; and extending the dialogue on EU-SEA S&T co-operation to include a wide range of stakeholders.



This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 311784

ASEAN OUTPUT

556 215
ASEAN PUBLICATIONS
2004-2014

TOP 5 RESEARCH
FIELDS PER COUNTRY

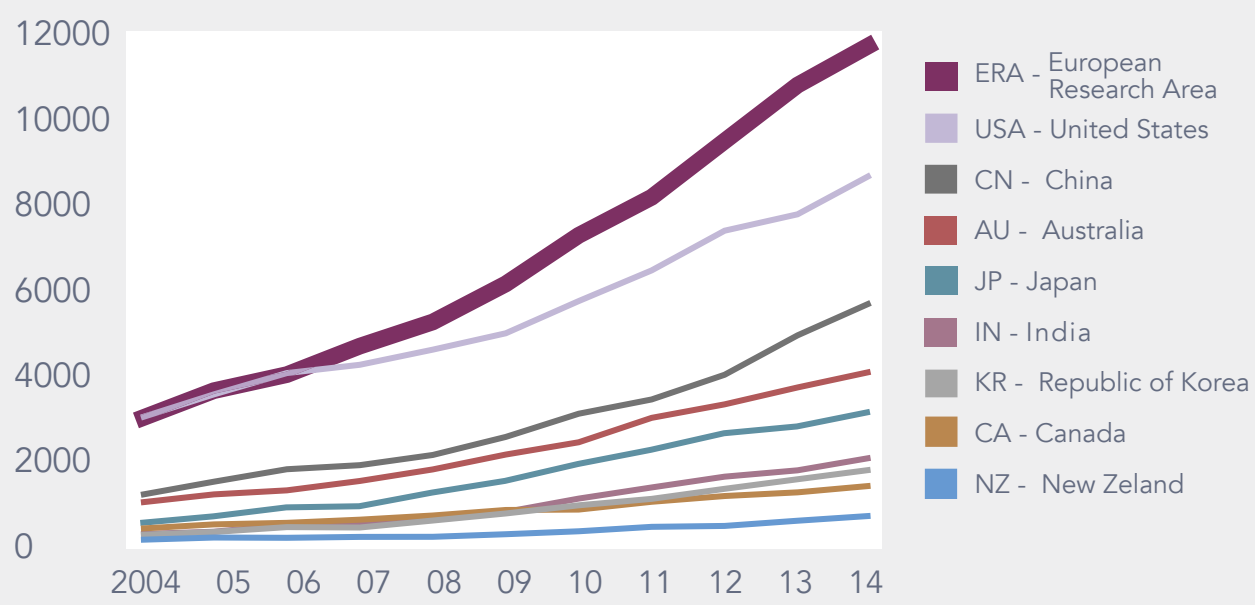
Brunei				
Cambodia				
Indonesia				
Laos				
Malaysia				
Myanmar				
Philippines				
Singapore				
Thailand				
Vietnam				

TOP 5 ASEAN
RESEARCH AREAS

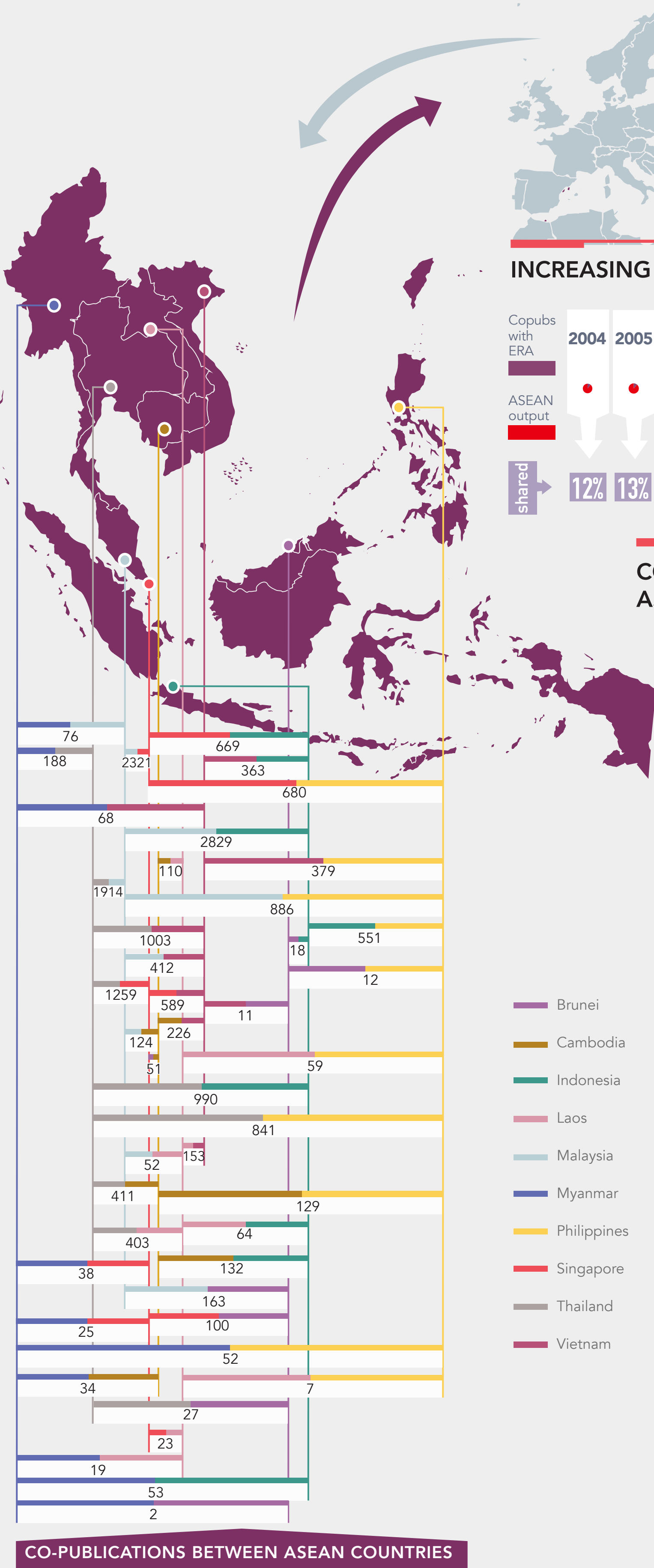
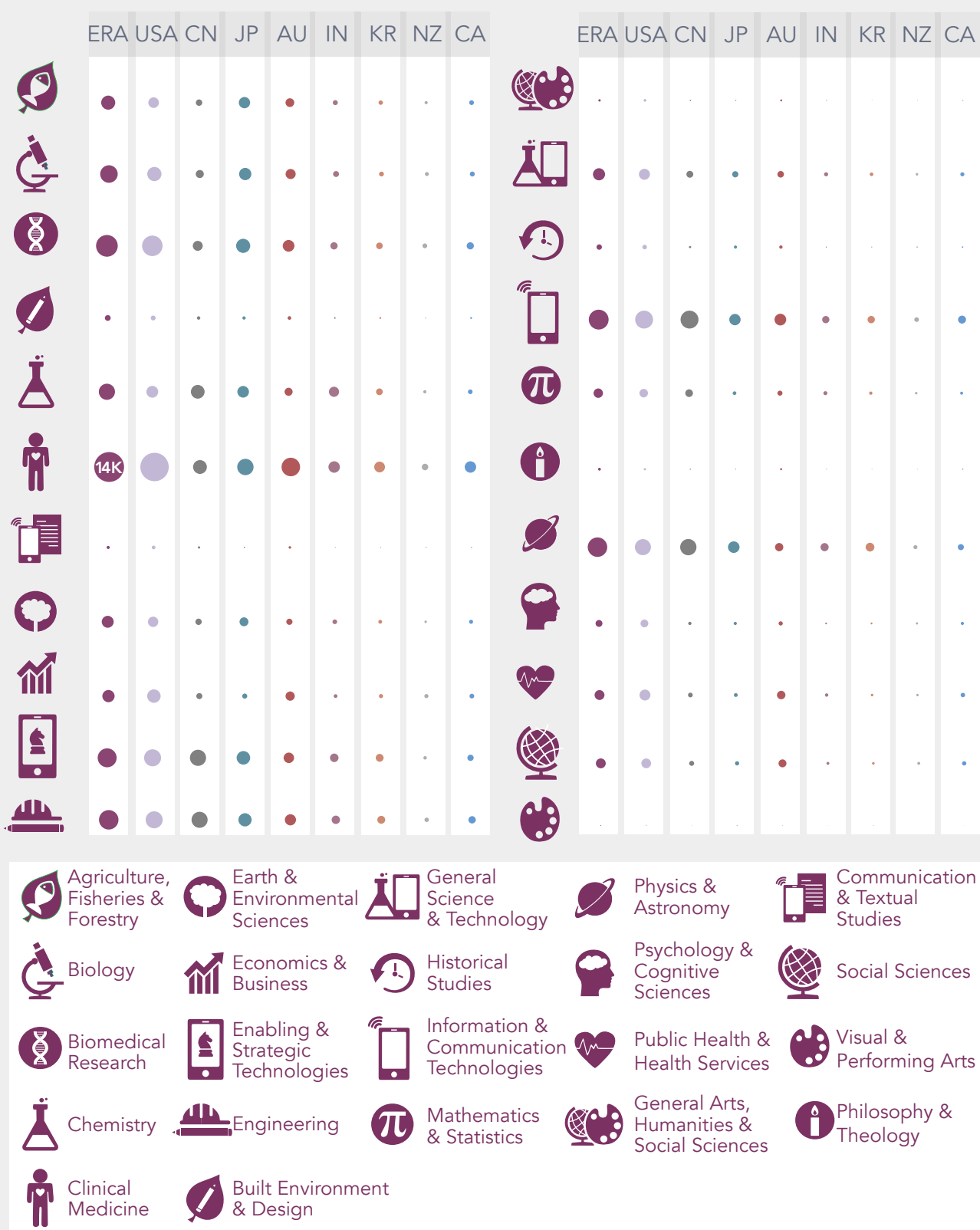
- Clinical Medicine
- Information & Communication Technologies
- Engineering
- Enabling & Strategic Technologies
- Physics & Astronomy

