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Scientific Output and Collaboration of European Universities

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Executive Summary

Background

Science-Metrix has been selected as the provider of bibliometric indicators for the European Commission's Directorate-General for Research and Innovation (DG Research), starting in September 2010 and extending to September 2014. This work involves the collection, analysis and updating of bibliometric data that will be integrated into the European Commission's evidence-based monitoring of progress towards the objectives set forth in the Lisbon framework and the post-Lisbon Strategy for the European Research Area (ERA). The bibliometric component of this monitoring system is part of a package of six complementary studies reporting on the dynamics of research activities along the whole spectrum of knowledge, from R&D investments to publications, patents, and licensing.

The analyses provided by Science-Metrix to the European Commission focus on the scientific performance—including impact and collaboration patterns—of countries, regions and research performers (such as universities, public research institutes and companies). The statistics produced by Science-Metrix are based on a series of indicators designed to take into account national and sector specificities, as well as to allow for a comprehensive analysis of the evolution, interconnectivity, performance and impact of national research and innovation systems in Europe. The statistics also provide an overall view of Europe's strengths and weaknesses in knowledge production across fields and subfields of science. In measuring progress towards past and current objectives, this information aims to support the coherent development of research policies for the ERA.

The Present Report

This report aims more specifically to assess the scientific performance and collaboration profile of European universities across main S&T fields and the 17 thematic priorities funded under the Seventh Framework Programme for Research and Technological Development (FP7). The report was first drafted in 2012 for data pertaining to the 2007–2010 period. The present report constitutes the first update. It examines the production profiles, from 2007 to 2011, of 303 selected universities within 35 countries of the ERA.

The 35 countries comprise members of the EU-27, candidate EU countries, members of the EFTA, and Israel. The universities were selected in order to provide information on those institutions within the ERA that publish the most while ensuring comprehensive coverage of all countries within the ERA. Consequently, a maximum of 20 universities in each country were selected on the basis of their number of published papers. Thus, the resulting selection is not equivalent to a list of the 300 most actively publishing universities throughout the ERA, irrespective of the countries in which they are located. Also, some universities have the same rank because they published the same number of papers in the period, and thus 303 universities have been selected. This resulting selection of ERA universities is also compared to the most actively publishing non-ERA universities.

The production profiles and collaboration patterns are based on a selected set of bibliometric indicators that aim to compare scientific performance across universities. These indicators include:

- **Number of publications:** Publications were counted based on both full (FULL) and fractional (FRAC) counting.
- **Specialisation Index (SI):** An indicator of research intensity in a given research area.

- **Average of Relative Citations (ARC):** a field-normalised measure of scientific impact (which also takes into account the publication year and document type of scientific contributions in the normalisation process) based on the citations received by an entity's papers; thus, it is a *direct* measure of scientific impact. In this report, the ARC is based on data from the 2000 to 2008 period, due to incomplete citation windows for documents published later.
- **Average of Relative Impact Factors (ARIF):** a field-normalised measure of the scientific impact of publications produced by a given entity (e.g., the world, a country, a NUTS2 region, an institution) based on the impact factors of the journals in which they were published (also taking the publication year of scientific contributions into account in the normalisation process). As such, the ARIF is an *indirect* impact metric reflecting the average citation rate of the publication venue instead of the actual publications. As a result this indicator may serve as a proxy for the "quality" of the research performed by a given entity. Indeed, the more cited a journal, the more researchers will seek to publish in it and the more the editors will be in a position to select the best papers.
- **Highly cited publications:** The percentage of papers within the top 10% most-cited papers in the reference database. This measure makes use of the normalised citation score of individual publications.
- **Number of co-publications:** The number of co-authored publications between two entities (e.g., institutions, countries). The number of co-publications is based on full counting and covers intra- and inter-institutional co-publications with academic and RPO partners, within the ERA and at the international level.

The report is primarily descriptive, focusing on the salient points relevant to the report's three main parts: universities' collaboration patterns in the sciences in general (aggregated data in Scopus, Section 2); scientific performance of ERA universities by field and FP7 thematic priority (Section 2); and comparative analysis of the most actively publishing ERA and non-ERA universities (Section 4).

Key Findings—Universities' Collaboration Patterns (see Section 2)

Section 2 focuses on the collaboration patterns of the 303 selected ERA universities for the 2007–2011 period, simultaneously highlighting their publication output and scientific impact, which have been overlaid with the collaboration network of these organisations. The collaboration patterns of the 25 most actively publishing ERA universities with other academic/RPO or private international partners are also examined.

- Co-publications of ERA universities are generally characterised by strong clustering according to their geographic location, with inter-institutional collaboration being stronger within than between countries.
- Seven countries constitute the heart of the collaboration network of ERA universities, namely the UK, Germany, France, Italy, the Netherlands, Sweden, and Spain (in descending order based on the average centrality score of a country's universities in the network).
- Three universities rank in the top 10 with respect to each of the four indicators of network importance used in this report. In descending order of number of publications based on fractional counting (FRAC), they include Imperial College London, the University of Manchester, and Pierre and Marie Curie University. University College London (UCL), the University of Cambridge and the University of Oxford rank within the top six for the size of their output (measured using fractional counting) and are also central players in the network, UCL and Oxford ranking in the top 10 based on their weighted degree scores. Four other universities are worth mentioning due to the diversity of their partners in the network: the

University of Helsinki, Lund University, the University of Oslo and the Charles University of Prague.

- In terms of the impact of their research output based on the journal impact factors (ARIF), the two top universities (i.e., the Weizmann Institute of Science and the University Nova Gorica) are not the most central. In terms of ARIF, they are followed by two universities in the UK which *are* central players in the network as described above, namely the University of Oxford and the University of Cambridge.
- The 25 ERA universities that publish the most produce 64% to 84% of their publications in partnership with other organisations. The highest collaboration rates are observed for the University of Paris XI (84%), Pierre and Marie Curie University (81%), the Karolinska Institute (79%), Paris Diderot University (78%) and Utrecht University (76%). The ranking hardly changes when based on inter-sectoral collaboration rates with academic institutions and/or RPOs and the rates are similar to those for inter-institutional collaboration, which is not surprising as universities and RPOs together account for most peer-reviewed publications.
- Among the 25 most actively publishing ERA universities, collaboration with the private sector is particularly high at technical universities, i.e., the Technical University Munich (10%) and the Swiss Federal Institute of Technology Zurich (ETH Zurich) (9%). Imperial College London, the Karolinska Institute and the University of Copenhagen also score highly (8%). If all 303 selected universities are considered, many technical universities score higher in this respect.
- ETH Zurich and the University of Zurich, both in Switzerland, have the highest proportion of co-authorships with foreign partners.
- In summary, the Karolinska Institute stands out for its inter-institutional, international and inter-sectoral (either academic/RPOs or private sector) collaboration rates. ETH Zurich stands out for both its international and inter-sectoral (i.e., with the private sector) collaboration rates.

Key Findings—Scientific Production Profiles of ERA Universities Overall in Scopus and in Main Fields (see Sections 3.1 and 3.2)

Section 3.1 and 3.2 focus on the scientific performance of ERA universities in, respectively, Scopus overall and each of the main S&T fields as per Science-Metrix's ontology. Please note that the focus is on the 25 most actively publishing universities among the 303 selected ERA universities. This selection of 303 universities is the same irrespective of the field; only the subset of 25 most actively publishing universities changes from one area to the next. Results are presented for Scopus as a whole and for the main research fields per domain in alphabetical order starting with Applied Sciences, followed by Arts & Humanities, Economic & Social Sciences, Health Sciences, Natural Sciences and General Fields. General Fields contains general Arts, Humanities & Social Sciences as well as Science & Technology journals which could not be assigned to a particular field as they cover multiple research areas.

It is often difficult to determine the position of entities being compared relative to one another without a well-structured ranking mechanism when multiple indicators are used to characterise the scientific performance of an entity (e.g., a university). To highlight the most salient results from the large amount of data presented in Section 3.2, Science-Metrix's analysts, aided by a multicriteria ranking tool (not presented in this report), have made use of expert judgements. The reader is referred to the presentation of individual indicators (Table III to Table XLIV) for a more thorough understanding of the performance of universities.

Scopus

- The ERA as a whole (i.e., including all types of organisations, not just universities) contributed to approximately one-third of the world's scientific publication in Scopus (more than 2.5 million articles based on FULL counting), and its scientific impact is slightly above or equivalent to the world level of impact.

  Five UK universities are among the eight most actively publishing academic institutions. UCL, the University of Cambridge, Imperial College London and the University of Oxford, respectively, occupy the first four positions, each having more than 18,000 articles (FRAC). Affiliated hospitals contributed, on average (for the 25 most actively publishing organisations among the 303 selected universities), to 26% of the universities' publications.

  Among the 25 universities that published the most, the University of Oxford, ETH Zurich and the University of Cambridge are consistently positioned among the top five for the three indicators of scientific impact. The University of Nova Gorica has the highest scientific impact based on ARC and percentage of highly cited papers and the second-highest ARIF among all 303 selected universities, indicating that the papers it produced have been influential within the scientific community and have been published in high-quality journals. The Weizmann Institute has the highest ARIF among all ERA universities. The École polytechnique fédérale de Lausanne (EPFL) has both the second highest ARC and percentage of its publications in the top 10% most-cited publications.

Applied Sciences:

- **Agriculture, Fisheries & Forestry:** The ERA countries (i.e., including all types of organisations) produced close to 90,500 papers in Food, Agriculture and Fisheries, representing one-third of the world publications in this area. While the ERA is not particularly specialised in the field, its scientific impact is above the world level. Only seven ERA universities publish more than 1,000 articles. Denmark is present with two among the five most frequently publishing universities in this area and three overall among the 25 most active. Food, Agriculture and Fisheries represents the only thematic priority where the UK is only represented by one university. If all bibliometric indicators are examined globally, WUR and the Swedish University of Agriculture Sciences are particularly high performers in this area among the 25 most-publishing institutions: they rank first and second in terms of scientific output, are highly specialised and their impact is considerably higher than the world average. Note that three universities within the 25 selected are very specialised, with the relative research intensity being particularly high at Mendel University Brno (SI 22).
- **Built Environment & Design:** One-third of world publications in this area were published within ERA countries (i.e., including all types of organisations; these add up to approximately 21,500 articles based on FRAC). With the exception of TU Delft, which performs best in terms of output and level of specialization, all of the 303 selected ERA universities published fewer than 350 articles (FULL) in this field. TU Delft's scientific impact is, however, not far above the world level. Ranking third for the size of its output (FULL; fifth according to FRAC), the Technical University of Denmark is highly specialised and performs strongly with respect to all three indicators of scientific impact among the 25 most actively publishing universities in this area. Among the other 303 selected universities, Vilnius Gediminas Technical University stands out with its high level of specialisation in this field (SI 10.93).
- **Enabling & Strategic Technologies:** The ERA's contribution in this field—including all types of organisations—accounts for one-fourth of the world's publications (191,000 FRAC). The ERA is not specialised in the field but has a scientific impact above that of the world. The UK and Germany, as well as (to a lesser extent) Sweden, Belgium, Switzerland and Italy, are performing well, as they are each represented by two to six institutions among the 25 most actively publishing universities. Among them, the Technical University of Denmark is notable for its overall performance in Enabling & Strategic Technologies, with the highest output

(based on both FULL and FRAC), the highest research intensity and high scores for several scientific impact indicators. The University of Cambridge also performs well, with a stronger impact but a low specialisation index (SI).

- **Engineering:** ERA countries (i.e., including all types of organisations) produced more than 204,000 Engineering articles (FRAC) in Scopus between 2007 and 2011, which amounts to one-quarter of world output in the field. As in all Applied Sciences fields except Built Environment & Design, the ERA is not specialised in Engineering but has a large scientific impact. One-quarter of the 25 most actively publishing ERA universities are located in either the UK or Italy, being represented by six and five universities, respectively. TU Delft published the highest number of papers (2,200 articles; FRAC), is specialised and has a high scientific impact. Other universities that are noteworthy include the Technical University of Catalonia, the Polytechnic University of Turin and the Polytechnic University of Milan, all of which perform well regarding all bibliometric indicators. Two Swedish universities, namely the Swedish University of Agricultural Sciences and Stockholm University, are notable for their proportion of Engineering-related articles in the top 10% most-cited publications (35% and 31%, respectively), but they did not produce enough papers to be included in the top 25 most actively publishing universities.
- **Information & Communication Technologies (ICT):** The ERA (including all types of organisations) produced almost one-third of the overall output in ICT (almost 248,000 articles, based on FRAC). The ERA is not specialised in this area but has a slightly higher impact than the world. Technical universities and polytechnics perform especially well in this field. Switzerland's performance is notable, being represented by two institutions (EPFL and ETH Zurich) among the five most actively publishing universities. When all indicators are examined together, EPFL, the Technical University of Catalonia and Aalto University in Finland appear among the best-performing universities. In terms of scientific impact, EPFL, Technion Israel and the University of Cambridge are among the top five for the three citation indicators of ARC, ARIF and percentage of highly cited papers.

Arts & Humanities:

Please note that the findings presented in this section are subject to certain biases, some of which favour Anglo-Saxon countries. Please refer to Section 6.5 for a detailed description of the limitations of bibliometrics in the social sciences and humanities (SSH).

- **Communication & Textual Studies:** The output of the ERA (including all types of organisations) in this field (more than 20,200 FRAC) represents approximately one-third of the world output. As can be observed for all fields in the Arts & Humanities, the ERA is specialised in Communication & Textual Studies but has low scientific impact. Of the 25 most actively publishing ERA universities, 11 are located in the UK and four are in the Netherlands. While all 25 universities are specialised in this field of research, most British universities (University of Leeds, University of Edinburgh, UCL, University of Nottingham, University of Sheffield and University of Warwick) and Dutch universities (University of Amsterdam [UvA] and the Radboud University of Nijmegen) also perform well in terms of all three scientific impact indicators. The University of Amsterdam (UvA), Ghent University and the University of Warwick are the top three universities according to overall scientific production and impact scores.
- **Historical Studies:** More than half of the worldwide scientific production in Historical Studies is produced within ERA countries (including all types of organisations; 37,100 FRAC). This is the largest share of ERA output among all 22 fields of research, which is reflected by the high level of specialisation. However, its scientific impact is, at best, comparable to the world average. With high SI and high scientific impact, the UK and Spain are well represented among the 25 most actively publishing universities and the top three universities according to

overall performance are British. The University of Cambridge, the University of Oxford and UCL show the highest overall performance regarding all bibliometric indicators in Historical Studies. The University of Rijeka in Croatia is remarkable for its high specialisation (SI of 19.19) and close to one-third of the University of Bern's papers are highly cited (i.e., within the top 10% most-cited articles).

- **Philosophy & Theology:** Over 40% of the world publications in Philosophy & Theology involved at least one ERA researcher (including all types of organisations; 13,700 FRAC). As shown for other Arts & Humanities fields, the ERA is specialised in Philosophy & Theology, but its scientific impact is below the world level. Academic institutions from the UK predominate in this field, as 10 of the 25 most actively publishing universities are located in this country. The Netherlands (six universities) and Belgium (three universities) are also well represented. The contribution of university hospitals is important for three of the institutions in the Netherlands, namely Erasmus University Rotterdam (41%), Radboud University Nijmegen (26%) and Utrecht University (16%). Among the 25 most actively publishing universities, the University of Oxford leads the field, being highly specialised and cited well above average. The Bar-Ilan University in Israel is remarkable for its very high specialisation, although its impact remains below the world average.
- **Visual & Performing Arts:** This field is comprised of as few as 8,075 articles at the world level, more than 40% of which were produced within the ERA (including all types of organisations). The relative research intensity of ERA countries is above, but its scientific impact below, the world level. As would be expected within a very small research field, only four universities published more than 30 articles: Gazi University, the University of Cambridge, the University of Amsterdam and Eötvös Loránd University in Hungary. With the exception of the ARIF for Gazi University, which is far below the world level, scientific impact in the field could not be computed due to the low number of papers.

Economic and Social Sciences:

Please note that the findings presented in this section are subject to certain biases, some of which favour Anglo-Saxon countries. Please refer to Section 6.5 for a detailed description of the limitations of bibliometrics in the SSH.

- **Economic and Business:** With 72,700 publications (FRAC), the ERA's production (including all types of organisations) equates to slightly more than one-third of the world output in this field. The relative research intensity and scientific impact of ERA countries is on par with the world level. The UK is, once again, well represented by nine institutions among the 25 most active, and is followed by the Netherlands with six institutions. Erasmus University Rotterdam and the University of Manchester published 1,090 and 1,040 papers during the 2007–2011 period, respectively, although Manchester has the larger output based on fractional counting (617). Copenhagen Business School and the Bucharest Academy of Economic Studies are notable for their very high levels of specialisation. Copenhagen Business School, Erasmus University Rotterdam and the University of Oxford perform well across all indicators. When all 303 selected universities are considered, the Norwegian School of Economics (NHH) stands out in terms of its high SI, and two Swiss universities (University of Basel and University of Zurich) in terms of relatively high citation impact (ARC scores of 2.14 and 2.11).
- **Social Sciences:** More than one-third of the world publications in the field are produced in ERA countries (i.e., including all types of organisations; 89,500 FRAC). The ERA is slightly specialised and has an impact just above the world level. Fifteen of the 25 most actively publishing universities—including the three with the highest scientific output and the top three according to overall performance—are located in the UK. Among the 25 most active, the University of Warwick, the University of Birmingham and VU–University Amsterdam are notable for their high specialisation and high impact in the field. Within the extended selection of 303 universities, Scandinavian organisations (e.g., Roskilde University, the Oslo and

Akershus University College of Applied Sciences and Copenhagen Business School) are especially more specialised than the three.