ASEAN COLLABORATION

CO-PUBLICATIONS WITH PARTNERS 2004-2014



CO-PUBLICATIONS BY RESEARCH FIELD



CO-PUBLICATIONS BETWEEN ASEAN COUNTRIES

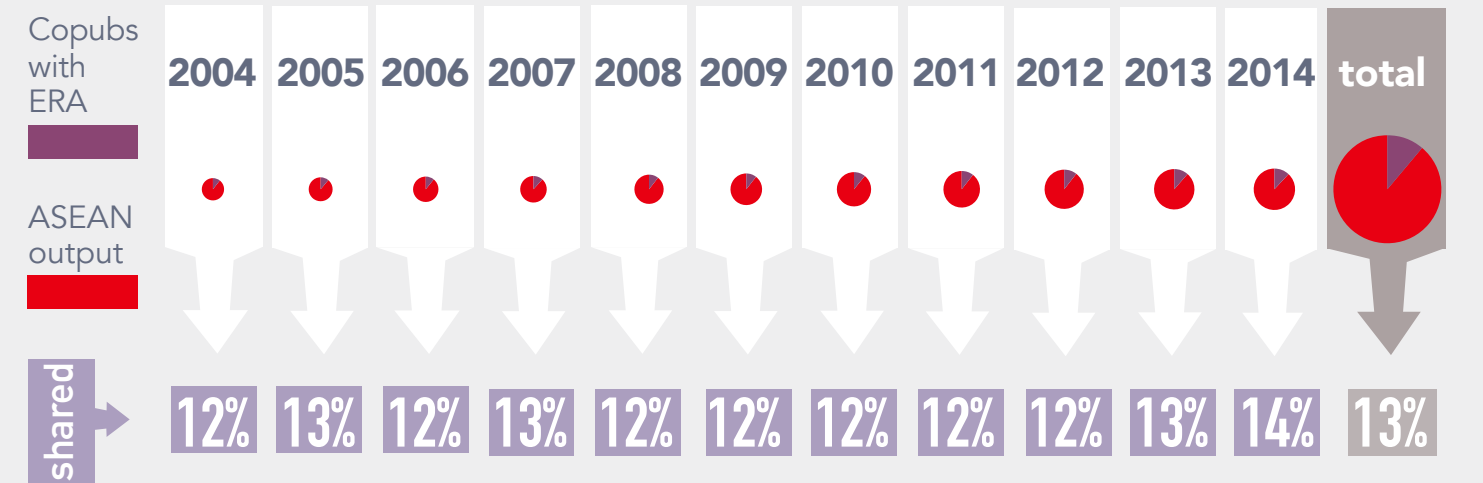
ASEAN-ERA

Key fact: The European Research Area is the most important international collaboration partner region of ASEAN

69 851
ASEAN-ERA CO-PUBLICATIONS

13%
OF ASEAN OVERALL OUTPUT

INCREASING ASEAN-EU RESEARCH COLLABORATION



CO-PUBLICATIONS WITH MAJOR PARTNERS AS A SHARE OF ASEAN OUTPUT

	ASEAN-EU	ASEAN-US	ASEAN-CN
	15%	9%	3%
	19%	13%	4%
	23%	21%	5%
	12%	9%	4%
	12%	6%	9%
	16%	15%	3%
	5%	7%	3%
	18%	14%	5%
	12%	14%	3%
	9%	7%	6%
	8%	6%	5%
	2%	3%	1%
	15%	12%	5%
	23%	16%	4%
	8%	7%	7%
	12%	10%	8%
	9%	6%	1%
	15%	10%	10%
	22%	28%	5%
	17%	21%	4%
	7%	7%	2%
	4%	7%	1%
	4%	7%	1%
ALL	13%	10%	5%