Health Sciences:

- **Biomedical Research:** With approximately 576,000 publications in Scopus, Biomedical Research is one of the largest fields. One-third of its output is produced within the ERA (i.e., including all types of organisations; 199,500 FRAC). Publications from the ERA perform slightly above world average in terms of specialisation and scientific impact. Seven among the 25 most actively publishing universities are from the UK, and three of them occupy the top three positions regarding the number of papers published in Biomedical Research. Affiliated hospitals contribute importantly to the output of universities; UvA–University of Amsterdam is first in this respect, as 70% of its publications are produced by or in collaboration with its affiliated hospitals. Except for Katholieke Universiteit Leuven, with an SI slightly above the world level, all of the 25 universities are specialised in Biomedical Research. The best performances across all indicators can be observed for the University of Oxford, Karolinska Institute and Cambridge; all are highly specialised in the field and score highest in all three scientific impact indicators. It should be noted that in the field of Biomedical Research many institutions perform similarly to these universities.
- **Clinical Research:** Clinical Medicine is the largest field in Scopus, with close to 2 million publications, 39% of which involve ERA countries (including all types of organisations; 767,000 FRAC). While the ERA is specialised in Clinical Research, its scientific impact is comparable to the world level. Six among the 25 most actively publishing universities are located in the UK, with UCL having the highest output among all selected universities. The ranking of institutions based on publication counts differs whether full or fractional counting is used, indicating that the extent to which multiple authors/organisations are involved in co-authoring papers varies across universities. As could be expected, contributions from affiliated hospitals are higher than in most other fields. The top performing institutions include UCL in the UK, Charité in Germany and the Karolinska Institute in Sweden, which combine high specialisation and strong scientific impact; note, however, that other universities perform comparably well.
- **Psychology & Cognitive Sciences:** ERA countries contributed to close to 40% of the world publications in this field (i.e., including all types of organisations; 58,000 FRAC). The ERA is slightly specialised but has a low scientific impact when compared with the world. UK institutions perform well in Psychology & Cognitive Sciences, 10 of them being among the 25 most actively publishing universities. The 25 universities with the largest output in Psychology & Cognitive Sciences are also highly specialised in the area. Combining large outputs, strong specialisation and high scientific impact, UCL, VU–Amsterdam University, King's College London and Utrecht University are among the top performers in this selection based on all bibliometric indicators. Surprisingly, within the extended selection of 303 ERA universities, the IT University of Copenhagen is the most specialised, followed by VU–Amsterdam University and University of Fribourg, while the University of Oulu in Finland, King's College London and the University of Cologne have the highest relative citation impacts.
- **Public Health & Health Services:** Using fractional counting, the ERA's share of the world output in this field accounts for one-third of articles (including all types of organisations; nearly 65,200 FRAC). The ERA is not specialised in the field (0.94) and has scientific impact scores exactly on the world level. About half (12) of the 25 universities with the highest numbers of publications in Public Health & Health Services are located in the UK; seven are in the Netherlands and three are in Sweden. Contributions by university hospitals differ greatly across institutions, ranging from no participation to contributing to as much as 80% of the university's publications. Overall, the majority of the most active universities in Public Health & Health Services are specialised in the field. The Karolinska Institute is noticeable for its high output and specialisation, as well as its strong impact, as are Maastricht University and

Erasmus University Rotterdam, which have some of the highest scores in all three impact indicators.

Natural Sciences:

- **Biology:** The ERA was involved in almost one-third of all publications in Biology between 2007 and 2011 (including all types of organisations; 79,000 FRAC). As can be observed for all Natural Sciences fields except Mathematics & Statistics, the ERA is not specialised in Biology, while its scientific impact is high and far above the world level. Of the 25 universities with the largest scientific production among the 303 selected, five are from the UK and four from Sweden. Overall, WUR Wageningen University and Research Centre and the Swedish University of Agricultural Science perform strongly in Biology, with large outputs, high levels of specialisation and overall strong impact. The University of Edinburgh and Pierre and Marie Curie University are not specialised in Chemistry, but show the highest ARC and share of highly cited papers among the 25 most active universities in the field. Among other universities worthy of mention outside of the top 25, the Daugavpils University, the University of Dubrovnik, Szent István University and the Estonian University of Life Sciences are remarkable for their high specialisation in Biology, publishing more than 10 times as much as expected.
- **Chemistry:** The field of Chemistry is a relatively important field, with almost 615,000 publications in Scopus, close to one-third of which involve ERA authors (including all types of organisations; 183,700 FRAC). The relative intensity of research in Chemistry for ERA countries is below average, but European research has more impact than the world average. Chemistry is one of the few among the 22 fields of research where the UK does not dominate. Of the 25 universities with the largest outputs in Chemistry, five are located in France and Germany, and Italy and the UK tie with four each for second strongest country among the most publishing universities. Overall, the University of Strasbourg, ETH Zurich, University of Bordeaux 1 and University of Münster are among the top performing universities in Chemistry, combining large outputs and high levels of specialisation with strong impact scores. The University of Cambridge, Pierre and Marie Curie University and the University of Manchester are not specialised in Chemistry but have large impact scores.
- **Earth & Environmental Sciences:** The ERA contributed to about one-third of the total publications in Earth & Environmental Sciences (including all types of organisations; 79,600 FRAC). As generally observed in the Natural Sciences, ERA is not specialised in the field, but its research has a higher impact than the world average. Of the 25 universities with the largest outputs in this field, nine are located in the UK, four in the Netherlands and three in both Denmark and France. When all bibliometric indicators are analysed together, ETH Zurich is by far the top performing university in Earth & Environmental Sciences, combining the highest SI score and some of the strongest impact indicators with the largest output of all European universities. Stockholm University also ranks highly—it compensates for its relatively small output with high specialisation and scientific impact. Among the 303 selected universities with smaller research output, the University of Antwerp is noteworthy for its scientific impact. It has the highest proportion of articles among the top 10% most-cited publications, the highest ARC and second highest ARIF.
- **Mathematics & Statistics:** The ERA's share of world publications in this field is about 37% using fractional counting (71,700 articles when including all types of organisations). Unlike in the other fields in the Natural Sciences, the ERA is specialised and nearly on par with the world level of scientific impact in Mathematics & Statistics. Among the 25 universities with the highest output within the 303 selected, six are located in Spain and France, while the UK ranks second with five universities among the most active in Mathematics & Statistics. Pierre and Marie Curie University is the most specialised university among the 25 that published the most; it has the largest output and a high scientific impact. The Paris Diderot University, the

University of Granada and University of Paris XI also perform strongly, being highly specialised and having higher citation impacts than the world on average.

- **Physics & Astronomy:** This large field comprises 700,000 publications in Scopus, one third of which involved at least one ERA author (including all types of organisations). The ERA is comparable to the world in Physics & Astronomy in terms of specialisation and scientific impact. Out of the 25 universities with the largest output in this field, seven are from the UK and France, four from Germany and three from Italy. Although not the most active, the Paris Institute of Technology shows the best overall performance as it is the most specialised and obtains some of the highest scientific impact among the 25 most active universities. The University of Paris XI and the University of Cambridge perform strongly in Physics & Astronomy with large outputs, high specialisation and overall high scientific impact. Among the universities with smaller outputs, the Dublin Institute for Advanced Studies is the most specialised, the University of Lugano has the highest relative citation impact, the University of Nova Gorica publishes in the highest-impact journals and Roskilde University has the largest share of articles within the top 10% most-cited publications.

General Fields:

- **General Arts, Humanities & Social Sciences:** (Note that the same limitations apply in this field as above for SSH.) This field is relatively small, with only 9,900 publications indexed in Scopus, less than one-third of which are produced within the ERA (including all types of organisations; 2,200 FRAC). Contrary to the other SSH fields, the ERA is not considered specialised in General Arts, Humanities & Social Sciences and has a scientific impact slightly above the world level. Only eight universities, six of which are in the UK, have more than 30 publications in this field using full counting. Although except for the University of Cambridge all four institutions are specialised, the University of Tartu in Estonia is notable for its SI score of 14.34. The University of Oxford and the University of Manchester stand out regarding their number of publications. Additionally, their ARIFs are slightly above the ERA and world averages. (Note that the ARC could not be computed for any of the institutions.)
- **General Science & Technology:** With 28,100 papers (FRAC) the ERA contributed close to one quarter of the world publication output based on fractional counting. While the ERA is not specialised in this field, its scientific impact is high based on all three bibliometric indicators. Among the 25 universities with the largest output in this field (among the selection of 303 universities in Scopus overall), eight are from the UK. With four institutions each, German and France are also well represented. For several of the 25 most actively publishing universities, affiliated hospitals contributed an important fraction of the university's total output—the highest share being 61% for the UvA–University of Amsterdam—indicating that a large share of publications in General Science & Technology journals represent medical research. Only 33 among the 303 selected universities are specialised in this field. Among the 25 most actively publishing universities, the University of Oxford, the University of Cambridge and the Karolinska Institute are the most specialised, and all publish research that has a high scientific impact. In fact, the two British universities stand out for their performances in all indicators.

Key Findings—Scientific Production Profiles of ERA Universities in FP7 Thematic Priorities (see Section 3.3)

Section 3.3 focuses on the scientific performance of ERA universities by FP7 thematic priority. Please note that the focus is on the 25 most actively publishing universities among the 303 selected ERA universities. This selection of 303 universities is the same irrespective of the thematic priority; only the subset of the 25 most actively publishing universities changes from one area to another.

- **FP7 Thematic Priorities (grouped):** Publications within the FP7 thematic priorities (grouped) represent approximately 70% of all publications in Scopus, at the world level as well as well as for the ERA countries (including all types of organisations). One-third of the world publications in FP7-related fields are produced by the ERA. The ERA is not specialised and has a scientific impact close to the world level. The performance of the most actively publishing ERA universities in the FP7 thematic priorities (grouped) is very similar to that observed for Scopus as a whole, with only slight variations in the ranking. The UK is the ERA country with the highest number of universities (seven) among the 25 with the largest research output in these areas. It is followed by Germany and the Netherlands, each with three universities. More than half of the 25 most active universities in terms of publication output consistently score higher than the world level according to their specialisation and impact indicators. UCL performs particularly well, having the highest FP7-related output and remaining close to the top-ranking universities in terms of specialisation and scientific impact. Imperial College London and the University of Oxford, often mentioned in the top positions for some indicators, are also top performers in the combined FP7 thematic priorities.
- **Health:** Health-related publications represent almost 3 million articles at the world level, more than one-third of which involve at least one ERA author (including all types of organisations; 112,600 FRAC). Together, ERA countries are slightly specialised in Health, but their scientific impact is on par with the world level. Universities in the UK predominate, as the 25 most active include six British universities, four of which rank in the top five universities according to scientific output. The Netherlands is also well represented with five universities in the top 25, and three institutions each are from Germany and France. Except for the University of Cambridge, all of the 25 selected universities are specialised in the thematic priority of Health, all are above the world level for their SI and all except the Autonomous University of Barcelona score above the world level in each of the three impact indicators. UCL and the Karolinska Institute perform particularly well, coming in first and second with regard to their number of publications (FULL and FRAC) and overall performances according to all indicators combined, reflecting high levels of specialisation and high scores in the impact indicators. Charité is also noteworthy, particularly for its high specialisation in Health.
- **Food, Agriculture and Fisheries:** The ERA countries produced close to 90,500 papers (i.e., including all types of organisations) in Food, Agriculture and Fisheries, representing one-third of the world publications in this area. While the ERA is not particularly specialised in the field, its scientific impact is above the world level. Only seven ERA universities published more than 1,000 articles. Denmark is present with two among the five most frequently publishing universities in this area and three overall among the 25 most active. Food, Agriculture and Fisheries represents the only thematic priority in which the UK is only represented by one university. If all bibliometric indicators are examined globally, WUR and the Swedish University of Agriculture Sciences are particularly high performers in this area among the 25 most-publishing institutions: they rank first and second in terms of scientific output, are highly specialised and their impact is considerably higher than the world average. Note that three universities within the 25 selected are very specialised, with the relative research intensity being particularly high at Mendel University Brno (SI 22).
- **Biotechnology:** The ERA contributed to one quarter of the world production in Biotechnology (including all types of organisations; 27,500 FRAC). It is not specialised in Biotechnology, but its scientific impact is higher than the world level. Of the five universities with the largest scientific output (i.e., the University of Cambridge, the University of Oxford, University College London, WUR and Imperial College London), four are in the UK. However, the Dutch university (WUR) performs best overall and is followed by DTU-Technical University of Denmark. Overall, the UK is represented by six, while Germany and Portugal have three universities among the most publishing in the thematic priority of Biotechnology. In the extended selection of 303 ERA universities, Radboud University Nijmegen and University of Geneva show noteworthy

percentages of highly cited papers, with 34% and 31% of its papers among the 10% most cited in the field of Biotechnology.

- **Information & Communication Technologies:** For the period examined, the world's output in this thematic area was about 846,500 publications, with the ERA producing less than one-third of these publications (including all types of organisations; FRAC 248,000). The ERA's research intensity in ICT is lower than that observed at the world level (SI 0.89); however, its scientific impact is slightly higher than the world average, as is its scientific impact. Technical universities generally lead the field. Switzerland has two institutions among the top five (EPFL and ETH Zurich). When all indicators are considered simultaneously, the universities with the highest performance in ICT-related research are EPFL, the University of Catalonia (which are also the universities with the largest number of papers) and the Finnish Aalto University (which is the most specialised). Ranking second in terms of the size of scientific production, EPFL's scientific impact is particularly high in this area of research, and it is very specialised. If the selection is extended to all 303 ERA universities, 17 have higher levels of specialisation than any of the 25 most active universities.
- **Nanosciences & Nanotechnologies:** With fewer than 70,000 articles published during the period from 2007 to 2011, the field of Nanosciences & Nanotechnologies is relatively small. One-quarter of these publications involved ERA countries (including all types of organisations; 17,000 FRAC). The research intensity of ERA countries in this area is 25% lower than expected, but the ERA's scientific impact is higher than the world level. Within the 25 most frequently publishing universities, only seven produced more than 300 publications (FULL). Analysing the overall performance of the 25 selected universities, EPFL and the University of Cambridge perform best in the field of Nanosciences & Nanotechnologies. ETH Zurich and the University of Freiburg rank second and third overall; Freiburg shows scientific impact far below the world average for all three citation indicators, while being highly specialised. The Ludwig Maximilian University of Munich is particularly noteworthy for its high impact according to ARIF and its proportion of highly cited papers.
- **Materials (excluding Nanotechnologies):** This area comprises a total of 361,500 publications, one-fifth of which were published by ERA countries (i.e., 72,400 FRAC, including all types of organisations). This share is lower than what is usually observed in other areas (i.e., between 25% and 35%). Despite a smaller concentration of the ERA's total scientific output in this area than the world, the impact of the ERA's scientific output is higher than the world level. The rankings of universities based on full and fractional counting differ, indicating that the propensity to co-author publications with many authors/organisations varies among ERA universities. The University of Aveiro and the Istanbul Technical University are globally among the top performing ERA universities in the Materials thematic priority, but other universities perform comparably well. Several universities which do not publish enough to be included among the 25 most active universities are more specialised than those in the top 25. The SI of the University of Žilina is particularly high (9.44). The Ludwig Maximilians University of Munich, the University of Mons and University of London, Queen Mary are remarkable for their high percentages of publications among the top 10% most-cited publications (40%, 39% and 36%, respectively).
- **New Production Technologies:** ERA countries participated in close to one-fourth of the world production in New Production Technologies (including all types of organisations; 44,000 FRAC). While the ERA is not globally specialised in this area, its scientific impact is higher than the world level. At the academic level, only five ERA universities published more than 500 articles (FULL) in this area. When analysing all of the bibliometric indicators together, the Polytechnic University of Milan, TU Delft, the Technical University of Catalonia and ETH Zurich emerge as strong performers. Whereas ETH Zurich stands out for its high scores across all three indicators of scientific impact, its somewhat lower specialisation places it in fourth place behind the three universities mentioned above. Note that other universities performed better

in terms of scientific impact than the Polytechnic University of Milan and the Technical University of Catalonia, namely ETH Zurich with the highest ARC, Technion Israel Institute of Technology with the highest ARIF and Katholieke Universiteit Leuven with the highest share of highly cited papers.

- **Construction and Construction Technologies:** The FP7 thematic priority of Construction and Construction Technologies is a small research area that comprises a total of fewer than 60,000 publications for the years 2007 to 2011, more than one-third of which involve ERA countries (including all types of organisations; 21,500 FRAC). At the university level, all ERA universities published far fewer than 500 scientific papers except for TU Delft, which is also by far the top performer when all bibliometric indicators are considered. Its scientific output is more than twice as large as the output of the institution in second place (i.e., Gazi University) and it is very specialised in this area. Nevertheless, its scientific impact is lower than observed at the world level. The Technical University of Denmark and Istanbul Technical University have high scores for all of the presented indicators; however, their research output is quite low. Among the other 303 selected universities, the Vilnius Gediminas Technical University is notable for its high specialisation in this area (SI close to 13).
- **Energy:** The ERA contributed to 51,800 publications (FRAC) during the 2007–2011 period, which represents slightly more than one-fifth of the world production in Energy-related research. Although the ERA is not specialised in this area, it has a high scientific impact. The UK has four universities among the 25 most active. Italy and Sweden follow with three universities each in the top 25. The Technical University of Denmark is the top performing university in the field of Energy, combining one of the largest outputs with high specialisation and high impact scores. Other remarkable performances are those of Chalmers University of Technology and the National Technical University of Athens with strong scores overall, particularly in SI. Among the 303 selected universities, three universities have more than 30% of their articles in the top 10% most-cited publications in this area: the University of Aveiro (39%), the University of Erlangen-Nuremberg (35%) and University College London (31%).
- **Environment (with Climate Change):** Research conducted in ERA countries (including all types of organisations) in the Environment thematic priority resulted in 116,500 publications (FRAC), representing one-third of the total production of the world. The concentration of output in this area is as pronounced for the ERA as it is for the world, with an SI of 1.00; thus the ERA devotes the same level of effort in this area as does the world in general. On the other hand, its impact is higher than the world level. Among the 25 universities with the highest scientific production, eight are located in the UK and three each in Denmark, France, the Netherlands and Sweden. Overall, all 25 universities have a high impact, with all scores being above the world level for all three indicators of scientific impact. Among these institutions, ETH Zurich stands out as the top performing university in Environment, being among the leaders for all indicators. WUR, the Swedish University of Agricultural Sciences and Stockholm University are also notable for their overall performance, particularly regarding specialisation and scientific impact. Among other ERA universities within the 303 selected, the University of Pannonia in Hungary is worth mentioning because of its notable proportion of highly cited papers, as almost 40% of its papers are within the top 10% most-cited publications.
- **Aeronautics & Space:** (The same finding applies to both thematic priorities, as they were matched to the same subfields; see Section 6.4.) The fields of Aeronautics/Space account for close to 49,100 publications in the Scopus database, 10,500 of which involved ERA countries (including all types of organisations). The ERA is not specialised in Aeronautics/Space, but it has a high scientific impact in these thematic areas. Among the top 25 publishing universities, nine are from the UK and seven are from Italy. TU Delft is by far the strongest player in Aeronautics/Space: it produced the largest number of publications, had the highest SI and

produced papers that, on average, have more impact than the average world paper (both in terms of ARC and ARIF). The Technion Israel Institute of Technology and the University of Southampton could also be considered leaders, given the overall quality of their research and their impact on the scientific community.

- **Automobiles:** Automobiles is a very small research area, comprising 10,300 articles in Scopus, one-third of which was produced by ERA countries (including all types of organisations; 3,600 FRAC). Overall, the ERA is only slightly specialised in the field, but its impact is relatively low when compared to the world. Of the 21 universities that produced at least 30 publications (FULL) in this area, five are located in the UK and the University of Southampton is the most active of all, publishing almost twice as much as the second-placed Aalborg University. Germany, Spain and Sweden follow, each with two universities among the top 21. Overall, the University of Southampton and Aalborg University are heavily specialised in the field. Aalborg University also has high scientific impact based on received citations and highly cited articles but publishes in low-impact journals, while for the University of Southampton it is the other way around. Note that ARC and the percentage of highly cited papers could only be computed for these two.
- **Other Transport Technologies:** Other Transport Technologies account for 207,400 publications in the Scopus database, close to one-quarter of which involved ERA countries (i.e., including all types of organisations; 42,700 FRAC). While the UK is represented in this thematic priority by seven universities and Italy by three, three countries have two institutions among the 25 universities that publish the most: Switzerland, Sweden and Lithuania. Overall, Lithuania has a strong presence in Other Transport Technologies, as its two universities are among the top five for size of production and for the most specialisation. In particular, Vilnius Gediminas Technical University is the top performing university, having a large scientific output, the highest SI (15.67) and some of the highest impact scores overall. It is joined by Kaunas University of Technology, which has a high level of specialisation combined with a strong ARIF. TU Delft is also among the leaders, with a strong performance across all indicators.
- **Socio-Economic Sciences:** (See above description of the limitations of bibliometrics for the SSH.) The ERA participated in more than one-third of the world production in this thematic priority, which represents 155,200 publications (including all types of organisations; FRAC). The ERA is at the world level, both in terms of specialisation and impact in the Socio-Economic Sciences. More than 50% (13) of the 25 universities with the largest output in this area are located in the UK, followed by the Netherlands with six and Belgium with two universities publishing frequently in Socio-Economic Sciences. The University of Warwick, University of Oxford, UvA–University of Amsterdam and University of Manchester stand out, having among the largest scientific productions and highest levels of specialisation and scientific impact. Note that other universities have comparable performances in this area. Other strong performances are those of Erasmus University Rotterdam, the University of Nottingham and VU–University Amsterdam, which combine high specialisation, large outputs and some of the highest impact indicators. Other noteworthy universities within the 303 selected include the Norwegian School of Economics (NHH), Copenhagen Business School and the Bucharest Academy of Economic Studies, whose very high research intensity in the Socio-Economic Sciences reflects their focus on Economics.
- **Humanities:** (See above description of the limitations of bibliometrics for the SSH.) The ERA's share of the total output in this thematic priority is particularly high at 46% (including all types of organisations; close to 71,200 papers). The ERA is highly specialised in the Humanities, but its scientific impact does not quite reach the world level. Twelve of the top 25 universities based on the size of their scientific output are located in the UK. The Netherlands and Spain follow, both with three universities in this selection. Overall, all 25 universities are specialised in the Humanities. Three British universities, namely University of Oxford, the

University of Cambridge and University College London, are among the top performing universities, with large outputs as well as high SIs and impact scores. Stockholm University and the University of Bristol also perform strongly. Although they have smaller outputs, they have strong SIs, as well as some of the highest impact scores.

- **Security:** Close to 37,500 publications relevant to Security are indexed in the Scopus database. The ERA contributed to about 30% of these publications (including all types of organisations; 11,100 FRAC). The ERA is not specialised in Security, but it has a high scientific impact when compared to the world. Among the 25 universities with the highest number of publications in this area, British and Italian universities predominate, with the UK and Italy each represented by four universities. Greece and Norway follow with three universities each. Overall, given the size of the area of Security, only a few universities have sizeable outputs in this field. Among these, the University of Stavanger stands out as being massively specialised, with an SI of 30, much higher than any other university. However, with the exception of ARIF, it has a very low scientific impact.

Key Findings—Comparative Analysis of ERA and Non-ERA Universities (see Section 4)

Section 4 compares the scientific performance of the 50 ERA universities that publish the most with that of the 50 most active non-ERA universities. This comparison is performed for all research fields in general (i.e., based on a university's total production, as indexed in Scopus for the 2007–2011 period).

- Overall, the most actively publishing non-ERA universities appear to have an edge over those within the ERA; they generally have larger outputs and slightly higher impact scores, according to their average amount of received citations (ARC), the quality of the journals in which they published (ARIF) and their share of highly cited publications.
- University hospitals in the ERA generally contribute a larger share of the total output of their corresponding universities compared to those outside of the ERA.
- Another difference between ERA and non-ERA universities relates to the importance of gaps in the performance of organisations within each of these groups. For instance, existing differences in the performances of non-ERA universities are slightly more pronounced than those among ERA universities; in other words, there seems to be slightly less inequality in the performance of ERA universities compared to non-ERA universities.

Research Output:

- Among the 50 most actively publishing non-ERA universities, US organisations outnumber those of any other country, accounting for more than half (27) of the strongest universities. With seven universities in this ranking, China is the second best-performing country in terms of number of universities among the 50 most active outside of the ERA. Canada and Japan come next, each with four universities. In total, the 50 most-published non-ERA universities are located in eight countries. With universities from 14 different countries within the top 50 most active, the most active universities are more evenly distributed within the ERA. There is nevertheless some degree of concentration, with 30% (14) of the 50 most published ERA universities located in the UK. Overall, if a ranking of the top 50 universities in the world is produced (ERA and non-ERA universities combined), 42 are from non-ERA countries and the remaining eight from ERA countries. Of these eight universities, five are in the UK and one each in France, Belgium and Denmark.
- At the non-ERA level, Harvard University, the University of Toronto and the University of Tokyo are ranked on top regarding their number of publications (based on full counting). Within the ERA the top four positions are occupied by British universities. UCL ranks first,

followed by the University of Cambridge in second place and the University of Oxford and Imperial College London tied in third place. The fifth place is occupied by an organisation from France: Pierre and Marie Curie University.

- Among non-ERA universities, Harvard University has the highest share of publications with contributions from affiliated hospitals (57%). Duke University is second (41%) and is followed by the University of Toronto (38%). Generally, the share of a university's output with contributions from affiliated hospitals is larger within the ERA than outside of the ERA—the median contribution from university hospitals among the 50 most-publishing ERA universities stands at 26% and is, in fact, twice as high as in non-ERA universities.

Scientific Impact:

- In terms of observed scientific impact, US universities clearly dominate among the 50 most actively publishing non-ERA universities, occupying the first 20 positions based on ARC with MIT, Harvard and Stanford University on top. At the ERA level, universities from the UK dominate, with seven ranking in the top 20 for ARC. The Netherlands is the second most highly cited country, with six universities in the top 20. Among the 50 most published ERA universities, all except one (98%) score above the world level with respect to ARC, whereas this is the case for only 86% of non-ERA universities. In fact, there is less variation among the scores of ERA universities than among non-ERA ones. Nevertheless, the ARC of universities is generally comparable between the two groups of universities, with the median ARC being only slightly higher for non-ERA universities. Furthermore, it should be noted that six of the seven universities scoring at or below the world level for ARC are Chinese universities.
- In terms of scientific quality at the non-ERA level, the US is again leading, with its universities occupying the top 21 positions based on ARIF. Ten universities in the UK rank among the top 20 ERA universities for ARIF. Among the 50 most actively publishing non-ERA universities, Harvard University is first, followed by MIT and Stanford University. The organisation with the highest ARIF among the 50 most actively publishing ERA universities is the University of Oxford; in a worldwide ranking it would be in 14th place. Although there is slightly less variation in the ARIF scores of ERA universities than among non-ERA ones, it should be noted that the ARIF of universities is in general comparable between the two groups, with the median score being slightly higher for non-ERA universities.
- With respect to the proportion of universities' papers that fall within the top 10% most-cited publications in the world, US universities clearly dominate, as they occupy the top 24 of 50 positions. MIT ranks first among the most published non-ERA universities, with 27% of its papers in the top 10% most-cited publications. It is followed by Harvard (25%) and three institutions in California, namely the University of California at San Francisco (25%), Stanford University (24%) and the University of California at Berkeley (24%). Among ERA universities, ETH Zurich obtains the highest score, with 22% of its papers in the top 10% most-cited publications; this score brings it to 14th place overall when pooling the most published ERA universities with the most actively publishing non-ERA universities. As observed for the ARC and ARIF, the median percentage of highly cited papers is slightly higher for non-ERA (18%) than ERA universities (17%).

Tables

Figures

Acronyms

ARC	Average of Relative Citations
ARIF	Average of Relative Impact Factors
CPEP	Co-Publications with at Least One External Partner
CPEP (Acad or RPO)	Co-Publications with at Least One External Academic or RPO Partner
CPEP (Company)	Co-Publications with at Least One External Academic or RPO Partner
CPEP Foreign	Co-Publications with at Least one External Partner Abroad
DG Research	Research Directorate-General
EFTA	European Free Trade Association
ERA	European Research Area
EU	European Union
EU-27	The 27 member countries of the European Union
EIUP	Exclusively Intra-University Publications
FP7	Seventh Framework Programme of the European Community for Research, Technological Development (2007 to 2013)
FRAC	Fractional Counting
FULL	Full Counting
GERD	Gross Expenditures on R&D
GI	Growth Index
GIS	Geographic Information System
IF	Impact Factor
NACE	Nomenclature Générale des Activités Économiques dans les Communautés Européennes (Industrial Sector Classification)
NSE	Natural Sciences and Engineering
NSF	United States National Science Foundation
NUTS2	Eurostat Nomenclature of Territorial Units for Statistics (Level 2)
PAI	Probabilistic Affinity Index
R&D	Research and Development
RC	Relative Citations
RIF	Relative Impact Factor
RFP	Request for Proposal
RPO	Non-University Research-Performing Organisations
RTD	Research and Technological Development
S&T	Science and Technology
SI	Specialisation Index
SSH	Social Sciences and Humanities
STC	Science, Technology and Competitiveness
STI	Science, Technology and Innovation
UCP	Unclassified Co-Publications

1 INTRODUCTION

This report provides a bibliometric assessment of the scientific performance of European universities based on their publication profiles. The report is part of a suite of six bibliometric reports aimed at supporting the European Commission's evidence-based monitoring of progress towards the objectives set forth in the Lisbon framework and the post-Lisbon Strategy for the European Research Area (ERA), particularly the Seventh Framework Programme for Research and Technological Development (FP7). The suite of reports provides a descriptive analysis of the scientific performance and collaboration patterns of countries, NUTS2 regions, universities, Research-Performing Organisations (RPOs) and companies with an emphasis on Europe.[1] It also provides a deeper analysis of the linkages between R&D inputs and outputs from an econometric perspective, the aim of which is to expand the knowledge base on the factors driving the scientific productivity (i.e., the efficiency with which research inputs are converted into research outputs) of nations and regions.[2]

The universities presented in this report are part of a selection of 303 ERA universities—that is, universities located in any of the following countries: EU-27 countries, candidate EU countries, EFTA countries and Israel. They were selected with a view to providing information on the universities within the ERA that publish the most scholarly literature while ensuring comprehensive coverage of all countries within the ERA. Consequently, up to a maximum of 20 universities were selected in each country on the basis of their number of published papers. Thus, while the resulting selection of 303 universities is representative of all countries in the ERA, it does not constitute a listing of the 300 most-publishing universities within the ERA. For instance, although the university ranking twenty-first in Germany likely published more papers than the university ranking first in Liechtenstein, it was not retained in order to ensure a representative sample of leading universities across countries. Table I presents the distribution of the number of most actively publishing universities retained in each country, as determined by Science-Metrix's analysts and European Commission officials. Note that a university's publication output includes the publications of all institutions under its umbrella. Also, because of tied ranks, 303 universities are included instead of 300.

The production profiles provided in this report are based on bibliometric indicators, which serve to measure, for example, the total number of publications of universities, their scientific specialisation in diverse areas of scientific enquiry (i.e., main S&T fields and FP7 thematic

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[1] Delivered output at this time: Campbell, D., Lefebvre, C., Picard-Aitken, M., Côté, G., Ventimiglia, A., Roberge, G., and Archambault, É. (2013). *Analysis and Regular Update of Bibliometric Indicators: Country and Regional Scientific Production Profiles (Analytical Report 2.3.1).* Report prepared by Science-Metrix for the European Commission Directorate-General for Research, 192 pages.

[2] Delivered outputs at this time: Campbell, D., Caruso, J., and Archambault, É. (2012). *Analysis and Regular Update of Bibliometric Indicators: Cross-Cutting Analysis of Scientific Output vs. Other STI Indicators (Analytical Report 2.3.2)*. Report prepared by Science-Metrix for the European Commission Directorate-General for Research, 67 pages.

Campbell, D., Caruso, J., and Archambault, É. (2012). Cross-Cutting Analysis of Scientific Output versus Other STI Indicators. *Conference Proceedings of the 17th International Conference on Science and Technology Indicators (STI)*, 5-8 September2012, Montréal, Québec, Canada.

priorities), the scientific impact of their publications and their collaboration patterns. In this way, a meaningful comparison of the scientific performance of universities based on scholarly publications is provided.

The broad comparative analysis in the present report comprises detailed datasets for subsets of the selected 303 universities within the ERA. These subsets consist of the 25 most actively publishing universities within each S&T field and FP7 thematic priority. Please note that the selection of the 303 ERA universities is the same, irrespective of the area of scientific enquiry. Only the selection of the top 25 universities within each area varies. The report also presents subsets of the 100 most actively publishing universities in Europe and outside of Europe (i.e., for the 50 most-publishing ERA and non-ERA universities). The complete datasets for the 303 selected ERA universities and the 100 most actively publishing ERA and non-ERA universities are available in a companion Excel data book to this report.

Table I Number of most actively publishing universities, by country

Country Code	Country Name	#	Country Code	Country Name	#
DE	Germany	20	PT	Portugal	10
FR	France	20	RO	Romania	10
UK	United Kingdom	20	SE	Sweden	10
IT	Italy	20	TR	Turkey	10
AT	Austria	10	HR	Croatia	5
BE	Belgium	10	IL	Israel	5
BG	Bulgaria	10	LT	Lithuania	5
CH	Switzerland	10	LV	Latvia	5
CZ	Czech Republic	10	SK	Slovakia	5
DK	Denmark	10	SI	Slovenia	4
EL	Greece	10	EE	Estonia	3
ES	Spain	10	MK	Macedonia	3
FI	Finland	10	IS	Iceland	2
HU	Hungary	10	CY	Cyprus	2
IE	Ireland	10	LI	Liechtenstein	2
NL	Netherlands	10	LU	Luxembourg	1
NO	Norway	10	MT	Malta	1
PL	Poland	10			

Source: Produced by Science-Metrix

A first version of the report, submitted in 2012, presented bibliometric information computed using Scopus—Elsevier's abstract and citation database of peer-reviewed literature—for the period from 2007 to 2010. This first report update provides the bibliometrics data for the period from 2007 to 2011. One subsequent annual update will follow, covering the period between 2007 and 2012. While this first update is similar to the first draft, the content to be included in the second update may differ from the first two reports in the series in order to better meet the time requirements of the Commission at the time of production. Note that data and maps on universities have been produced as part of the project in addition to those presented in this report and its companion Excel data book. The goal of the present report is to synthesize the information of relevance to Commission officials, since presenting all of the collected information would overwhelm the reader. The methods used in this study are presented in Section 6, based on documentation previously prepared and submitted to the DG Research.

Organisation of This Report

The analysis is organized under three main conceptual headings. The first and second sections focus on the collaboration patterns and scientific performance of European universities, while the third section compares the production of the leading ERA universities with that of leading non-ERA universities:

- **Collaboration behaviour of ERA universities:** Section 2 presents the collaboration network of the selected 303 ERA universities overall in Scopus, as well as maps of their numbers of publications and scientific impact on the network. It also analyses the co-publication patterns of the most actively publishing universities (i.e., top 25 organisations) among the selected 303 ERA universities by looking at their international collaboration rates, as well as their collaboration rates with other academic/RPO or private partners (i.e., companies) based on documents covered by Scopus.
- **Scientific production profiles of ERA universities:** Section 3 looks at the publication output, citations, impact and specialisation of a subset of the 303 selected ERA universities, overall in Scopus, by main research field and by FP7 thematic priority. A brief introduction presenting some of the key outliers among the 303 selected ERA universities with regard to each of the presented bibliometric indicators (the specialisation index in particular) is followed by a deeper analysis of the scientific performance of those universities that publish the most within each area (i.e., the top 25 organisations).
- **Comparative analysis of ERA and non-ERA universities:** Section 4 compares the publication output, citations and impact of the 50 most actively publishing European universities with that of the 50 non-ERA leading universities worldwide in Scopus as a whole.

2 UNIVERSITIES' COLLABORATION PATTERNS WITHIN THE ERA

This section first presents the collaboration network of the whole set of 303 ERA universities in Scopus to provide an overview of the composition of this sample. It also maps the number of publications and scientific impact of the selected universities in the network to provide a brief overview of the scientific performance of selected institutions. It subsequently analyses the co-publication patterns of the most actively publishing universities (i.e., top 25 organisations) among the selected 303 ERA universities by looking at their international collaboration rates as well as their collaboration rates with other academic/RPO or private partners (i.e., companies) in Scopus-covered documents.