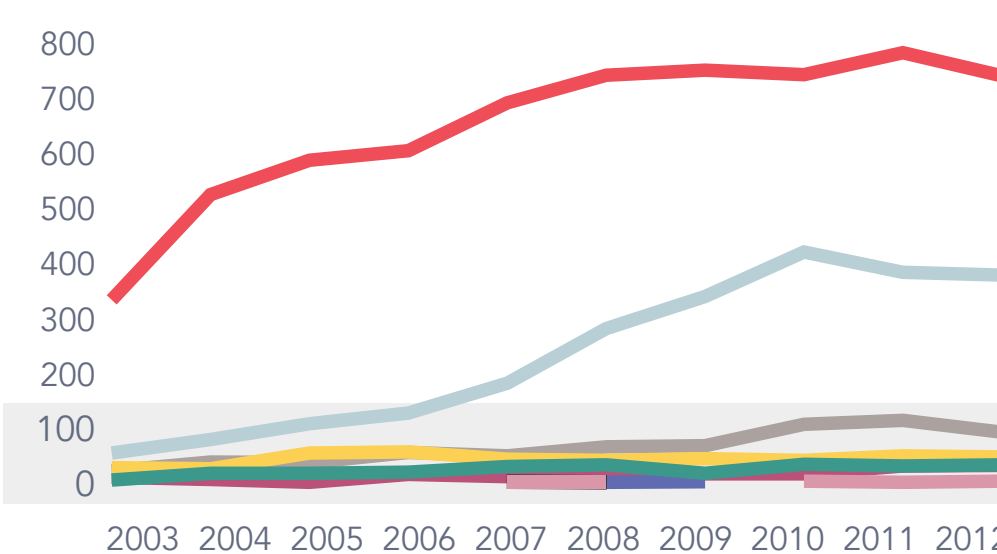
ANALYSIS OF COLLABORATIVE PATENTING - CO-INVENTIONS

PCT APPLICATIONS WITH INVENTORS BASED IN ASEAN, 2003-2013

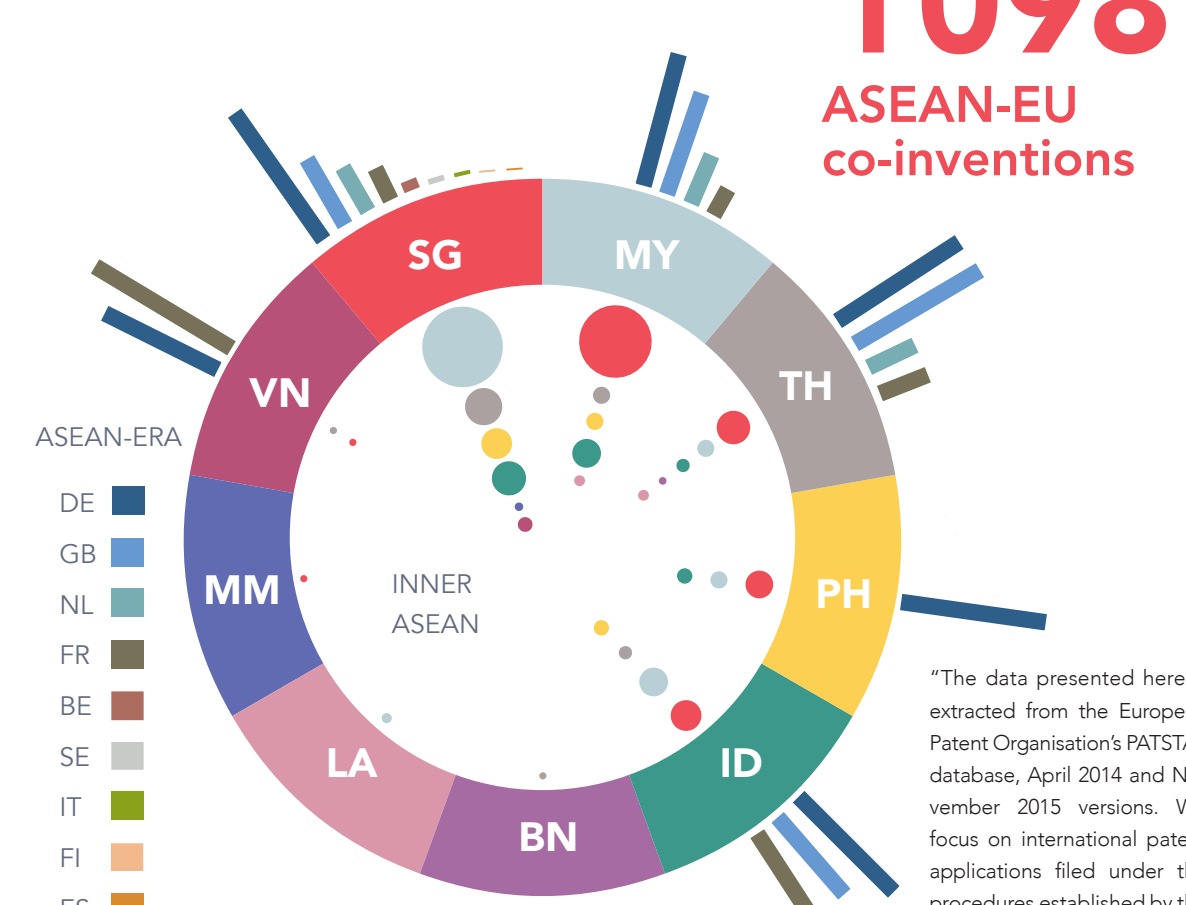


NUMBER OF PCT APPLICATIONS WITH INVENTORS FROM SOUTHEAST-ASIA - PER COUNTRY 2003-2012

12 488
PCT applications with
ASEAN inventors
(2003-2013)

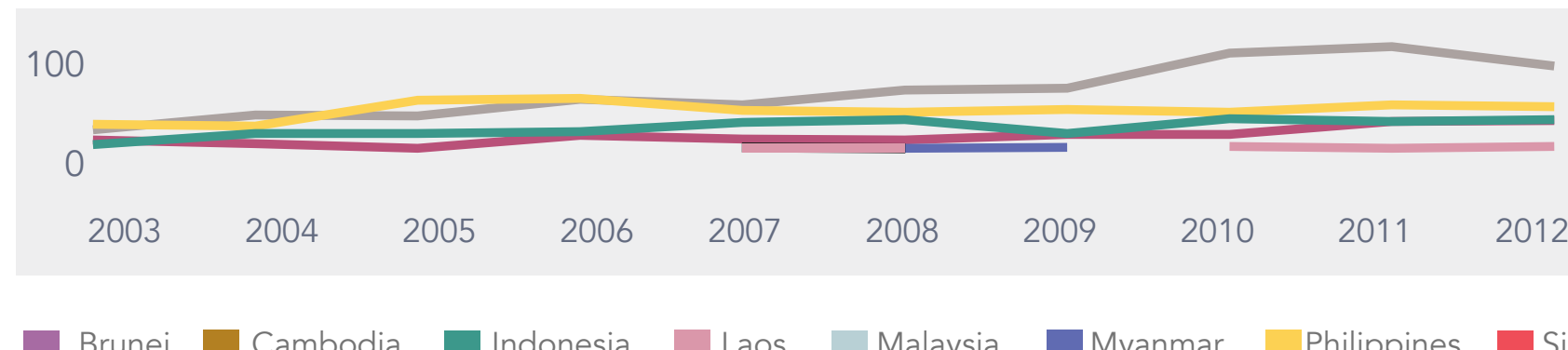
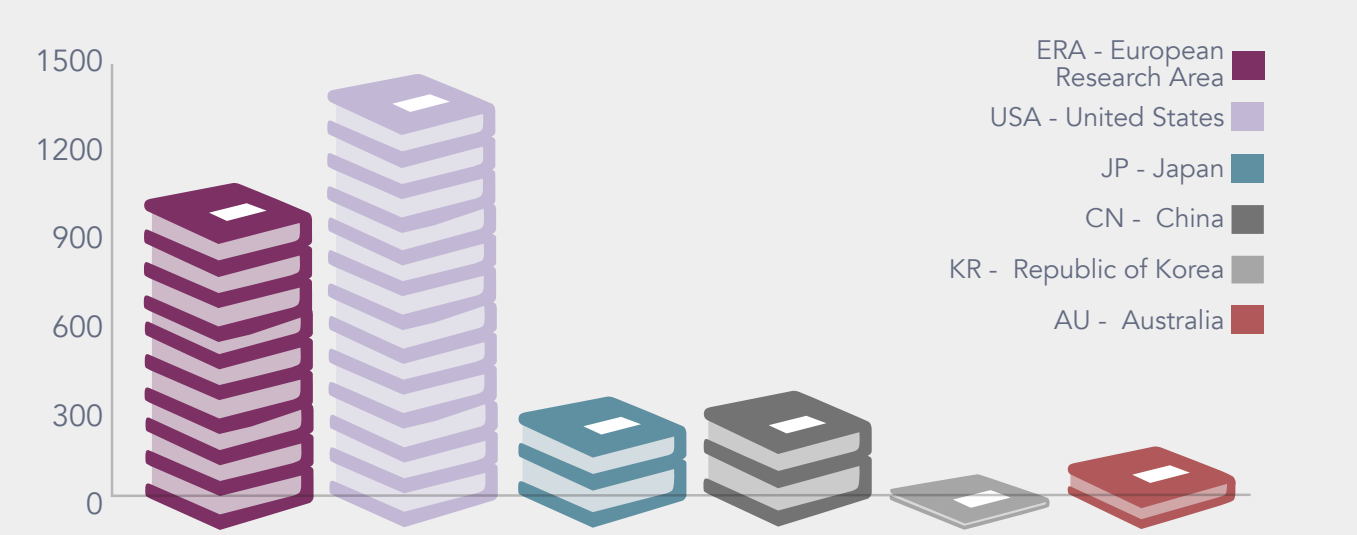


COUNTRY CO-INVENTION LINKS INNER-ASEAN AND ASEAN-EU



1098
ASEAN-EU
co-inventions

PCT CO-INVENTIONS LINKS 2003-2013



"The data presented here is extracted from the European Patent Organisation's PATSTAT database, April 2014 and November 2015 versions. We focus on international patent applications filed under the procedures established by the Patent Cooperation Treaty (PCT). Please refer to the backside for more information on the methodology and additional data".

INTRODUCTION

The SEA-EU-NET team carried out analyses of knowledge co-production in the member states of the Association of Southeast Asian Nations (ASEAN). This infographic poster shows selected results of these analyses, both with regard to publications and to patent applications. Our aim in presenting this material is to give readers an overview of knowledge production dynamics in Southeast Asia. We particularly aim at pointing out patterns of collaboration within and beyond Southeast Asia.

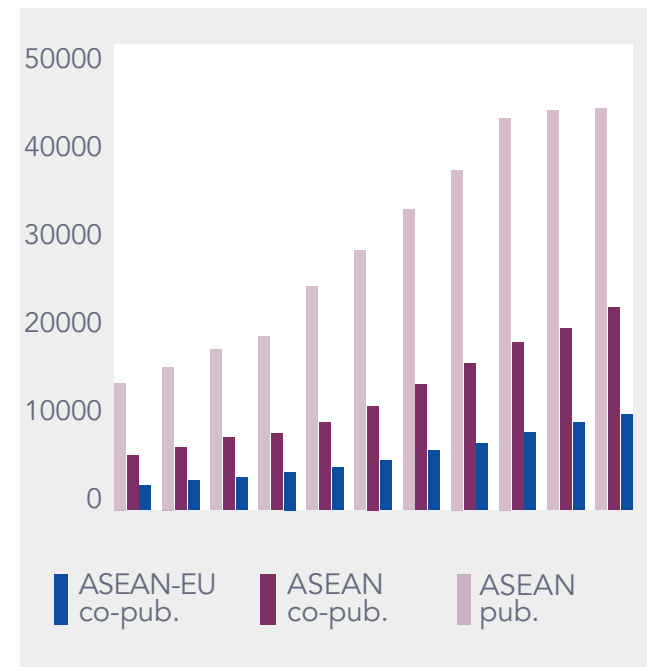
As far as the publication analysis part is concerned, the period covered is 2004 to 2014. Web of Science and Scopus were the databases used for identifying journal publications with Southeast Asia-based authors. World output benchmarks were compiled using Scimago country data. In 2014, the world publication output was about 2.6 million documents. In the examined time span of 2004 to 2014, the overall ASEAN scientific output (in terms of scholarly publications) amounted to about 550,000 documents. The yearly output tripled from about 23,000 in 2004 (or 1.4 % of world output) to more than 80,000 in 2014 (3 % of world output). This growth in output is much stronger than the growth patterns in Europe or other regions where annual output in 2014 was less than double that of 2004.

ASEAN PUBLICATIONS

The co-publication analysis examined scholarly works that involved at least one author affiliated with an organisation in an ASEAN country and that were published between 2004 and 2014.

During this 11-year period, the overall ASEAN scientific output indexed in either Scopus or Web of Science amounted to about 550,000 papers.

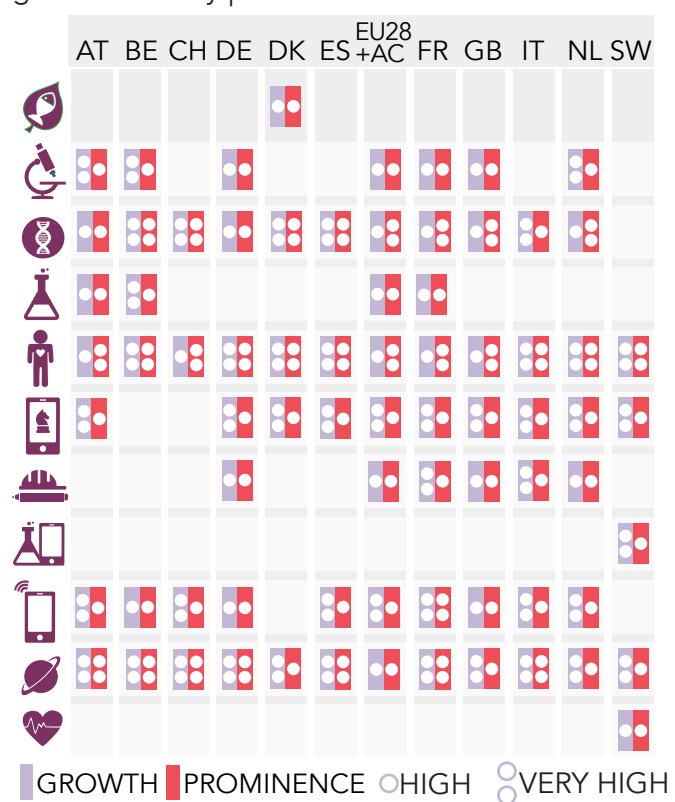
ASEAN PUBLICATIONS DEVELOPMENT OVER TIME