2.1 COLLABORATION NETWORKS

Figure 1 and Figure 2 show the collaboration network of the selected 303 ERA universities. In these figures, each university is represented by a node in the network and identified using a numbered label that includes its country code. (The legend for universities is available in the Appendix.) Both networks are identical with the exception of the size of the nodes; in the first figure, the size of the nodes reflects the number of publications of the corresponding university based on fractional counting, and in the second figure it reflects the university's scientific impact based on the impact factors of the journals it published in (Average of Relative Impact Factor [ARIF]; see Section 6 for details on these indicators). Note that this latter measure is also used as a proxy for the "quality" of research performed by an entity. Of the 303 selected universities, only those with at least 30 papers for which a relative impact factor could be calculated are presented in the figures. The width of links in both figures is proportional to the number of co-publications between any pair of universities, and only those links representing at least 300 co-publications are shown.

The first characteristic of the collaboration network of the 303 ERA universities that strikes the eye is the strong clustering of institutions according to their geographic location (Figure 1 and Figure 2). This does not come as a surprise, since the physical and/or societal proximity of institutions tends to favour partnerships, resulting in some degree of isolation by distance. This is not to say that there is no integration of countries within the ERA but simply that the strength of inter-institutional collaboration is usually greater within than between countries. For instance, a previous study that is part of the same suite of reports as the current document has shown that the integration of the collaboration network of ERA countries increased during the 2008–2011 period compared to the 2004–2007 period in the sciences in general (i.e., overall in Scopus), as well as in various FP7 thematic priorities.[3]

[3] Campbell, D., Roberge, G., Haustein, S., and Archambault, É. (2011). *Analysis and Regular Update of Bibliometric Indicators: Intra-European Cooperation Compared to International Collaboration of the ERA Countries (Analytical Report 2.3.6).* Report prepared by Science-Metrix for the European Commission Directorate-General for Research, 166 pages.

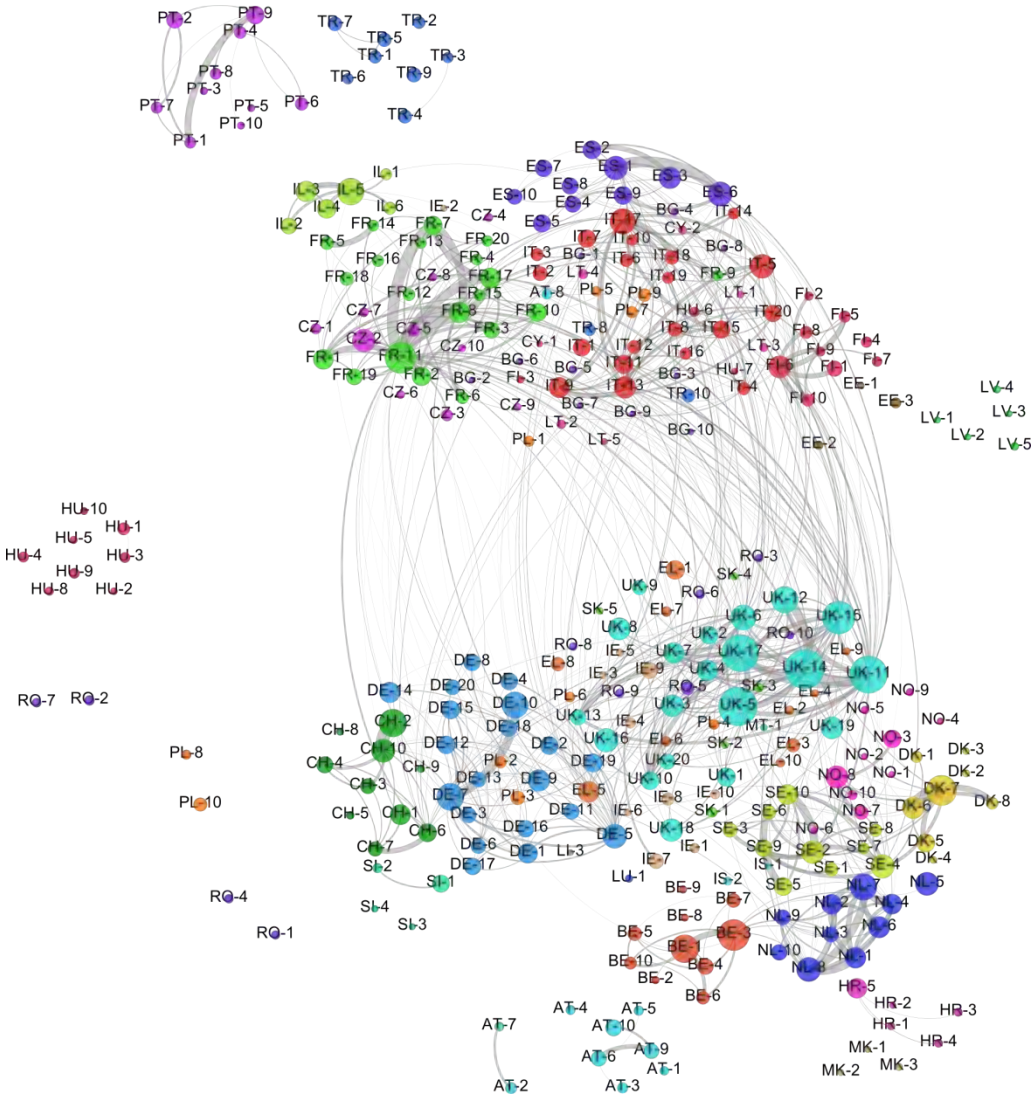

Figure 1 Mapping of the scientific output (fractional counting) of organisations within the collaboration network of the 303 selected ERA universities in Scopus (2007–2011)

Note: Each university is represented by a node in the network and identified using a label that includes its country code. (The legend for universities is available in the Appendix.) Of the 303 selected universities, only those with at least 30 papers for which a relative impact factor could be calculated are presented in the network. The size of nodes is proportional to the number of publications (based on fractional counting) of universities. The width of links is proportional to the number of co-publications between any pair of universities. Only links representing at least 300 co-publications are shown.

Source: Computed by Science-Metrix using Scopus

To study the structure of the network, four indicators were analysed to assess the importance of each university within the network:

- the degree of a node; i.e., the number of distinct nodes to which it is connected (i.e., not taking into account the number of co-authored papers with each university);
- the weighted degree of a node, which is equal to the sum of all bilateral pairs (i.e., taking into account the total number of co-authored papers with all other universities in the network);
- the PageRank, an analogous measure to the eigenvector centrality of a node, which measures the relative importance of a node within the network without taking into account

the number of co-authored papers with each university (i.e., as if all pairs of universities within the network were equally important in maintaining the structure of the network); and

- the weighted PageRank, an analogous measure to the weighted eigenvector centrality of a node, which measures the relative importance of a node within the network, taking the number of co-authored papers into account.

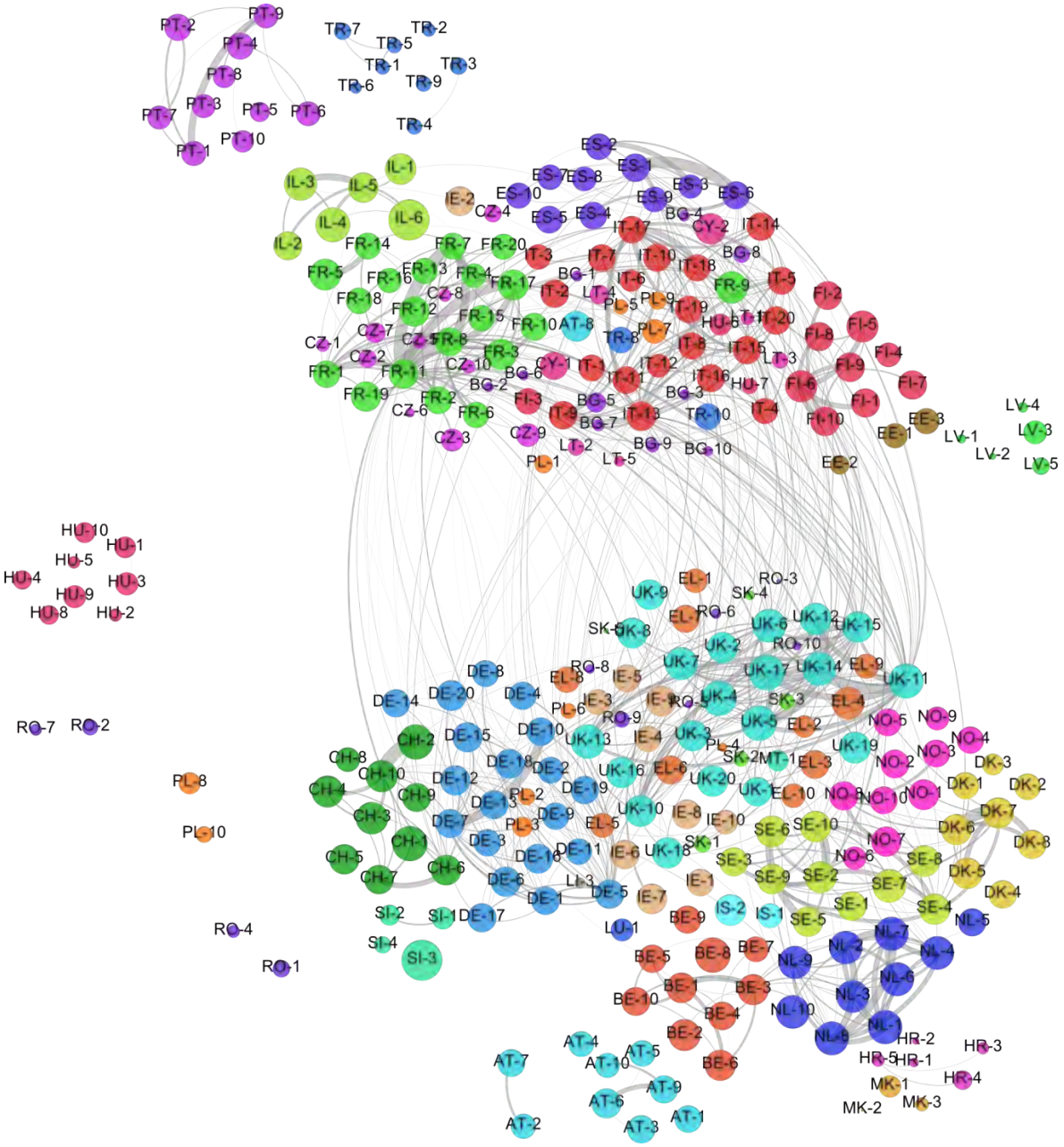

Figure 2 Mapping of the scientific impact (ARIF) of organisations within the collaboration network of the 303 selected ERA universities in Scopus (2007–2011)

Note: Each university is represented by a node in the network and identified using a label that includes its country code. (The legend for universities is available in the Appendix.) Of the 303 selected universities, only those with at least 30 papers for which a relative impact factor could be calculated are presented in the network. The size of nodes is proportional to the Average of Relative Impact Factors (ARIF) of universities. The width of links is proportional to the number of co-publications between any pair of universities. Only links representing at least 300 co-publications are shown.

Source: Computed by Science-Metrix using Scopus

Although the use of weighted indicators of the importance of nodes within the network is a logical measure as it takes all available information into account, the use of unweighted indicators remains pertinent in identifying smaller institutions with a diversified pool of partners. Based on the analysis of the performance of a country's universities (i.e., the sum of a country's universities' scores) combining all four indicators, the most central (or key) countries within the network of ERA universities are: the UK, followed by Germany, France and Italy—all three with similar scores—followed by the Netherlands, Sweden and Spain. Similar results are obtained using the average of a country's universities' scores. Indeed, the same set of countries rank at the top; only their relative positioning changes. In this case, the UK leads again and is followed by the Netherlands, Germany, then France, Italy and Sweden—all three with similar scores—and Spain. This also corroborates the finding, made in a previous study performed at the level of countries, that the most central countries in the scientific collaboration network of the ERA are, in descending order: Germany, the UK, France, Italy, Spain and the Netherlands.[4] The slight differences in these rankings between the current study and this preceding study can be attributed to the different timeframes used (2007–2011 for universities vs. 2007–2009 for countries), as well as to the fact that the current study considers only the fraction of a country's publications that is attributable to its most-publishing universities.

At the institutional level, three universities rank in the top 10 with respect to each of the four indicators of network importance described above. In descending order of their number of publications based on fractional counting (i.e., of the size of nodes in Figure 1), they include the Imperial College London (UK-11, ranked third with nearly 19,000 papers), the University of Manchester (UK-15, ranked fifth with approximately 16,000 papers) and Pierre and Marie Curie University (FR-11, ranked sixth with about 15,000 papers). University College London (UK-14, ranked first with 20,000 papers), the University of Cambridge (UK-5, ranked second with nearly 20,000 papers) and the University of Oxford (UK-17, ranked fourth with nearly 19,000 papers), which also rank within the top six for the size of their output measured using fractional counting, are other central players in the network and rank among the top 10 based on their weighted degree scores (except the University of Cambridge, which ranks 11th). These six universities also lead in terms of the size of their scientific production when measured using full counting (see Section 3.1). Four smaller institutions that stand out for the diversity of their partners in the network when using the two unweighted indicators (i.e., they make the top 10 based on both indicators) include the University of Helsinki (FI-6, with about 9,700 papers), Lund University (SE-4, with about 10,500 papers), the University of Oslo (NO-8, with about 9,700 papers) and the Charles University in Prague (CZ-2, with about 10,000 papers). The University of Helsinki and Lund University occupy the first and second place respectively based on these two indicators.

[4] Delivered output at this time: Campbell, D., Lefebvre, C., Picard-Aitken, M., Côté, G., Ventimiglia, A., Roberge, G., and Archambault, É. (2013). *Analysis and Regular Update of Bibliometric Indicators: Country and Regional Scientific Production Profiles (Analytical Report 2.3.1).* Report prepared by Science-Metrix for the European Commission Directorate-General for Research, 192 pages.

Table II Co-publication patterns of the selected 25 ERA universities in Scopus (2007–2011)

University	CC	Pubs (FULL)	EIUP (%)	UCP (%)	CPEP (%)	CPEP (Foreign;%)	CPEP (Acad or RPO; %)	CPEP (Company; %)
Univ of London, Univ Coll London	GB	38,979	26%	0.2%	74%	49%	70%	5.3%
Univ of London, Imperial Coll London	GB	36,244	27%	0.2%	73%	52%	68%	8.2%
University of Cambridge	GB	36,240	29%	0.1%	71%	52%	67%	7.3%
University of Oxford	GB	36,159	27%	0.1%	73%	54%	70%	6.2%
Pierre and Marie Curie University	FR	33,360	19%	0.1%	81%	47%	78%	4.0%
University of Manchester	GB	28,612	32%	0.1%	68%	44%	62%	7.1%
Katholieke Universiteit Leuven	BE	27,337	28%	0.2%	72%	54%	66%	7.0%
University of Copenhagen	DK	27,054	28%	0.7%	72%	53%	66%	8.1%
Ludwig Maximilian University of Munich	DE	24,253	27%	0.2%	73%	46%	69%	6.9%
ETHZ-Swiss Federal Inst of Tech Zurich	CH	24,005	27%	0.1%	73%	60%	68%	9.3%
Utrecht University	NL	24,000	23%	0.2%	76%	45%	72%	6.0%
Univ of London, King's Coll London	GB	22,925	29%	0.2%	71%	44%	67%	5.4%
UNIROMA1 - Sapienza University of Rom	IT	22,886	24%	0.8%	75%	38%	71%	4.2%
Ghent University	BE	22,125	32%	0.2%	68%	48%	62%	6.4%
Technical University Munich	DE	21,928	30%	0.1%	70%	42%	64%	10.2%
University of Barcelona	ES	21,899	24%	0.3%	76%	44%	72%	5.1%
University of Edinburgh	GB	21,760	29%	0.1%	71%	49%	67%	5.5%
UvA - University of Amsterdam	NL	21,665	23%	0.2%	76%	47%	72%	5.5%
Heidelberg University	DE	21,308	25%	0.1%	75%	46%	72%	6.7%
Karolinska Institute	SE	20,963	20%	0.1%	80%	57%	76%	8.2%
Autonomous University of Barcelona	ES	20,594	25%	0.3%	74%	42%	69%	5.5%
Tel Aviv University	IL	20,511	36%	0.3%	64%	41%	60%	5.5%
University of Zurich	CH	20,137	26%	0.1%	74%	58%	70%	6.3%
University of Paris XI	FR	20,015	16%	0.1%	84%	50%	81%	4.5%
Paris Diderot University	FR	19,843	22%	0.1%	78%	45%	76%	5.0%

Note: EIUP (%) = % of exclusively intra-university publications; UCP (%) = % of unclassified co-publications; CPEP (%) = % of publications co-authored with at least one external partner; CPEP (Foreign; %) = % of publications co-authored with at least one external partner abroad; CPEP (Acad or RPO; %) = % of publications co-authored with at least one external partner in the academic or RPO sector; CPEP (Company; %) = % of publications co-authored with at least one external partner from the private sector. The sum across EIUP, UCP and CPEP equals 100% of publications (FULL), as they are mutually exclusive categories. The sum across the remaining indicators does not equal 100% of CPEP, as they are not mutually exclusive categories.

Source: Computed by Science-Metrix using Scopus

In terms of the impact (or journal "quality") of their research output as measured indirectly using the impact factor of the journals in which their research was published (Figure 2), the universities that stand out in the network are the Weizmann Institute of Science (IL-6) and the University Nova Gorica (SI-3) with, respectively, ARIFs of 1.67 and 1.66 (Figure 2). As will be seen in Section 3.1, the latter also stands out for the observed impact of its scientific publications, ranking first with an ARC of 2.38. They are followed by two universities in the UK, namely the University of Oxford (UK-17) and the University of Cambridge (UK-5).

Table II presents data on the co-publication patterns of a subset of the selected 303 ERA universities. This subset includes the 25 ERA universities within this initial selection that published the most in the sciences in general (i.e., as indexed in Scopus) during the 2007–2011 period (based on full counting). Between 16% and 36% of the publications of these universities were authored exclusively by their own researchers (i.e., percentage of exclusively intra-university publications); conversely, between 64% and 84% of their publications are the result of inter-institutional co-authorship (i.e., percentage of publications co-authored with at least one external partner). The universities that collaborated the most are the University of Paris XI (84% of papers involving inter-institutional co-authorship), Pierre and Marie Curie University (81%), the Karolinska Institute (79%), Paris Diderot University (78%) and Utrecht University (76%). The top

institutions in this respect are not the same as the most central institutions in the above network; this is because this indicator takes into account collaborations worldwide, not just collaborations within the network of the selected 303 ERA universities.

In terms of their absolute propensity to co-author publications with foreign partners, the two leading institutions among the selected 25 universities are from Switzerland. They are ETH Zurich, with an international collaboration rate of 60%, and the University of Zurich, with a collaboration rate of 58%. They are followed by the Karolinska Institute (57%) and the University of Oxford (54%). In terms of inter-sectoral collaboration, the institutions with the highest collaboration rate with other academic and/or research-performing organisations (RPOs) are very similar to those with the highest inter-institutional collaboration rate. This is not surprising, as universities and RPOs together account for most of the world's scientific production in the form of peer-reviewed scientific articles. The University of Paris XI and Pierre and Marie Curie University are again first and second, with 81% and 78% of their articles, respectively, published in collaboration with at least one external partner in the academic or RPO sector. The Paris Diderot University (third) switched places with the Karolinska Institute, which is now in fourth place, and Heidelberg University ranks fifth. In terms of collaboration with the private sector, the leading universities are, as expected, technical universities. Among the most-publishing universities the leaders are Technical University Munich (10.2%), ETH Zurich (9.3%), the Karolinska Institute (8.2%), Imperial College London (8.2%) and the University of Copenhagen (8.1%). Universities outside the selection of the top 25 that publish more than 15% of their output with the private sector include Chalmers University of Technology (16.5%), Tampere University of Technology (16.0%), Graz University of Technology (15.7%) and Johannes Kepler University of Linz (15.5%).

In summary, the Karolinska Institute stands out for its inter-institutional, international and inter-sectoral (either academic/RPOs or private sector) collaboration rates. ETH Zurich stands out for both its international and inter-sectoral (with the private sector) collaboration rates.

3 SCIENTIFIC PRODUCTION PROFILES OF UNIVERSITIES

This section focuses on the scientific performance of ERA universities. Data on the scientific production profiles of these universities is presented overall in Scopus (Section 3.1) by main research field as per Science-Metrix's ontology[5] (Section 3.2) and by FP7 thematic priorities (Section 3.3). In each of these sections, only the 25 universities that published the most (based on full counting) among the selected 303 universities are presented. Complete profiles of the performance of the 303 selected universities are provided in a companion Excel data book.

Six bibliometric indicators are used to characterise the scientific performance of universities:

- the number of publications, based on full (FULL) counting;
- the number of publications, based on fractional (FRAC) counting;
- the percentage of a university's publications (FRAC) with at least one author from the university's affiliated hospitals (Contribution by University Hospitals);
- the specialisation index (SI), based on FRAC;
- the average of relative citations (ARC), based on full counting of publications and citations;
- the average of relative impact factors (ARIF), based on full counting of publications and citations; and
- the percentage of a university's papers in the top 10% most-cited publications, based on fractional counting of publications and on full counting of citations.

The number of publications reflects the quantity of research output and thus the formal scholarly production of an entity, in this case of a university. Full counting of publications values each document authored by a researcher affiliated with a particular university once for that university regardless of the number of collaborators. Fractional counting divides a publication by the number of co-authors or collaborating institutions and assigns each collaborator an equal fraction of an article. The latter method normalises for differences in collaboration patterns between fields.

The specialisation index (SI) is an indicator of the relative intensity of an entity's activity in a given research area relative to a reference entity (i.e., the world) in the same area. It is equal to the ratio of the concentration of a university's output in a given area to the same ratio for the world. If the university's concentration in a given area is higher than that of the world in the same area, the SI is above 1 and the university is said to be specialised in this area. If the opposite is true, the SI is below 1 and the university is not specialised in this area.

The ARC, the ARIF and the percentage of a university's papers in the top 10% most-cited publications are all based on counts of citations to publications. Thus, they all measure some aspects of the influence/impact of a university's peer-reviewed scientific papers on the research community. By looking at the average of the standardised citation scores of a university's publications, the ARC aims to provide an indication of the overall scientific impact of a university's scientific output. The ARIF also focuses on the average (or overall) scientific impact of a university's publications. However, the ARIF is said to provide an *indirect* measure of the impact of a university's articles because it is based on the average citation scores of the journals in which its papers are published and not on a direct count of its papers' citations (as is the case for the

[5] http://www.science-metrix.com/OntologyExplorer/#

ARC, which in contrast provides a direct measure of scientific impact). When the law of large numbers is respected, the ARIF also constitutes a good proxy for the "quality" of a university's scientific output. Indeed, as the most-cited journals generally have more restrictive inclusion policies, they generally publish higher quality work; as journals are more cited, more researchers want to publish in them and more papers are submitted, resulting in a higher rejection rate. Finally, the percentage of papers in the top 10% most-cited publications provides an indication of the contribution of an entity to the production of the most influential papers. In this regard, it can be viewed as a measure of scientific "excellence".

Citations were counted from the year of publication to year + 3 in computing the ARC and the percentage of an entity's publications in the top 10% most-cited publications. Thus, these two indicators were only computed for two years (i.e., 2007 and 2008), as publications in 2009, 2010 and 2011 have incomplete citation windows. As a result, the size of universities' populations of publications was sometimes too small to allow for the computation of these measures of scientific impact. However, when compared to the first version of the report, for which the indicator could be computed only for one year (2007), this first update report contains ARC data for many more universities. In addition, this limitation is in part compensated for by the use of the ARIF, which can be computed up to the most recent year available (i.e., 2011).

Tables presented in this section are limited to the 25 most-publishing universities based on full counting. In all tables, the SI, ARC, ARIF and percentage of papers in the top 10% most-cited publications are presented alongside a colour-coded icon, which shows whether the entity performs above (green arrow), near (yellow horizontal line) or below (red arrow) the world level. For the SI, ARC and ARIF, the world level is equal to one. For the percentage of papers in the top 10% most-cited publications, it is equal to 10% (for more information on indicators, see Section 6.1; for more information on dashboard graphs, see Section 6.2.1).

Efforts were made to present the results in a systematic matter throughout this section. As such, each theme (main theme or FP7 theme) is consistently described starting with the performance of ERA countries for all indicators (publications, specialisation and impact). The 25 most-publishing universities are then presented, highlighting the top performers for each indicator. A text box was added to present the top-performing universities when analysing all indicators together. Finally, specialisation and scientific impact indicators are presented for the extended list of 303 universities, highlighting the universities with scores higher than the first place among the list of 25 most-publishing universities.

3.1 OVERALL IN SCOPUS

Between 2007 and 2011, the ERA contributed to approximately one-third of the world's scientific publications in Scopus (Table III). Note that the values shown in the table for the world and total ERA encompass all publications in the database (as opposed to publications only produced by universities in their respective areas).

Table III Scientific performance for the selected 25 ERA universities in Scopus (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	ARC	ARIF	Top 10 (%)
World		9,091,464	9,091,464	n.c.	1.00	1.00	10.0
Total ERA		3,330,266	2,928,919	n.c.	1.11	1.08	11.4
Univ of London, Univ Coll London	GB	38,979	20,053	21	1.70	1.43	19.6
Univ of London, Imperial Coll London	GB	36,244	18,767	31	1.86	1.46	21.0
University of Cambridge	GB	36,240	19,688	14	1.85	1.48	20.9
University of Oxford	GB	36,159	18,654	16	1.94	1.50	21.7
Pierre and Marie Curie University	FR	33,360	15,044	32	1.47	1.28	15.8
University of Manchester	GB	28,612	16,110	15	1.59	1.33	15.7
Katholieke Universiteit Leuven	BE	27,337	14,974	16	1.70	1.32	18.1
University of Copenhagen	DK	27,054	14,486	43	1.76	1.32	19.1
Ludwig Maximilian University of Munich	DE	24,253	12,624	23	1.68	1.25	18.3
ETHZ-Swiss Federal Inst of Tech Zurich	CH	24,005	13,008	0	1.93	1.47	22.0
Utrecht University	NL	24,000	12,374	40	1.74	1.42	19.4
Univ of London, King's Coll London	GB	22,925	12,330	36	1.67	1.35	18.4
UNIROMA1 - Sapienza University of Rome	IT	22,886	11,683	9	1.30	1.20	12.8
Ghent University	BE	22,125	13,105	13	1.60	1.30	17.9
Technical University Munich	DE	21,928	12,060	17	1.50	1.23	15.8
University of Barcelona	ES	21,899	10,871	35	1.53	1.21	15.5
University of Edinburgh	GB	21,760	11,547	15	1.69	1.42	19.6
UvA - University of Amsterdam	NL	21,665	10,803	46	1.80	1.42	19.6
Heidelberg University	DE	21,308	10,762	29	1.55	1.26	16.9
Karolinska Institute	SE	20,963	10,170	32	1.63	1.35	16.6
Autonomous University of Barcelona	ES	20,594	10,535	37	1.42	1.23	14.3
Tel Aviv University	IL	20,511	12,363	31	1.32	1.29	13.4
University of Zurich	CH	20,137	10,362	36	1.73	1.36	20.3
University of Paris XI	FR	20,015	8,593	17	1.58	1.32	16.9
Paris Diderot University	FR	19,843	8,957	47	1.57	1.25	15.7

Note: Number of publications based on full (FULL) and fractional (FRAC) counts, percentage of contribution by affiliated university hospitals, ARC, ARIF and percentage in the top 10% most-cited publications (Top 10 [%]) for the 25 most active ERA universities based on publications during the 2007–2011 period. The ARC and % in top 10% most-cited publications are computed for 2007 to 2008 publications only due to incomplete citation windows for more recent publications. A university's performance in comparison to the world level is indicated by green (above), yellow (similar to) and red (below the world average) colouring for ARC, ARIF and percentage of top 10% most-cited publications.

Source: Computed by Science-Metrix using Scopus

Based on full counting of publications, five universities published more than 30,000 scientific papers over the period, four out of the five leading universities being from the UK.[6] This does not come as a surprise, as it was shown at the country level that the UK was the most actively

[6] This ranking of ERA universities remains roughly unchanged when counting publications using fractional counting.

publishing ERA member based on both full and fractional counting during the 2000–2010 period.[7] University College London (UCL), Imperial College, the University of Cambridge and the University of Oxford are the four most actively publishing universities, all with more than 36,000 published papers (FULL). The second to fourth positions are very close together, the difference between them being less than 100 articles. Pierre and Marie Curie University in France is the only non-UK university in the top five most actively publishing universities, with more than 33,000 published articles. Germany and France, which rank second and third behind the UK in terms of publication activity in Scopus (2000–2010), each have three universities ranking in the 25 most actively publishing universities among the 303 selected universities, one more than for the 2007-2010 period. On the other hand, each of these countries has two very larg Level 1 Research-Performing Organisations (RPOs) within the five most actively publishing ERA RPOs (data not shown; a report is underway for ERA RPOs). In fact, RPOs play a key role in the scientific production of these two countries. On average, the contribution of affiliated hospitals to the publication output of the 25 most actively publishing universities is approximately 26%. The universities with the greatest contributions by affiliated hospitals are Paris Diderot University (47%), the University of Amsterdam (46%), the University of Copenhagen (43%) and Utrecht University (40%). Only one university among the selected 25 universities, ETH Zurich, has no affiliated hospital, which can be explained by its technical orientation.

Three indicators measuring a slightly different dimension of scientific impact are also presented in Table III: the ARC, the ARIF and the percentage of an entity's publications in the top 10% most-cited publications. Not surprisingly, the performance of a university across these three indicators is usually similar. Globally the scientific impact of the ERA is slightly above or equivalent to the world scientific impact with ARC and ARIF scores of 1.11 and 1.08, respectively, as well as 11.4% of papers in the top 10% most-cited publications. The 25 most actively publishing universities presented in Table III always score above the world level for these three indicators. Within the 25 institutions shown, the University of Oxford, ETH Zurich and the University of Cambridge are consistently positioned in the top five for these indicators.

Among the 25 most-publishing universities, the University of Oxford and ETH Zurich are in first and second position in terms of ARC with scores above 1.9 (1.94 and 1.93). Imperial College London, the University of Cambridge and the University of Amsterdam have similarly high ARC scores between 1.8 and 1.9. The University of Oxford, the University of Cambridge, ETH Zurich, Imperial College London and UCL compose the top five for the journal-based impact indicator (ARIFs between 1.43 and 1.5). Among this top 25, the five universities with the highest proportion of their articles among the top 10% most-cited publications are (from the first to fifth) ETH Zurich (22%), the University of Oxford (21.7%), Imperial College London (21%), the University of Cambridge (20.9%), and the University of Zurich (20.3%).

[7] Delivered output at this time: Campbell, D., Lefebvre, C., Picard-Aitken, M., Côté, G., Ventimiglia, A., Roberge, G., and Archambault, É. (2013). *Analysis and Regular Update of Bibliometric Indicators: Country and Regional Scientific Production Profiles (Analytical Report 2.3.1).* Report prepared by Science-Metrix for the European Commission Directorate-General for Research, 192 pages.

Of the 303 ERA universities examined, about two-thirds have an ARC score above the world level (higher than 1.1), indicating that their publications are, on average, cited at least 10% more frequently than the average world paper. Eighty-five universities have publications that are, on average, cited 50% more often than the average world paper (ARC higher than or equal to 1.5). Even though it does not make the top 25 for the size of its scientific contribution, the University of Nova Gorica in Slovenia and EPFL are worthy of mention—they rank first and second among the 303 selected ERA universities for their *observed* scientific impact (ARCs of 2.38 and 2.01). These universities are the only ones with ARC scores above 2. The Weizmann Institute of Science has the first rank in terms of ARIF (1.67). The University of Nova Gorica again stands out for the impact of its publications, being second for its impact based on the journals they published in (ARIF of 1.66). This not only indicates that the papers produced by this university are, on average, influential within the scientific community, but also that the "quality" of their publication venues is high. Finally, the University of Nova Gorica is first again with the highest percentage of publications in the top 10% most-cited publications (24.6%). EPFL is second, just above ETH Zurich, which, with more than 22% of its papers within the most frequently cited, is first among the 25 most-publishing universities. One hundred fifteen universities have 15% or more of their publications in the top 10% most-cited papers in Scopus.

3.2 MAIN FIELDS

Journal-based classifications of research outputs into scientific disciplines are widely used to analyse the relative strengths and weaknesses of entities (i.e., to identify the areas in which an entity performs better or worse relative to comparables) at various aggregation levels (e.g., countries, regions, institutions). In this study, Science-Metrix's ontology—which classifies scientific journals by research domain, field and subfield—is used.[8] This section presents the performance of the selected ERA universities by main field and is structured according to the ontology's highest aggregation level into the six following domains:

- Applied Sciences (Section 3.2.1);
- Arts & Humanities (Section 3.2.2);
- Economics & Social Sciences (Section 3.2.3);
- Health Sciences (Section 3.2.4);
- Natural Sciences (Section 3.2.5); and
- General Fields (Section 3.2.6).

Figure 3 provides a synthesis of the structure of the scientific system based on Science-Metrix's ontology. In this network, research fields are positioned closer to those fields with which they are the most connected, based on an analysis of citation inflows (i.e., citations to fields) and outflows (i.e., references from fields). Because references are chosen by the researchers themselves, the proximity of two fields, especially when both citation inflow and outflow are important between them, reflects the strong relevance of literature from both fields to researchers active in these

[8] Refer to the following paper for a detailed description of the approach used in building the Science-Metrix ontology: Archambault É., Caruso J., and Beauchesne O. (2011). Towards a Multilingual, Comprehensive and Open Scientific Journal Ontology, in Noyons, B., Ngulube, P. and Leta, *J. Proceedings of the 13th International Conference of the International Society for Scientometrics and Informetrics (ISSI)*, Durban, South Africa, pp 66-77.

areas. For example, Biomedical Research is located next to Clinical Medicine, and each of these fields appears to be highly relevant to the other given the presence of a strong citation outflow from Biomedical Research to Clinical Medicine (i.e., yellow link), as well as from Clinical Medicine to Biomedical Research (i.e., green link).

Note that in all tables presented in each of the sub-sections presented below (i.e., within Section 3.2), the values shown for the world and all of the ERA encompass all publications in the database as opposed to publications produced only by universities.