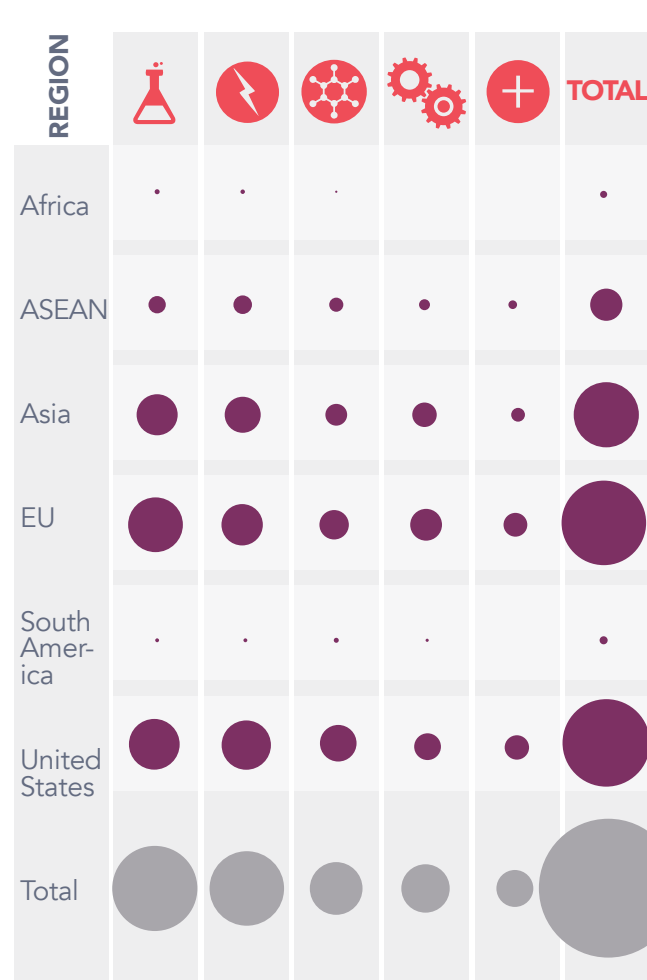
About 39% (or 210,000) of those were co-authored internationally (i.e., with at least one researcher affiliated with organisations outside the ASEAN countries). A third of those international co-publications involved an organisation in the EU.

HIGH GROWTH AND HIGH PROMINENCE OF ASEAN CO-PUBLICATIONS WITH EU COUNTRIES

Several research fields show a noteworthy growth (relative to 2004). That alone may be interesting but combined with the prominence of those research field for each EU country provided further insights. Prominence is given if a the share of a research field relative to all co-publications between an EU country and ASEAN countries is high (up to 10 %) or very high (10 % and above). Growth is considered high if the number of co-publications is 1.5 to 3 times higher than in 2004, it is considered very high if it is 3 times or more. Growth and prominence are shown in the chart below - the first symbol represents growth, the second one prominence. For instance, in Agriculture, Fisheries & Forestry, the only remarkable instance is ASEAN-DK co-publications - it shows high growth and a high prominence. Another example is ASEAN-AT in Clinical Medicine, which shows high growth and very prominence.



PCT CO-INVENTIONS



At the technology sectors level, the most important co-invention ties with the European Union are in chemistry, pharmaceuticals and mechanical engineering. In the case of the United States, by comparison, the most important sectors are electrical engineering, instruments and other fields.

Although over the 11-year period Singapore (SG) had the highest average share of the worldwide journal publication output (0.59 %), Malaysia (MY) overtook SG in 2010 and arrived at a share of 0.97 % in 2014 (versus 0.16 % in 2004). Thailand's (TH) share increased to 0.46 % (from 0.24 % in 2004), Indonesia (ID) is up to 0.21 % (from 0.06 % in 2004) and Vietnam (VN) is up to 0.14 % (from 0.04 % in 2004). The Philippines (PH) is stable around 0.07 %. The other ASEAN countries' share of the world overall output is below 0.05%. These figures obviously reflect levels of public and private investments in research and development, which vary greatly among Southeast Asian countries—a fact that needs to be taken into account when interpreting both publication and patent application output.

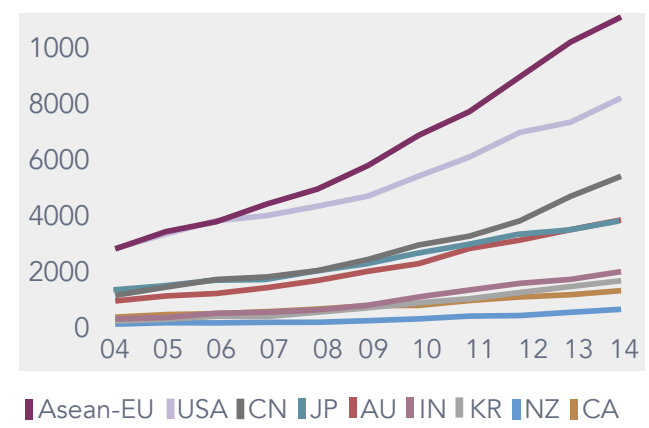
As far as the patent analysis part is concerned, the period covered is 2004 to 2013. Southeast Asia's share in worldwide patenting is lower than its share of publication output. Patent Cooperation Treaty (PCT) applications that include inventors based in ASEAN countries and that were filed in the last ten years make up 0.5 % of worldwide PCT application output. However, patenting activity has been increasing heavily (0.4 % of world output in 2003; 0.7 % in 2012).

As specified above, an important part of this analysis is the focus on collaborative knowledge production. Publication-wise, globally, the EU is the strongest partner in co-publication collaboration, followed by the United States, China, Japan, Australia, and India. As far as patent applications are concerned, co-inventions with US-based partners are slightly more frequent. However, particularly in terms of PCT patent applications, EU countries play a major role.

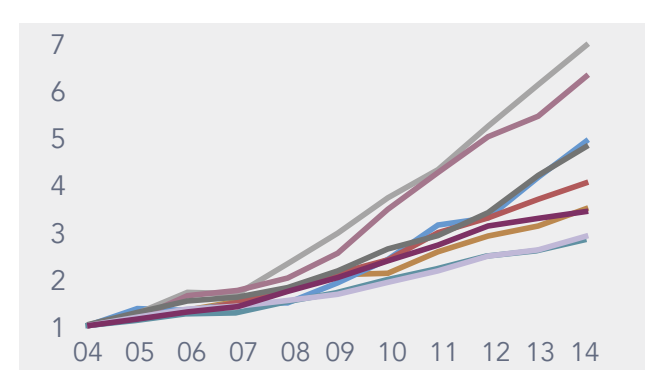
ASEAN CO-PUBLICATIONS

In terms of the amount of co-publications, the ASEAN-EU output is strongest; it is followed by ASEAN collaboration with the United States, China, Japan, and Australia.

ASEAN CO-PUBLICATIONS STRONGEST INTERNATIONAL TIES



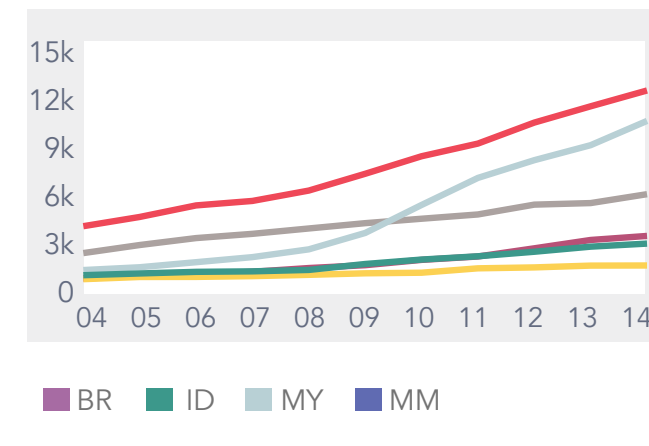
ASEAN CO-PUBLICATION GROWTH STRONGEST INTERNATIONAL TIES



In terms of growth, ASEAN-KR and ASEAN-IN show the highest dynamics, followed by ASEAN-NZ, ASEAN-CN, ASEAN-AU, ASEAN-EU, and ASEAN-CA. The growth of ASEAN-US co-publications, as well as ASEAN-JP, is considerably lower. Given the highest amount of co-publications, the ASEAN-EU growth (a 400% increase since 2004) is noteworthy.