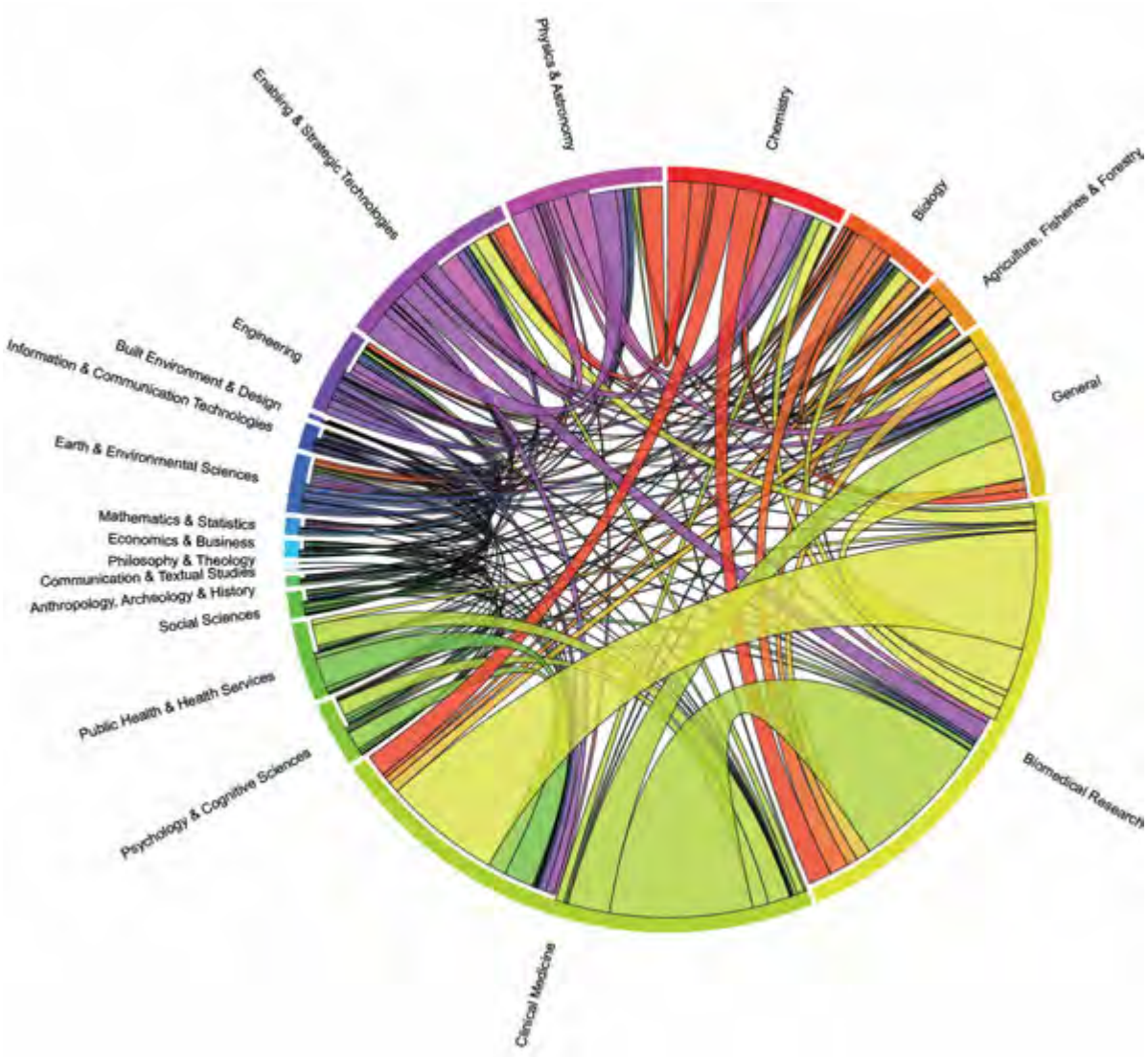

Figure 3 References from, and citations to, fields based on Science-Metrix's Ontology

Note: Each field cites other fields (outgoing links are coloured according to the source field), and each field is cited by other fields (incoming links are coloured according to the source field).

Source: Computed by Science-Metrix using Scopus

3.2.1 Applied Sciences

Agriculture, Fisheries & Forestry

As shown in Table XXVIII, close to 274,000 scientific articles were published in Food, Agriculture& Fisheries; close to 101,000 were in ERA countries, representing more than one-third of the world publication in this area (FRAC).[9] Taken all together, the research intensity of ERA countries in this priority area is equivalent to that of the world, but their scientific impact is slightly higher than the world level.

When bibliometric indicators are examined globally, WUR and the Swedish University of Agriculture Sciences are particularly strong performers in the area of Food, Agriculture & Fisheries. They are first and second in terms of scientific output, they are highly specialised and their impact is considerably higher than the world level.

At the university level, three universities within the selection of 25 universities are from Denmark and five countries have two institutions (Germany, Belgium, Switzerland, Italy and the Netherlands). Only seven ERA universities published more than 1,000 articles (FULL). Wageningen University and Research Centre (WUR) has the highest output among selected ERA universities based on both counting methods (2,500 FULL; 1,400 FRAC) and is followed by the Swedish University of Agriculture Sciences, Ghent University and the University of Copenhagen. Denmark has two universities among the five most actively publishing universities in this area. As expected, the contribution of hospitals to publications in Food, Agriculture & Fisheries research is very low. The relative intensity of research in this area is very high among the 25 most actively publishing universities presented in Table XXVIII, as indicated by an average SI of 4. The most specialised organisation is the Mendel University Brno (22.37); however, it has a very low scientific impact, as shown by a low ARC (0.35), a small ARIF (0.41) and a low percentage of articles within the top 10% most-cited publications (1.8%). Two other universities have specialisation indices higher than 10—the Swedish University of Agricultural Sciences (SI 12.28) and the Norwegian University of Life Sciences (10.8)—and only one university, Katholieke Universiteit Leuven, is at the world level (SI 1.04). The Autonomous University of Barcelona, WUR and Katholieke Universiteit Leuven have high scientific impact, being consistently among the five leaders for the three indicators (ARC, ARIF and % in top 10%). The scientific impact of four universities is below or near the world level for the three indicators. Publications from the Autonomous University of Barcelona, WUR, Utrecht University and Katholieke Universiteit Leuven are, on average, the most cited (ARCs of 2.04, 1.83, 1.8 and 1.8, respectively). The Autonomous University of Barcelona is also first in terms of its publications in the most highly cited journals (ARIF 1.61) and in terms of the highest percentage of its articles in the 10% most cited publications (28.2%).

[9] The Food, Agriculture & Fisheries FP7 thematic priority is closely related to the scientific field of Agriculture, Fisheries & Forestry, within the Applied Sciences domain. Therefore, the results presented here are the same as those presented in Section 3.3.

Table IV Scientific performance as measured in Scopus for the selected 25 ERA universities in Agriculture, Fisheries & Forestry (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		**273,887**	**273,887**	**n.c.**	**1.00**	**1.00**	**1.00**	**10.0**
Total ERA		**100,996**	**90,452**	**n.c.**	**1.02**	**1.19**	**1.13**	**13.1**
WUR - Wageningen Univ and Res Centre	NL	2,460	1,395	0	7.82	1.83	1.51	22.5
Swedish Univ of Agricultural Sciences	SE	1,888	1,110	0	12.09	1.64	1.48	19.2
Ghent University	BE	1,653	1,087	1	2.70	1.47	1.30	17.7
University of Copenhagen	DK	1,453	790	1	1.61	1.61	1.47	15.9
University of Aarhus	DK	1,162	677	1	2.32	1.53	1.53	18.3
Mendel University Brno	CZ	1,131	907	0	22.37	0.35	0.41	1.8
University College Dublin	IE	1,056	594	0	3.15	1.66	1.38	19.6
University of Helsinki	FI	957	494	0	1.57	1.64	1.47	19.8
Utrecht University	NL	900	494	4	1.29	1.80	1.45	21.1
University of Zagreb	HR	879	615	0	2.44	0.55	0.60	3.6
UNIMI - University of Milan	IT	873	557	0	1.99	1.17	1.22	13.4
University of Zurich	CH	858	525	2	1.61	1.46	1.23	17.5
University of Edinburgh	GB	816	398	1	1.07	1.60	1.48	18.0
Katholieke Universiteit Leuven	BE	795	472	0	1.00	1.80	1.49	23.3
Alma Mater Studiorum Univ of Bologna	IT	794	498	1	1.44	1.23	1.22	14.2
Ankara University	TR	778	449	0	3.65	0.67	0.74	5.3
UMV - Norwegian Univ of Life Sciences	NO	768	377	0	10.80	1.49	1.36	15.8
Autonomous University of Barcelona	ES	746	428	1	1.22	2.04	1.61	28.2
University of Göttingen	DE	726	401	1	1.97	1.73	1.50	21.1
Technical University Munich	DE	714	410	2	1.02	1.59	1.34	20.0
DTU-Technical University of Denmark	DK	708	372	0	1.74	1.66	1.43	15.6
University of Ljubljana	SI	668	483	0	2.41	0.92	0.99	10.2
University of Bern	CH	662	363	1	1.71	1.36	1.35	16.6
Aristotle University of Thessaloniki	GR	659	446	0	1.85	1.26	1.22	12.8
BOKU-Univ of Nat Res and Appl Life Sci	AT	622	352	0	7.23	1.76	1.28	21.9

Note: Number of publications based on full (FULL) and fractional (FRAC) counts, percentage of contribution by affiliated university hospitals, SI, ARC, ARIF and percentage in the top 10% most-cited publications (Top 10 [%]) for the 25 most active ERA universities based on publications during the 2007–2011 period. The ARC and % in top 10% most-cited publications are computed for 2007 to 2008 publications only due to incomplete citation windows for more recent publications. A university's performance in comparison to the world level is indicated by green (above), yellow (similar to) and red (below the world average) colouring for SI, ARC, ARIF and percentage of top 10% most-cited publications.

Source: Computed by Science-Metrix using Scopus

If the analysis is expanded to all 303 selected universities (not just those presented in Table XXVIII), 220 universities published more than 30 articles in the field. Sixty universities are more specialised and have higher scientific impact (according to the three citation indicators) than the world level. Among them, the Norwegian School of Veterinary Science and the University of Trás-os-Montes and Alto Douro are particularly noteworthy for their high specialisation in this field (SIs of 15.3 and 6.6, respectively) and their high scientific impact (ARC > 1.75; ARIF > 1.37; top 10% > 22.1%). The Mendel University of Brno remains the most specialised among all selected ERA universities (SI 22.37); Trakia University is second (16.64) and the Norwegian School of Veterinary Science (15.29) is third. Publications from the University of Warwick have the highest average citation score (ARC 2.34), closely followed by those of the Umeå University (2.3) and the University of Groningen (2.22). The Autonomous University of Barcelona, first among the selection of 25 universities presented above, drops to seventh place. Nineteen universities among

the 303 selected, led by the University of Neuchâtel (ARIF 1.88), published on average in higher impact journals than any of the 25 most actively publishing universities presented in Table XXVIII (ARIF ≥ 1.61). However, with the exception of ETH Zurich, which published 500 articles, all of these universities published fewer than 130 articles in this area. Finally, six universities have more than 30% of their articles in this area among the top 10% most-cited publications. However, these six universities only published between 87 and 127 scientific papers during the period. The Umeå University is particularly strong with a score of 39%, followed by the University of Warwick (35.09%) and UvA–University of Amsterdam (34.29%). The Autonomous University of Barcelona is in ninth place.

Built Environment & Design

Built Environment & Design is a small research field that comprises a total of about 60,000 publications for the years 2007 to 2011 (Table V). ERA countries contributed one-third of these publications (23,500 FULL; 21,500 FRAC). Globally, ERA countries are aligned with the overall research trend in this field at the world level, having an SI slightly above (1.12) and a scientific impact close to the world level.

Universities located in the UK are particularly well represented among the most active universities, with six universities in the top 25, three of them in the top 10 most-publishing universities. Turkey and Italy have three universities in this selection. With the exception of TU Delft, which leads with 635 papers (FULL; 484 FRAC), all of the selected universities published fewer than 350 scientific papers. Gazi University, the Technical University of Denmark (DTU) and UCL are respectively second, third and fourth (respectively 301, 269 and 267 articles FULL; 234, 177 and 203 FRAC). Unsurprisingly, hospitals do not contribute to the university publications in this field. All of the 25 most actively publishing universities are specialised in Built Environment & Design, with the exception of the University of Cambridge. The SI scores of Gazi University (SI 7.74), TU Delft (7.65) and Istanbul Technical University (6.11) are particularly high.

TU Delft may be seen as the best-performing university in the field of Built Environment & Design when analysing all indicators simultaneously. Its scientific output is more than twice the output of the institution in second place and its SI in the field is very high. Nevertheless, depending on the examined indicator, its scientific impact is equal to or lower than observed at the world level. DTU and Istanbul Technical University also perform well and have high scores for all of the presented indicators except for the size of their research output, which is quite low.

EPFL and DTU–Technical University consistently display high ARC and ARIF values, as well as a large percentage of papers in the top 10% most-cited publications (among the top five for these 25 universities). They have the highest ARC values (2.08 and 2.02), just ahead of Technion Israel (2.01). DTU is also the university with the highest ARIF value (1.49), tied with Ghent University, indicating that its publications relating to construction and construction technologies are published, on average, in journals with impact factors 49% higher than the average. DTU and Ghent University are closely followed by EPFL (1.48). EPFL, DTU and the University of Manchester are the three universities among the 25 most actively publishing in this area that have the highest proportion of their articles within the top 10% most-cited publications, with a share of 23.2%, 22.7% and 22.4%, respectively. The University of Sheffield is the only other university in this selection with a share higher than 20% (21.5%).

Table V Scientific performance as measured in Scopus for the selected 25 ERA universities in Built Environment & Design (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		**59,835**	**59,835**	**n.c.**	**1.00**	**1.00**	**1.00**	**10.0**
Total ERA		**23,510**	**21,526**	**n.c.**	**1.12**	**1.08**	**1.05**	**11.3**
TUDelft - Delft University of Technology	NL	635	484	0	7.65	1.11	1.03	10.3
Gazi University	TR	301	234	0	7.74	0.34	0.36	0.8
DTU-Technical University of Denmark	DK	269	177	0	3.82	2.02	1.49	22.7
Univ of London, Univ Coll London	GB	267	203	0	1.44	1.12	0.95	13.5
Polytechnic University of Milan	IT	254	192	0	4.59	0.88	0.85	8.4
Cardiff University	GB	224	166	0	3.32	1.11	1.14	12.5
Katholieke Universiteit Leuven	BE	216	135	0	1.32	0.99	1.46	11.8
École polytechnique fédérale de Lausanne	CH	204	132	0	2.41	2.08	1.48	23.2
University of Cambridge	GB	194	132	0	0.96	1.47	1.19	15.5
Polytechnic University of Turin	IT	194	148	0	4.62	0.98	1.35	9.4
Technical University of Catalonia	ES	192	132	0	3.05	1.15	1.24	14.1
University of Manchester	GB	192	132	0	1.19	1.89	1.12	22.4
University of Sheffield	GB	191	140	0	2.09	1.79	1.34	21.5
ETHZ-Swiss Federal Inst of Tech Zurich	CH	180	117	0	1.37	1.17	1.24	19.5
Aalto University	FI	179	124	0	3.40	1.62	1.23	18.0
Royal Institute of Technology	SE	178	128	0	2.80	0.96	1.11	9.3
Technical University Munich	DE	177	133	1	1.51	1.25	1.01	12.0
Istanbul Technical University	TR	176	133	0	6.11	1.50	1.13	19.1
Ghent University	BE	169	115	0	1.31	1.92	1.49	19.3
Newcastle University (UK)	GB	166	121	0	2.49	0.89	1.01	7.6
Middle East Technical University	TR	159	115	0	4.33	1.27	1.20	13.8
Technion Israel Institute of Technology	IL	156	115	0	2.35	2.01	1.40	18.3
Alma Mater Studiorum Univ of Bologna	IT	150	106	0	1.40	1.13	1.14	11.4
Technical University of Lisbon	PT	148	100	0	2.57	1.31	1.45	11.5
RWTH Aachen University	DE	144	103	0	1.65	0.48	0.57	2.3

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

More than one-third of the 303 selected universities (125) published at least 30 articles in the field. The Vilnius Gediminas Technical University is remarkable for its high specialisation in Built Environment & Design (SI 10.93; 119 publications), the only university more specialised than Gazi University (first in the top 25). Impact indicators could not be calculated for several universities because their output was too low. In terms of ARC, two universities scored better than the first presented in the 25 most-publishing universities (EPFL, ARC 2.08): the Aalborg University (ARC 2.29) and the Ege University (2.15). Uppsala University has the highest ARIF (1.75), followed by WUR (1.58) and Umeå University (1.57). All in all, there are six universities above the university that scored best among the 25 most-publishing universities. The Ege University (32.5%), and UvA–University of Amsterdam (22.7%) are ahead of EPFL in terms of the proportion of publications among the top 10% in the area of Built Environment & Design.

Enabling & Strategic Technologies

More than 855,400 publications are indexed in Scopus in the field of Enabling & Strategic Technologies, the ERA contributing close to 219,400 (26%) of these in full counting (Table VI). Using fractional counts, the ERA has about 191,000 publications (i.e., a 22% share of all publications). Although the ERA is not at all specialised in this field (0.69), it has a high scientific impact, with both ARC (1.24) and ARIF (1.27) scores well above the world level. European authors also publish slightly more highly cited papers than expected, with 12.8% of ERA publications included in the top 10% most-cited publications.

DTU is among the top performing universities in Enabling & Strategic Technologies, with the largest output based on both full and fractional counting, the strongest SI and some of the highest impact indicators within the selection of the 25 most actively publishing universities. Imperial College London and the University of Cambridge, which have outputs comparable in size to DTU's, publish papers with comparable impact; however, they are not specialised in this field. Other notable performances are those of EPFL, TU Delft, ETH Zurich and the Swedish Royal Institute of Technology, all of which are specialised and obtain citation scores above the world level according to the three impact indicators.

Within the selection of the 25 universities with the largest output in Enabling & Strategic Technologies, six are located in the UK, four in Germany and four countries are each represented by two institutions, namely Sweden, Belgium, Switzerland and Italy. With more than 2,500 publications (FULL; 1,600 FRAC) DTU ranks first, Imperial College London ranks second and the University of Cambridge is third using full counting (about 2,500 each). This ranking changes slightly when based on fractional counting, with TU Delft above the University of Cambridge (2,319 FULL; 1,415 FRAC). Among the selection of the 25 most active universities, contributions from affiliated hospitals are quite limited in this field, with 2% or less of a university's publications being authored with researchers from its affiliated hospitals.

DTU is the most specialised institution in this selection. With an SI of 2.42, it ranks above the Warsaw University of Technology (2.19) and the Politehnica University of Bucharest (2.02). Among these, DTU is the only institution with a higher impact than the world in this field.

The scientific impact of the University of Cambridge and ETH Zurich is particularly strong, as they rank consistently among the top five regarding the three indicators (in the selection of 25 universities). The University of Erlangen-Nuremberg is, on average, the most-cited (ARC 2.23) and the University of Manchester is the only other university with an ARC higher than 2 (2.04), although the University of Cambridge (1.97) and Imperial College London (1.94) are not far behind in third and fourth place and ETH Zurich is in fifth position for the ARC (1.83). According to the ARIF, the University of Cambridge (1.8), the University of Oxford (1.71), ETH Zurich (1.69), UCL (1.69) and Imperial College London (1.68) occupy the first five positions. None of these universities are specialised in Enabling & Strategic Technologies. On par with the world level, ETH Zurich has the highest SI (1.01) among them. The University of Cambridge is also first according to its share of highly cited publications (23.3%), in front of ETH Zurich (20.9%) and University of Erlangen-Nuremberg (20.4%).

Table VI Scientific performance as measured in Scopus for the selected 25 ERA universities in Enabling & Strategic Technologies (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		**855,410**	**855,410**	**n.c.**	**1.00**	**1.00**	**1.00**	**10.0**
Total ERA		**219,396**	**191,693**	**n.c.**	**0.69**	**1.24**	**1.27**	**12.8**
DTU-Technical University of Denmark	DK	2,549	1,616	0	2.42	1.79	1.53	19.2
Univ of London, Imperial Coll London	GB	2,532	1,492	2	0.75	1.94	1.68	18.6
University of Cambridge	GB	2,515	1,383	2	0.71	1.97	1.80	23.3
TUDelft - Delft University of Technology	NL	2,319	1,415	0	1.55	1.18	1.31	12.7
École polytechnique fédérale de Lausanne	CH	2,139	1,225	0	1.56	1.74	1.58	18.5
ETHZ-Swiss Federal Inst of Tech Zurich	CH	2,113	1,240	0	1.01	1.83	1.69	20.9
University of Manchester	GB	1,902	1,144	1	0.73	2.04	1.47	15.0
Royal Institute of Technology	SE	1,900	1,096	0	1.67	1.36	1.47	15.0
Katholieke Universiteit Leuven	BE	1,757	911	1	0.62	1.40	1.32	13.3
University of Oxford	GB	1,674	926	2	0.49	1.66	1.71	18.8
RWTH Aachen University	DE	1,571	1,005	1	1.11	1.17	1.30	12.5
Polytechnic University of Milan	IT	1,454	937	0	1.56	0.89	1.18	7.2
Ghent University	BE	1,434	841	1	0.67	1.62	1.48	17.0
University of Southampton	GB	1,367	817	1	0.87	1.77	1.66	16.5
Pierre and Marie Curie University	FR	1,362	591	1	0.38	1.78	1.66	18.1
Univ of London, Univ Coll London	GB	1,328	727	2	0.36	1.61	1.69	17.8
Dresden University of Technology	DE	1,274	642	1	0.87	1.27	1.51	14.7
Chalmers University of Technology	SE	1,233	743	0	1.86	1.80	1.62	19.0
Polytechnic University of Turin	IT	1,229	805	0	1.74	1.19	1.24	11.8
Technical University Munich	DE	1,227	668	2	0.53	1.44	1.41	14.9
University of Erlangen-Nuremberg	DE	1,222	759	1	0.91	2.23	1.62	20.4
NTNU - Norwegian Univ of Sci and Tech	NO	1,220	725	0	1.11	1.48	1.29	15.6
Warsaw University of Technology	PL	1,206	832	0	2.19	1.03	0.96	7.5
Politehnica University of Bucharest	RO	1,204	768	0	2.02	0.54	0.64	3.2
University of Aveiro	PT	1,201	637	0	1.86	1.51	1.56	19.4

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

Extending the analysis to the entire selection of ERA universities, there are 275 out of the 303 which published more than 30 articles. Five universities have higher SIs than the most specialised among the 25 universities presented above. The University of Žilina is the most specialised institution, with an SI of 4.51, above the University of Food Technologies–Plovdiv (3.31) and the University of Miskolc (3.07). Based on scientific impact, several universities obtain higher citation scores than the 25 universities presented in the top 25: 12 in terms of ARC, 17 in terms of ARIF and 10 according to the percentage of papers among the top 10% most-cited publications. Universities from the Netherlands and Belgium perform especially well. The Radboud University Nijmegen is first according to the ARC (3.14), ahead of Hasselt University (2.70), and Utrecht University (2.68). None of these three institutions are specialised in this area of research. Regarding the ARIF, the University of Mons is first (2.16), with the University of Nova Gorica (2.11) and the University of Groningen (2.08) coming in second and third place with similar scores. Only the University of Nova Gorica is specialised, but its output is too low to calculate the other scientific impact indicators. Finally, the University of Mons is first according to highly cited publications (43.5%), far above the other universities. The second and third places are occupied by Abo Akademi University (31.5%) and Ludwig Maximilian University of Munich (29.9%). Charité

(29.7%) and the University of London at Queen Mary (27.9%) follow just behind. As was the case based on ARC, none of these leading institutions are specialised in Strategic & Enabling Technologies.

Engineering

The field of Engineering represents more than 812,700 publications in Scopus for the 2007–2011 period (Table VII). Of these, close to 230,200 involved at least one researcher from the ERA (28%). Overall, the ERA's share of the total output in Engineering is 25% based on fractional counting (about 204,200 publications). The ERA is not specialised in this area (0.78), but it has a high scientific impact, as expressed by its ARC (1.23), ARIF (1.18) and percentage of papers in the top 10% most-cited publications (13.0%), above the world levels and ERA's performance in the Scopus as a whole and in most of the other research fields.

Of the 25 universities with the largest outputs in Engineering among the 303 ERA universities selected in this study, six are in the UK and five are located in Italy. Switzerland and Germany rank third in this regard, each with two universities in the top 25. With more than 3,500 publications (FULL; 2,165 FRAC), TU Delft ranks first among the European universities in terms of publication output in Engineering. Imperial College London places second with about 2,800 publications (FULL; 1,702 FRAC) and ETH Zurich is the third largest producer of Engineering papers in the ERA (2,484 FULL; 1,577 FRAC). Overall, many universities have an output of similar size within the top 25; 20 of them have an output size ranging from 1,300 to 1,800 publications using full counting. As expected for this field, the contribution from affiliated hospitals is negligible. In fact, affiliated hospitals did not contribute at all to the production of 14 of the universities in the top 25, and the highest contribution (for the Technical University Munich) is 4%.

Sixteen of the 25 selected universities, several of which are technical universities, are specialised in Engineering. The Warsaw University of Technology, the Polytechnic University of Turin and the Polytechnic University of Milan occupy the first three positions with SIs of 3.01, 2.83 and 2.81, respectively. In terms of scientific impact overall, only three universities scored below the world level for one or more of the three indicators (ARC, ARIF and proportion in the top 10% most-cited publications). On the other hand, three universities, the UNIPD–University of Padua, EPFL and the Katholieke Universiteit Leuven, are worthy of mention for their particularly high impact, always being in the top five of this listing for the three indicators. UNIPD is first according to received citations with an ARC of 2.10, above ETH Zurich (2.0) in second place (2.17) and Katholieke Universiteit Leuven (1.96) in third place. Top performers based on ARIF are Technion Israel Institute of Technology, ranking first (1.69), followed closely by a group of four universities scoring between 1.50 and 1.57: UNIPD, Katholieke Universiteit Leuven, EPFL, and the Royal Institute of Technology. Again, UNIPD leads according to the percentage of their publications falling in the top 10% most-cited articles with a percentage of 24.2%. The Katholieke Universiteit

> When all indicators are analysed together, 13 of the 25 most actively publishing universities are above the world level for SI and the three indicators of scientific impact. TU Delft, the Technical University of Catalonia, the Polytechnic University of Turin and the Polytechnic University of Milan perform well above the world level for all four indicators and also have some of the largest outputs in the field.

Leuven is very close behind with a score of 23.4%. Finally, ETH Zurich, EPFL, and the Polytechnic University of Turin all have proportions close to 20% (22.5%, 21.3% and 20.1%, respectively).

Table VII Scientific performance as measured in Scopus for the selected 25 ERA universities in Engineering (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		**812,711**	**812,711**	**n.c.**	**1.00**	**1.00**	**1.00**	**10.0**
Total ERA		**230,192**	**204,149**	**n.c.**	**0.78**	**1.23**	**1.18**	**13.0**
TUDelft - Delft University of Technology	NL	3,560	2,165	0	2.51	1.51	1.38	16.7
Univ of London, Imperial Coll London	GB	2,761	1,702	2	0.89	1.70	1.44	19.5
ETHZ-Swiss Federal Inst of Tech Zurich	CH	2,484	1,577	0	1.36	2.00	1.49	22.5
Technical University of Catalonia	ES	2,403	1,597	0	2.71	1.64	1.42	16.5
Polytechnic University of Milan	IT	2,327	1,599	0	2.81	1.19	1.30	13.5
RWTH Aachen University	DE	1,809	1,297	2	1.52	1.23	1.00	13.2
Technical University Munich	DE	1,801	1,212	4	1.03	1.11	1.02	9.7
NTNU - Norwegian Univ of Sci and Tech	NO	1,778	1,172	0	1.89	1.57	1.31	18.6
Technical University of Lisbon	PT	1,753	1,088	0	2.05	1.34	1.24	14.4
École polytechnique fédérale de Lausanne	CH	1,750	1,092	0	1.47	1.87	1.50	21.3
University of Manchester	GB	1,723	1,126	1	0.74	1.27	1.28	13.3
Polytechnic University of Turin	IT	1,721	1,241	0	2.83	1.72	1.44	20.1
Royal Institute of Technology	SE	1,710	1,093	0	1.75	1.66	1.50	18.4
University of Southampton	GB	1,640	1,101	1	1.24	1.19	1.25	13.5
Katholieke Universiteit Leuven	BE	1,545	974	2	0.70	1.96	1.54	23.4
University of Cambridge	GB	1,542	960	2	0.51	1.67	1.49	19.3
DTU-Technical University of Denmark	DK	1,438	932	0	1.47	1.52	1.39	18.0
UNIPD - University of Padua	IT	1,427	986	0	1.16	2.10	1.57	24.2
UNIROMA1 - Sapienza University of Rome	IT	1,426	873	0	0.78	1.17	1.35	12.6
Warsaw University of Technology	PL	1,395	1,082	0	3.01	0.94	0.70	7.4
Politehnica University of Bucharest	RO	1,384	987	0	2.74	0.43	0.55	4.0
University of Sheffield	GB	1,382	922	1	1.02	1.37	1.43	16.2
Technion Israel Institute of Technology	IL	1,378	969	1	1.35	1.72	1.69	19.4
University of Nottingham	GB	1,332	902	1	0.91	1.63	1.37	15.8
Alma Mater Studiorum Univ of Bologna	IT	1,322	849	1	0.83	1.69	1.44	19.5

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

Overall, 271 ERA universities published at least 30 articles in Engineering. Of this number, 89 scored higher than the world level according to the SI. With the Transilvania University of Braçov (SI 5.55), Gheorghe Asachi Technical University (4.47), Kaunas University of Technology (4.24), the Vilnius Gediminas Technical University and the Bucharest Academy of Economic Studies, three Romanian and two Lithuanian universities are the most specialised. Overall, nine universities are more specialised than the Warsaw University of Technology. However, only Vilnius Gediminas Technical University performs above the world level in terms of all three scientific impact indicators (i.e., ARC of 2.54, ARIF of 1.25 and share of highly cited publications at 20%) and Gheorghe Asachi Technical University scores above average based on the ARC (1.13) and highly cited papers (11.5%). The university with the highest ARC among all universities is Stockholm University (2.92), which is, however, not specialised at all in Engineering (0.14), as it published only 144 documents in the field. Stockholm University is slightly ahead of Leiden University (2.81). In terms of ARC, 14 universities have better scores

than Technion Israel (first for this indicator among the 25 most-publishing universities). According to ARIF, five universities also scored better than the first presented in the previous list of 25 (also Technion Israel). The UMV–Norwegian University of Life Sciences ranks first (1.96), ahead of the Paris Diderot University (1.81) and a group of three universities ranging from 1.71 to 1.76 for this indicator. Finally, based on the share of a university's articles within the most-cited publications, 11 universities were more cited than UNIPD. The Swedish University of Agricultural Sciences and Stockholm University achieve the highest scores, both higher than 30% (35.2% and 31.3%, respectively).

Information & Communication Technologies (ICT)

The performances of universities in the field of Information & Communication Technologies (ICT) are shown in Table VIII. For the period examined (2007 to 2011), the world output in this field consisted of a total of about 846,500 publications, with the ERA producing close to one-third of these papers (FULL 276,100 and FRAC 248,000). Although the ERA is not specialised in ICT (SI of 0.89), its scientific impact is slightly higher than the world average.

Five of the 25 most-publishing universities in ICT are from the UK and three are from Italy. As expected, several universities among the 25 most active universities in this field are technical universities or polytechnics. Note that Switzerland has two institutions among the five most actively publishing universities: EPFL is second (2,711 FULL; 1,665 FRAC) and ETH Zurich is fifth (2,558 FULL; 1,628 FRAC). The Technical University of Catalonia (about 3,000 FULL; 1,900 FRAC) is first, the Technical University Munich is third (2,661 FULL; 1,847 FRAC) and TU Delft is fourth (2,650 FULL; 1,764 FRAC). Based on fractional counting, the ranking changes; only the Technical University of Catalonia keeps the same place. The most important changes are observed for the Vienna University of Technology, which climbs from sixth to fourth place, and for EPFL and the Technion Israel Institute of Technology, both of which lose two places.

When all indicators are analysed simultaneously, the universities with the highest performance in ICT-related research are EPFL, the Technical University of Catalonia and Aalto University. Second in terms of scientific production, EPFL has particularly high scientific impact in this area of research and is also very specialised.

Seventeen of the 25 most actively publishing universities have an SI between 1.1 and 3.3, indicating a certain level of specialisation for a majority of these institutions. Aalto University, the Vienna University of Technology and the Technical University of Catalonia have the highest specialisation indices in ICT (SIs of 3.3, 3.14 and 3.01, respectively). In terms of scientific impact, EPFL, Technion Israel and the University of Cambridge are among the leaders (top five) for the three bibliometric indicators (ARC, ARIF and % in top 10%). ETH Zurich is the most-cited university in ICT research (ARC 2.69). EPFL is second (2.58) and Katholieke Universiteit Leuven third (2.26). On average, Technion published more ICT-related research output in highly-cited journals, as indicated by an ARIF of 1.87. EPFL, Tel Aviv University and the University of Cambridge follow, but from a distance, all ranking second in this respect (ARIF 1.53). EPFL, Technion Israel and ETH Zurich have the highest proportion of their articles in the top 10% most-cited publications (25.7%, 21.1% and 20.5%, respectively). Four universities are very close behind with scores between 19.5% and 20.3%.

Table VIII Scientific performance as measured in Scopus for the selected 25 ERA universities in Information & Communication Technologies (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		**846,511**	**846,511**	**n.c.**	**1.00**	**1.00**	**1.00**	**10.0**
Total ERA		**276,125**	**247,973**	**n.c.**	**0.90**	**1.17**	**1.05**	**12.0**
Technical University of Catalonia	ES	3,011	1,861	0	3.01	1.10	1.11	12.4
École polytechnique fédérale de Lausanne	CH	2,711	1,665	0	2.13	2.58	1.53	25.7
Technical University Munich	DE	2,661	1,847	1	1.47	1.19	0.95	10.8
TUDelft - Delft University of Technology	NL	2,650	1,764	0	1.95	1.16	1.06	12.2
ETHZ-Swiss Federal Inst of Tech Zurich	CH	2,558	1,628	0	1.34	2.69	1.39	20.5
Vienna University of Technology	AT	2,479	1,720	0	3.14	1.38	0.93	12.3
Aalto University	FI	2,252	1,638	0	3.30	1.41	1.16	15.8
Univ of London, Imperial Coll London	GB	2,122	1,443	2	0.72	1.93	1.34	17.9
Katholieke Universiteit Leuven	BE	2,046	1,311	2	0.90	2.26	1.27	18.5
Technion Israel Institute of Technology	IL	2,020	1,318	0	1.73	2.04	1.87	21.1
Polytechnic University of Valencia	ES	2,013	1,481	0	2.58	1.09	1.03	11.5
RWTH Aachen University	DE	1,985	1,480	1	1.66	1.27	0.93	13.5
Ghent University	BE	1,848	1,398	1	1.12	1.80	1.38	19.9
Polytechnic University of Milan	IT	1,825	1,278	0	2.14	1.46	1.10	15.9
Alma Mater Studiorum Univ of Bologna	IT	1,784	1,192	0	1.11	1.65	1.23	19.5
University of Manchester	GB	1,747	1,178	1	0.73	1.58	1.30	18.2
Pierre and Marie Curie University	FR	1,736	1,003	1	0.66	0.86	1.00	8.3
University of Edinburgh	GB	1,686	1,069	1	0.92	1.70	1.32	16.7
Tel Aviv University	IL	1,686	1,073	1	0.84	1.58	1.53	19.8
Royal Institute of Technology	SE	1,674	1,097	0	1.68	1.14	1.15	11.8
Univ of London, Univ Coll London	GB	1,651	958	2	0.48	1.65	1.40	17.5
Technical University of Lisbon	PT	1,617	1,103	0	1.99	1.17	1.01	8.6
University of Cambridge	GB	1,600	998	1	0.51	2.17	1.53	20.3
Polytechnic University of Turin	IT	1,565	1,035	0	2.26	1.76	1.34	17.5
NTUA - Natl Tech University of Athens	GR	1,530	1,095	0	2.64	1.01	1.27	12.8

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

When extending the analysis to include the whole set of 303 ERA universities selected in this study, 273 published at least 30 articles between 2007 and 2011. Several of these universities are more specialised or have a higher scientific impact than the 25 most actively publishing universities. Whereas the highest SI score within the top 25 was 3.3, 17 universities that published less in ICT research have higher SI scores; nine of them score higher than 4, indicating that they publish more than four times as much in ICT than what would been expected given the size of the field and their overall publication output. The South East European University in Tetovo in Macedonia is the most specialised (SI 8.07), although it published only 55 articles during the period in ICT. Except for ARIF, where it performs 71% below world average, citation impact could not be computed due to the low number of publications. The IT University of Copenhagen (7.67) and Reykjavik University (6.75) are also highly specialised and published more than 300 articles. Both of these perform well in terms of citation measures (ARCs of 1.64 and 1.42 and 24.6% and 12.9% of highly cited papers, respectively) but, in general, do not publish in high-impact journals (ARIFs of 0.87 and 1.05). The universities that were the most-cited, on average, are the University of Warsaw (ARC 3.12), the University of Tartu (3.04), the Weizmann Institute of Science (2.86) and the University of Oxford (2.81), all with scores above ETH Zurich's, which

ranked first in the top 25 (2.69). Only the University of Gazi published in journals with higher impact than Technion (ARIF 1.93). Two universities have more than 30% of their ICT publications within the top 10% most-cited publications, namely the University of Tartu (31.1%) and Weizmann Institute of Science (30.4%). EPFL, first for this indicator among the 25 most-publishing universities, follows in third place (25.7%).