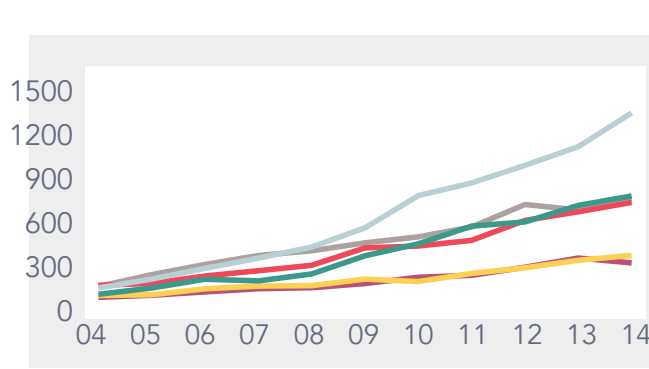
CO-PUBLICATION OUTPUT ON THE ASEAN COUNTRY LEVEL

The strongest output in terms of co-publications of ASEAN countries with international partners involve Singapore, Malaysia (with the highest growth), Thailand, Vietnam, Indonesia, and the Philippines.



TOP INTRA-ASEAN CO-PUBLICATION COUNTRIES

The top intra-asean collaboration countries in terms of number of co-publications, i.e. an ASEAN country collaborating with at least one other ASEAN country, are Malaysia, which shows the highest dynamic between 2004 and 20014, Indonesia, Thailand, Singapore, the Philippines, and Vietnam.



PCT CO-INVENTIONS

The co-invention patterns for PCT patent applications between ASEAN and other regions or countries vary technology-wise. For the bilateral cooperation within the ASEAN region, the technology fields of semiconductors, medical technology and basic materials chemistry are the most common links. Cooperation between ASEAN-based inventors and colleagues from the United States most often results in patent applications in the fields of semiconductors, pharmaceuticals and computer technology.

Collaborative PCT patenting between ASEAN and Japanese inventors is most frequently seen in applications in the technology fields of audio-visual technology, biotechnology and macromolecular chemistry as well as polymers. Cooperation with the BRICS countries is most common in the fields of organic fine chemistry, pharmaceuticals and macromolecular chemistry, and polymers. The collaborative development of PCT patent applications with the involvement of ASEAN and European inventors is most frequent in applications in the fields of organic fine chemistry, pharmaceuticals and macromolecular chemistry as well as polymers.

Overall, the most important technology fields for co-inventions with ASEAN inventors involved are **basic materials chemistry, pharmaceuticals and organic fine chemistry.**



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In terms of the publications co-produced by ASEAN and EU authors, the strongest collaboration has been noted for Great Britain, France, and Germany. Strong collaboration countries in the geographical proximity of ASEAN are China, Japan, and Australia.

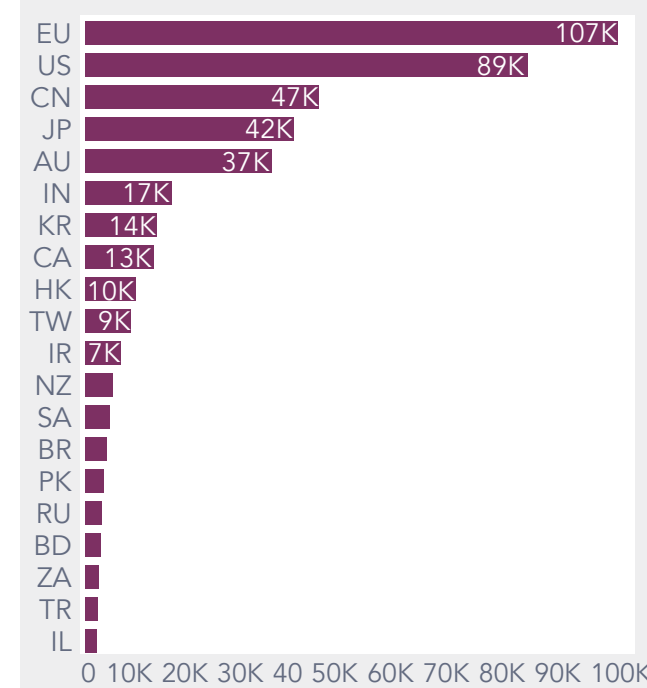
ASEAN COPUBS WITH THE STRONGEST EU COUNTRIES 2004-2014



ASEAN COPUBS WITH COUNTRIES NEAR ASEAN FROM 2004-2014



TOP INTERNATIONAL COUNTRIES/REGIONS



ABBREVIATIONS/ACRONYMS

ASEAN	Association of Southeast Asian Nations
AT	Austria
AU	Australia
BE	Belgium
BN	Brunei Darussalam
BR	Brazil
CA	Canada
CN	China
copub	co-publications
DE	Germany
ES	Spain
EU	European Union
EU28	the 28 EU member states
EU28+AC	the EU28 plus the countries associated to the European Framework Programme for Research and Technological Development
FR	France
GB	Great Britain
HK	Hong Kong
ID	Indonesia
IN	India
IT	Italy
JP	Japan
KH	Cambodia
KR	Korea
LA	Lao PDR
MM	Myanmar
MY	Malaysia
NL	the Netherlands
NZ	New Zealand
PH	the Philippines
PK	Pakistan
pub	publications
RU	Russia
SA	South Africa
SE	Sweden
TH	Thailand
TW	Taiwan
UK	United Kingdom
US or USA	United States of America
VN	Vietnam

DOMESTIC OWNERSHIP

RANK	INVENTOR BY COUNTRY OF RESIDENCE	APPLICANT'S LOCATION BY COUNTRY	SUM OF APPLICATIONS
1	SG	SG	6,525
2	MY	MY	2,360
4	TH	TH	634
6	PH	PH	417
9	ID	ID	226
12	VN	VN	148
39	LA	LA	10
47	BN	BN	7
59	MM	MM	3
68	KH	KH	2

The share of domestically owned PCT patent applications varies between 80% and 30% in the ASEAN countries. The share of domestically owned patent applications is highest in Singapore, Malaysia and Vietnam. In general, high patenting activity and domestic ownership shares show a positive proportional correlation.

PROJECT ACHIEVEMENT HIGHLIGHTS

- Establishing a multilateral project consortium of 21 European and ASEAN organisations all centrally involved in science and technology (S&T) policies and funding.
- Building on the SEA-EU-NET I project success and implementing an even stronger focus on strategically and coherently expanding the scientific collaboration between Europe and Southeast Asia.
- Intensifying the bi-regional dialogue between high-level EU and ASEAN S&T policy-makers.
- Hosting the annual ASEAN-EU STI Days as a forum to exchange experiences on knowledge co-production for researchers, innovation stakeholders, policy-makers and private businesses.
- Jointly tackling topics of health, food security and safety, metrology, and water management that are societal challenges highly relevant for both regions by organising events, providing fellowships for SEA researchers and conducting studies on potential future collaborations.
- Launching a dialogue on a joint funding scheme to enhance the bi-regional cooperation, involving representatives from European and Southeast Asian funding agencies, from the ASEAN Secretariat, and the European Commission.
- Providing in-depth analyses of the current state of play in the fields of health, food security and safety, and water management to identify gaps, synergies, and potential for bi-regional cooperation. Developing and feeding recommendations into the official dialogue process.
- Informing the Southeast Asian research community on the Horizon 2020 programme as well as increasing the level of their participation.
- Extending the dialogue on EU-SEA S&T cooperation to include a wide range of stakeholders by connecting to already existing networks and dialogues.

TOP 10 RESEARCH TOPICS



TOP 10 SHARES

RESEARCH FIELDS	share of ASEAN intl	share of ASEAN-EU
Agriculture, Fisheries & Forestry	7%	6%
Biology	7%	8%
Biomedical Research	15%	16%
Chemistry	7%	7%
Clinical Medicine	23%	26%
Enabling & Strategic Technologies	7%	6%
Engineering	7%	5%
Information & Communication Technologies	4%	4%
Physics & Astronomy	5%	7%
Social Sciences	2%	1%

METHODOLOGY - PATENT ANALYSIS

What we present here is selected data from a broader analysis of patent output in Southeast Asia. The study builds on data from the European Patent Office's (EPO) PATSTAT database. PATSTAT is the most comprehensive global database of patent applications. We use the April 2014 and November 2015 versions of the database.

In our analysis, we focus on patent applications. Whether or not a patent application is actually granted depends on a number of factors, some of which have to do with the application's contents, others with applicant strategies. For our purposes, a patent application is a sufficient indication of novel, codified, potentially innovation-related knowledge that the applicants consider relevant enough to disclose.

When counting patent applications per country and technology sector, we apply full counting instead of fractional counting. This means that, for instance, an application involving inventors from Thailand and Malaysia is counted as one application for Thailand and one for Malaysia. When regional sums are built, only one application is counted in this example. Double-counting is thus controlled for.

Unless otherwise stated, we consider only patent applications filed according to the procedures established by the Patent Cooperation Treaty (PCT applications). In order to assess international cooperation patterns, we analyse both co-inventions and foreign ownership patterns. Please refer to the full report available on our project website.

FOREIGN OWNERSHIP

Patent applications that are developed by an ASEAN-based inventor and are owned by an applicant in another country are called foreign-owned patent applications. Foreign ownership represents a form of knowledge transfer. Most of the patent applications developed by ASEAN inventors are owned domestically but foreign ownership is observable and varies technology-wise and among the partner regions.

Most foreign-owned applications have an applicant from either the European Union or the United States. The European countries with most PCT applications developed by ASEAN inventors are the Netherlands, Germany and Great Britain. Other countries with significant foreign ownership of ASEAN inventions are Japan, China, Australia, Canada and India.

RANK	INVENTOR BY COUNTRY OF RESIDENCE	APPLICANT'S LOCATION BY COUNTRY	SUM OF APPLICATIONS
3	SG	EU	703
5	SG	USA	481
7	MY	EU	279
8	SG	ASIA	260
10	MY	USA	222
11	TH	EU	153
13	MY	SG	143
14	TH	ASIA	80
15	PH	USA	78
16	SG	Non-EU EU	72

CONSORTIUM MEMBERS

- DLR** Project Management Agency at the German Aerospace Center, Germany (Coordinator)
- AIT** Asian Institute of Technology, Thailand
- BHC** British High Commission Singapore
- CIRAD** Agricultural Research for Development, France
- CNRS** National Centre for Scientific Research, France
- DOST** Department of Science and Technology, The Philippines
- EURResearch** EURResearch, Switzerland
- ISPA** National Research Council, Italy
- KNAW** The Royal Netherlands Academy of Arts and Sciences, The Netherlands
- LIPI** Indonesian Institute of Sciences, Indonesia
- MOST** Ministry of Science and Technology, Laos
- NASATI** National Centre for Scientific and Technological Information, Vietnam
- NSTDA** National Science and Technology Development Agency, Thailand
- NTU** Nanyang Technological University, Singapore
- PAN** Polish Academy of Sciences, Poland
- RCISD** The Regional Centre for Information and Scientific Development, Hungary
- RCN** The Research Council of Norway, Norway
- SIRIM BERHAD** National Metrology Laboratory, Malaysia
- SPI** Portuguese Innovation Society, Portugal
- TÜBITAK** The Scientific and Technological Research Council of Turkey, Turkey
- ZSI** Centre for Social Innovation, Austria

METHODOLOGY - PUBLICATION ANALYSIS

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 and Thomson Reuter's Web of Science. The following countries are covered under the ASEAN region: BN, ID, KH, LA, MM, MY, PH, SG, TH, VN. EU28/AC, on the other hand, covers all 28 EU member states and the accession countries to the European Framework Programme for Research and Technological Development. The study analyses all publications from both databases that featured any affiliation to at least one of the ASEAN countries and to at least one of the countries from EU28/AC.

The data in both sources are available with only partly different field names and somewhat different quality. A bundle of software tools was specially developed to assure (1) that the formats of the data allow unification, and (2) to measure the rise of quality of metadata of publications tracked in both databases after unification. The data quality is usually limited—about 65–75% of the resources available for analysis go into data normalisation/cleaning. The goal of the unification—a complex process of consolidating the data of both sources—is to gain an additional 20–25% of quantitative data and a qualitative increase through complementary data.

Please note that the impact is measured in terms of numbers of citations. These numbers should be considered as just a momentary snapshot of ongoing activities. More recent works are usually less cited than older works.

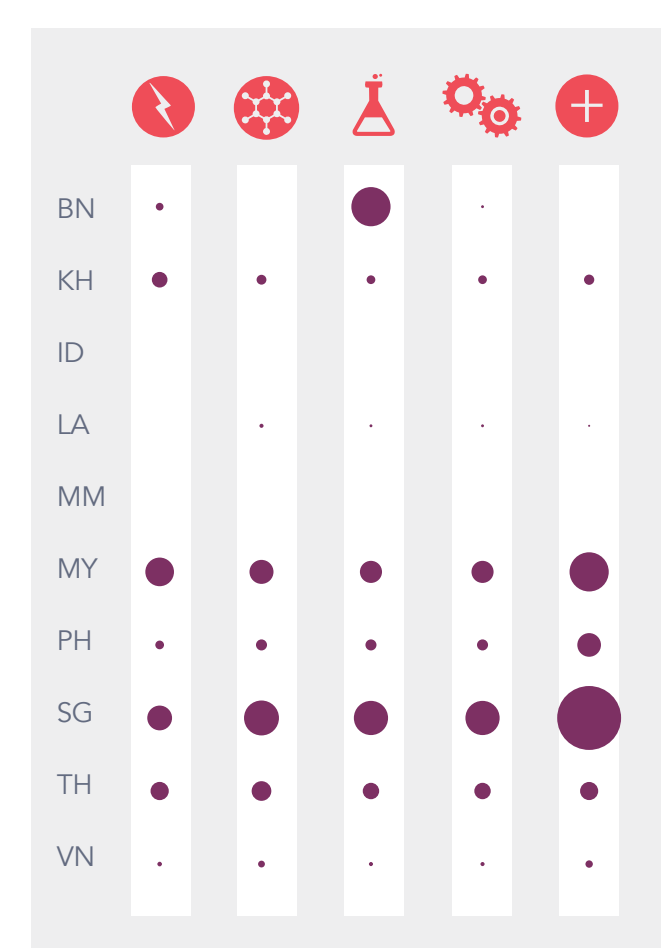
METHODOLOGY - PATENT ANALYSIS

During the years covered by the patent analysis (2003–2013), an overall increase in patenting activity is observable for both national and PCT patent applications in ASEAN countries. During this period, more than 12,000 national and more than 10,000 PCT patent applications were developed with the contributions of inventors based in ASEAN countries. Singapore and Malaysia account for more than 80% of all patents filed with the involvement of ASEAN-based inventors.

We also analysed the technological specialisation patterns of the region. The highest numbers of PCT patent applications with ASEAN-based inventors are related to semiconductors, computer technology, audio-visual technology, electrical machinery and apparatuses, energy as well as measurement technology. Due to the fact that most of the patent applications are developed by inventors based in Singapore or Malaysia, this specialisation pattern represents the specialisation of these two countries and varies for other countries.

The co-invention patterns for PCT patent applications with at least one ASEAN-based inventor show that bilateral cooperation within the region is not as important as external ties. Within the region, most co-inventions are observable between Singapore and Malaysia. But the ties between the ASEAN region and European countries and the United States are much more significant. Technology-wise, the co-inventions vary by a region's specialization in total output. Most collaborative patent applications are related to basic materials chemistry, pharmaceuticals, organic fine chemistry, macromolecular chemistry and polymers as well as to biotechnology.

FOREIGN OWNERSHIP BY TECHNOLOGY SECTOR



The technology sectors with the most foreign-owned, ASEAN-invented PCT patent applications are electrical engineering and chemistry as well as pharmaceuticals. The shares of foreign-owned PCT patent applications are between 20% and 30% for all technology sectors and are lowest for instruments and highest for other fields.

KNOWLEDGE CO-PRODUCTION IN ASEAN AND BETWEEN ASEAN AND EU

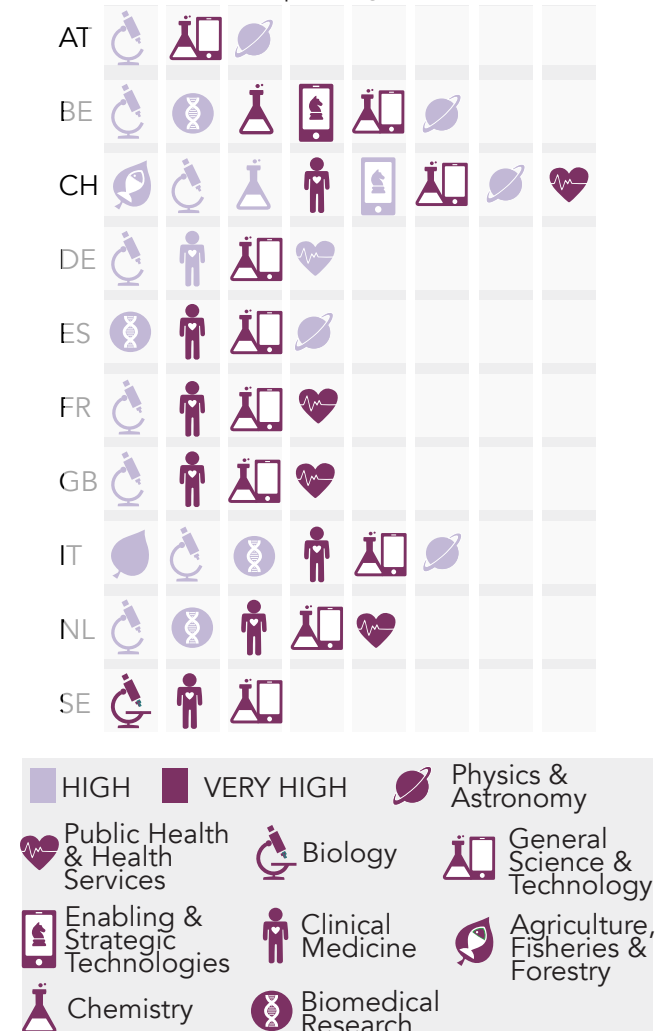


EU-ASEAN S&T cooperation to jointly tackle societal challenges



This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 311784.

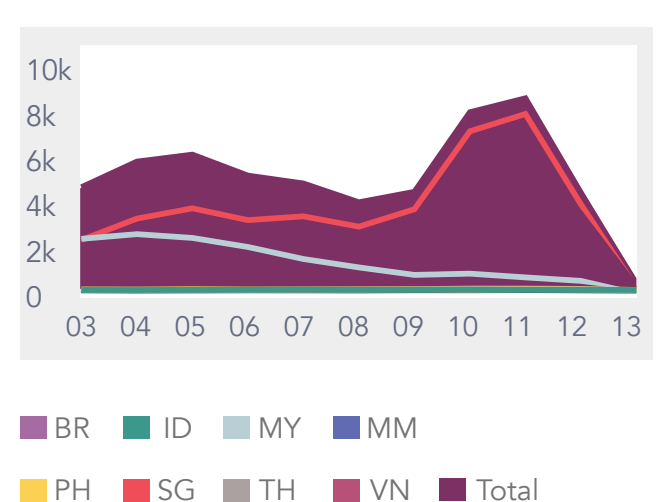
TOP EU COUNTRIES PER RESEARCH FIELD (relative to ASEAN-copub avg. citations)



OFFICES

The data presented above represents all national and PCT patent applications at patent authorities in ASEAN countries. The national patent applications also comprise non-priority filings. Therefore, the total volume at ASEAN intellectual property offices is depicted for the period 2003–2013.

In these 11 years, a total of more than 57,000 applications have been filed in ASEAN countries. For the years 2003–2011, an increase in patenting activity is observable. The drop in the years 2012 and 2013 can be explained by delays in publishing and reporting of filings, which is common in patent data.



FOREIGN OWNERSHIP BY TECHNOLOGY FIELD

Most PCT patent applications with ASEAN-based inventors that are owned by applicants from non-ASEAN-affiliated countries in Asia are filed under the technology fields of organic fine chemistry and audio-visual technology. Patent applications with European applicants are most often filed under the technology fields of civil engineering, audio-visual technology and basic materials chemistry. Foreign-owned patent applications from ASEAN inventors in the United States are most often related to computer technology, semiconductors, and electrical machinery, apparatus or energy.

BN	Civil engineering	Control	
KH	Pharmaceuticals	Food chemistry	Biotechnology
ID	Civil engineering	Basic materials chemistry	Semiconductors
LA	Biotechnology	Other special machines	Measurement
MY	Civil engineering	Basic materials chemistry	Semiconductors
MM	Basic materials chemistry		
PH	Semiconductors	Digital communication	IT methods for management
SG	Audio-visual technology	Computer	Electrical machinery, apparatus, energy
TH	Organic fine chemistry	technology Pharmaceuticals	Measurement
VN	Food chemistry	Biotechnology	Chemical engineering
TOTAL	Civil engineering	Computer technology	Semiconductors