3.2.2 Arts & Humanities

Communication & Textual Studies

Table IX presents the results associated with the 25 ERA universities with the largest outputs, based on full counting, in Communication & Textual Studies among the selected 303 universities for the 2007–2011 period. Close to 53,000 publications were published by universities and other types of institutions in this field at the world level during this period. ERA countries contributed to 39% of these publications (close to 21,000 publications based on full counting). Based on fractional counting, the ERA's share of the total output in this field is 38% (20,300 using fractional counting). As is the case for most other research fields in the Arts & Humanities, the ERA is specialised in this field (1.19) but has a low scientific impact as expressed by its ARC (0.88), ARIF (0.86) and share of highly cited publications (8.9%), below the world levels.

Among the top 25 universities, more than 40% (11) are located in the UK and four are in the Netherlands. Please note that the strong presence of the UK in this field might, at least in part, be attributable to important biases in measuring the social sciences and humanities (SSH) using bibliometrics, some of which favour Anglo-Saxon countries; these limitations apply to the entire section on Arts & Humanities. Please refer to Section 6.5 for a detailed description of these limitations. Israel and Spain have two universities each in this selection. UvA–University of Amsterdam ranks first with about 300 (FULL; 250 FRAC) publications, followed by Ghent University (290; 243 FRAC) and the Katholieke Universiteit Leuven (250; 207 FRAC). As expected given this field of research, the contribution of affiliated hospitals to their universities' publications is almost nonexistent.

The 25 most actively publishing universities are all specialised in Communication & Textual Studies. UvA–University of Amsterdam and Ghent University are the leaders in the field. The University of Warwick also performs well but with a lower output.

Overall, the 25 most active universities are highly specialised in Communication & Textual Studies, with scores ranging from 1.2 to 6.6. Ranking first is the University of Tartu (6.6), well ahead of any other university. The University of Warwick ranks second (3.45), followed by the University of Antwerp (2.33). The University of Warwick and UvA–University of Amsterdam are the only universities in this selection of 25 institutions that rank among the top 5 for all scientific impact indicators. According to ARC, King's College London ranks first (2.10), ahead of the University of Warwick (1.75) and UvA–University of Amsterdam (1.56). These three universities also lead, in the same order, in terms of share of articles in the most cited publications, with 23.6%, 21.1% and 16.9%, respectively. Based on the impact factors of the journals in which they published (ARIF), the Hebrew University of Jerusalem, Radboud University Nijmegen and Tel Aviv University obtain the three top ranks (ARIFs of 1.58, 1.33 and 1.32). UvA–University of Amsterdam (1.31) and the University of Warwick (1.30) follow closely behind.

Table IX Scientific performance as measured in Scopus for the selected 25 ERA universities in Communication and Textual Studies (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		**52,928**	**52,928**	**n.c.**	**1.00**	**1.00**	**1.00**	**10.0**
Total ERA		**20,966**	**20,257**	**n.c.**	**1.19** ▲	**0.88** ▼	**0.86** ▼	**8.9** ▼
UvA - University of Amsterdam	NL	306	246	0	3.17 ▲	1.56 ▲	1.31 ▲	16.9 ▲
Ghent University	BE	290	243	0	3.14 ▲	1.23 ▲	0.95	9.1
Katholieke Universiteit Leuven	BE	250	207	0	2.28 ▲	1.02	0.96	11.7 ▲
University of Oxford	GB	247	214	0	1.78 ▲	0.92	1.21 ▲	11.2 ▲
University of Cambridge	GB	241	210	0	1.70 ▲	1.06	0.92	8.8 ▼
University of Manchester	GB	211	180	0	1.81 ▲	1.06	0.95	10.4
Complutense University of Madrid	ES	193	178	0	3.14 ▲	0.55 ▼	0.42 ▼	2.8 ▼
University of Leeds	GB	191	172	0	2.94 ▲	1.27 ▲	1.20 ▲	11.9 ▲
University of Edinburgh	GB	187	156	0	2.16 ▲	1.18 ▲	1.24 ▲	11.0 ▲
Radboud University Nijmegen	NL	182	131	1	2.33 ▲	1.28 ▲	1.33 ▲	15.2 ▲
Univ of London, Univ Coll London	GB	180	158	0	1.26 ▲	1.21 ▲	1.16 ▲	13.7 ▲
University of Helsinki	FI	178	153	0	2.52 ▲	0.63 ▼	0.97	3.3 ▼
Autonomous University of Barcelona	ES	165	150	0	2.21 ▲	0.52 ▼	0.73 ▼	5.6 ▼
University of Nottingham	GB	159	142	0	2.19 ▲	1.54 ▲	1.22 ▲	16.8 ▲
Utrecht University	NL	155	125	0	1.68 ▲	1.26 ▲	1.07	13.3 ▲
Leiden University	NL	132	95	0	1.88 ▲	1.30 ▲	1.10	15.8 ▲
University of Sheffield	GB	131	114	2	1.95 ▲	1.30 ▲	1.12 ▲	16.6 ▲
Univ of London, King's Coll London	GB	128	114	0	1.37 ▲	2.10 ▲	1.07	23.6 ▲
University of Warwick	GB	127	116	0	3.45 ▲	1.75 ▲	1.30 ▲	21.1 ▲
Hebrew University of Jerusalem	IL	124	109	0	2.07 ▲	1.41 ▲	1.58 ▲	10.7
University of Glasgow	GB	121	112	0	2.09 ▲	0.97	1.05	9.2
University of Oslo	NO	120	104	0	1.70 ▲	0.88 ▼	1.04	12.7 ▲
Tel Aviv University	IL	118	96	0	1.20 ▲	0.91	1.32 ▲	8.9 ▼
University of Antwerp	BE	114	84	0	3.33 ▲	n.c.	1.01	n.c.
University of Tartu	EE	114	102	0	6.60 ▲	0.33 ▼	0.63 ▼	0.0 ▼

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

Extending the analysis to all 303 ERA universities, 104 produced at least 30 publications using full counting and 26 of these scored lower than the world level according to SI. The Alexandru Ioan Cuza University is ahead of the University of Tartu, which, with an SI of 7.4, ranked first within the top 25 for this indicator. However, its output in Communication & Textual Studies is low (43 articles in full counting). In terms of the ARC, Newcastle University is the most-cited university with an ARC of 2.49, ahead of King's College London (2.1). There is no other university within the 303 selected that scores better than those presented above according to the ARIF. Finally, in terms of the share of the publications among the top 10% most-cited articles, Newcastle University (27.9%) and Stockholm University (25.1%) have the highest scores, ahead of King's College London (23.6%).

Historical Studies

Historical Studies account for more than 71,000 publications in the Scopus database between 2007 and 2011 (Table X). ERA countries contributed to about 40,300 (FULL) of these publications (56%) and have a share of 52% of the total output in this field (about 37,100 papers based on FRAC). This share is extremely large in relation to the ERA's share of world output in the sciences

in general. This translates into a high SI (1.62) for the ERA in Historical Studies, which is, in fact, the highest level of specialisation by far of all research fields analysed. The ERA's scientific impact in Historical Studies is on par with the world level, irrespective of the indicator used (ARC of 1.03, ARIF of 0.97 and share of highly cited publications at 10.4%).

Table X Scientific performance as measured in Scopus for the selected 26 ERA universities in Historical Studies (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		**71,063**	**71,063**	**n.c.**	**1.00**	**1.00**	**1.00**	**10.0**
Total ERA		**40,308**	**37,097**	**n.c.**	**1.62**	**1.03**	**0.97**	**10.4**
University of Cambridge	GB	759	498	0	3.01	1.76	1.34	20.5
University of Zagreb	HR	741	480	50	8.23	0.73	0.72	4.5
Univ of London, Univ Coll London	GB	718	410	1	2.50	1.70	1.43	22.4
University of Oxford	GB	655	393	0	2.44	2.04	1.40	25.1
Complutense University of Madrid	ES	469	313	0	4.23	1.06	0.95	10.0
Utrecht University	NL	392	230	1	2.31	2.09	1.37	27.0
University of Copenhagen	DK	378	215	0	1.69	2.10	1.30	30.2
Ghent University	BE	350	241	0	2.31	1.41	1.12	15.7
University of Bristol	GB	346	186	1	2.56	2.38	1.39	29.0
University of Warsaw	PL	322	234	0	8.76	0.48	0.44	2.6
University of Manchester	GB	303	236	0	1.76	1.56	1.21	16.1
University of Southampton	GB	298	167	0	2.14	1.51	1.37	19.3
University of Edinburgh	GB	297	195	0	2.03	1.93	1.35	18.5
Katholieke Universiteit Leuven	BE	288	214	0	1.75	1.11	1.05	10.9
University of Bern	CH	287	135	0	2.46	2.62	1.49	35.5
Autonomous University of Barcelona	ES	280	160	0	1.77	1.14	1.19	13.1
Stockholm University	SE	272	145	0	3.65	1.88	1.41	27.9
University of Barcelona	ES	272	167	0	1.78	1.11	1.09	18.7
Leiden University	NL	269	201	2	2.95	1.36	1.07	15.2
University of Rijeka	HR	269	184	56	19.19	0.80	0.74	4.1
Hebrew University of Jerusalem	IL	266	186	0	2.64	1.42	1.41	19.3
UNIROMA1 - Sapienza University of Rome	IT	255	167	0	1.71	0.96	1.05	5.1
Aix-Marseille Université	FR	250	122	1	1.79	1.17	1.31	13.7
University of Bergen	NO	242	116	0	3.04	2.05	1.43	24.6
University of Leicester	GB	239	144	0	3.47	1.21	1.18	13.8
Claude Bernard University Lyon 1	FR	239	105	0	1.66	1.17	0.99	10.1

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

Among the 26 universities with the largest outputs in this field, seven are located in the UK and three are in Spain. Belgium, the Netherlands, France and Croatia follow, each with two universities. The University of Cambridge has the largest output in this group, with about 760 (FULL; 500 FRAC) publications. The University of Zagreb follows in second place based on both full and fractional counting of publications (741 FULL; 480 FRAC), whereas UCL ranks third (718 FULL; 410 FRAC). In general, the hospital contribution to Historical Studies publications is fairly limited, although two Croatian universities, the University of Rijeka and the University of Zagreb, stand out with about 56% and 50% of their output published by authors from one of their affiliated hospitals.

The 26 most actively publishing universities are highly specialised in Historical Studies, the least specialised among them still producing 66% more papers in this field than expected. The University of Rijeka ranks first with an SI of 19.19, more than twice as high as the second (University of Warsaw, 8.76) and third highest SI (University of Zagreb, 8.23). Irrespective of the impact indicator used, these three organisations have low scientific impact. In terms of scientific impact, the University of Bern has the highest impact, being first for all indicators presented (ARC of 2.62, ARIF of 1.49 and share of the most cited articles at 35.5%). In terms of ARC, it is followed by the University of Bristol (2.38) second and the University of Copenhagen (2.10) third. In terms of ARIF, the University of Bergen and UCL are in second place (1.43), followed by Stockholm University and the Hebrew University of Jerusalem (1.41). Scoring ARIFs between 1.34 and 1.40, a group of five universities are close behind. According to the percentage of papers in the top 10% most-cited publications, the University of Copenhagen (30.2%) and the University of Bristol (29.0%) are again positioned in the top three, ranking respectively second and third, behind the University of Bern (35.5%).

The 26 most actively publishing universities are highly specialised in Historical Studies. Overall, the University of Cambridge, the University of Oxford, UCL and the University of Zagreb are among the top-performing organisations in this field, with strong results for the three scientific impact indicators.

There are 113 universities with fewer than 30 articles published in Historical Studies between 2007 and 2011. Out of 165 universities with at least 30 publications using full counting in the selected 303 ERA universities, 122 score higher than the world level in terms of SI. The University of Rijeka is again first based on SI in this extended group. It is followed by J.J. Strossmayera University of Osijek, which is also heavily specialised (12.57), but has very low impact when compared to the world. According to ARC, the University of Bern still leads, followed by the Université Catholique de Louvain (ARC 2.43). In terms of ARIF, five universities are ahead of the University of Bern: the Weizmann Institute of Science is first (1.70), just ahead of Joseph Fourier University (1.57), the University of Warwick (1.56), ETH Zurich (1.53) and the University of Tromsø. The University of Bern is also first in this extended selection in terms of highly cited publications (35.5%). VU–University of Amsterdam (32.5%), the University of Iceland (32.3%) and the University of Copenhagen (30.2%) follow, all of them with a share of publications in the 10% most-cited publications higher than 30%.

Philosophy & Theology

About 33,700 publications relevant to Philosophy & Theology are indexed in the Scopus database (Table XI). ERA researchers (including those outside of the academic circle) were involved in close to 14,300 of these publications (FULL; 42%). Based on fractional counting, the output represents slightly more than 13,700 publications, a share of 41% of the total output in this field. Overall, the ERA is specialised in this area (1.27), but its scientific impact is at the world level with its scores for all three impact indicators being slightly below the world level (ARC of 0.97, ARIF of 0.92 and share of highly cited publications at 10%).

Table XI Scientific performance as measured in Scopus for the selected 25 ERA universities in Philosophy & Theology (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		**33,662**	**33,662**	**n.c.**	**1.00**	**1.00**	**1.00**	**10.0**
Total ERA		**14,264**	**13,704**	**n.c.**	**1.27**	**0.97**	**0.92**	**10.0**
University of Oxford	GB	335	265	1	3.51	1.95	1.36	24.0
Katholieke Universiteit Leuven	BE	270	216	0	3.76	0.96	0.94	7.4
University of Edinburgh	GB	182	166	1	3.64	1.27	0.88	15.8
University of Manchester	GB	176	156	0	2.47	1.67	1.38	17.8
University of Cambridge	GB	150	135	2	1.74	1.20	1.22	14.3
Bar-Ilan University	IL	150	134	0	11.23	0.89	0.94	10.3
Hebrew University of Jerusalem	IL	149	136	3	4.07	0.86	1.12	10.6
University of Leeds	GB	146	132	3	3.60	2.21	1.55	29.1
UvA - University of Amsterdam	NL	135	107	6	2.23	1.18	1.31	11.9
Université catholique de Louvain	BE	130	117	0	4.74	0.88	0.59	3.3
Univ of London, Univ Coll London	GB	125	108	2	1.37	2.15	1.25	26.2
University of Oslo	NO	125	95	3	2.48	1.24	1.28	15.7
University of Nottingham	GB	123	108	2	2.67	1.16	1.27	12.3
Univ of London, King's Coll London	GB	122	102	4	1.97	1.48	1.25	17.8
VU - University Amsterdam	NL	117	88	0	4.36	1.92	1.15	26.7
University of Glasgow	GB	116	105	3	3.09	0.68	0.90	7.3
Utrecht University	NL	114	79	16	1.68	1.90	1.37	24.3
University of Copenhagen	DK	112	103	1	1.71	1.08	0.97	14.4
Ghent University	BE	110	89	1	1.81	1.57	1.19	19.4
University of Bristol	GB	108	88	0	2.57	1.80	1.47	20.6
University of Groningen	NL	108	84	7	2.04	1.54	1.35	18.2
Radboud University Nijmegen	NL	107	74	26	2.18	1.06	1.13	8.4
University of Helsinki	FI	106	92	1	2.41	n.c.	1.15	n.c.
Erasmus University Rotterdam	NL	104	74	41	2.35	2.34	1.34	21.0
Charles University in Prague	CZ	103	97	0	2.38	n.c.	0.34	n.c.

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

Among the 25 most actively publishing universities within the selection of 303 ERA universities, 10 are located in the UK. The Netherlands ranks second in this category (six universities) and Belgium is third (three). The University of Oxford has the largest production in both full (335) and fractional counting (265). The Katholieke Universiteit Leuven ranks second (270 FULL; 216 FRAC) and the University of Edinburgh third (182 FULL; 166 FRAC). Three institutions within this top 25 have noticeable contributions from their affiliated hospitals: Erasmus University Rotterdam (41%), Radboud University Nijmegen (26%) and Utrecht University (16%). Other than these, the highest contribution by university hospitals is at 7% (University of Groningen).

All 25 universities are specialised in Philosophy & Theology. However, none is as specialised as Bar-Ilan University (11.23), which is more than twice as specialised as the Université Catholique de Louvain in second place (4.74) and VU–University

All of the 25 selected universities are specialised in Philosophy & Theology. The University of Oxford, the Bar-Ilan University and the University of Leeds appear to be the leading institutions in this field. The University of Oxford performs well for all indicators, the Bar-Ilan University leads the way with the highest SI among leading universities by far and the University of Leeds has high impact.

Amsterdam in third place (4.36). Regarding scientific impact, the University of Leeds is worthy of mention for its high scores in all indicators presented. It has the second highest ARC (2.21), the highest ARIF (1.55) and the highest share of publications in the field among the most-cited, with 30.2%. Three universities have ARCs higher than 2, indicating that their publications were cited twice as much as the average of publications in this field at the world level. Erasmus University Rotterdam ranks first (2.34), the University of Leeds is second (2.21) and UCL is third (2.15). According to ARIF the University of Bristol is second, behind the University of Leeds, with a score of 1.47. Six universities follow, led by the University of Manchester in third place (1.38), with ARIF scores between 1.31 and 1.38. Seven universities have a share of highly cited publications higher than 20%. VU–University of Amsterdam (26.7%) and UCL (26.7%) have the second and third highest shares of highly cited papers, behind the University of Leeds (29.1%).

Within the 303 universities, only 83 have at least 30 publications in this area of research. Among them, the universities presented above are the leaders in every indicator presented. Bar-Ilan University is still the most specialised among them (11.42), followed by Alexandru Ioan Cuza University (10.59) with about 70 publications (FULL). Other noticeably high SIs are those of Comenius University (8.92), the University of Fribourg (8.74), and Babes-Bolyai University (7.27). Rankings based on the ARC and percentage of highly cited publications are the same as those presented for the top 25 universities, as these indicators could not be computed for any other universities due to the small size of outputs in this field. In terms of ARIF, Karolinska Institute ranks second (1.48) between the University of Leeds (1.55) and the University of Bristol (1.47).

Visual & Performing Arts

Table XII presents the results for the field of Visual & Performing Arts. As few as 8,100 publications are indexed in Scopus in the 2007–2011 period and defined as relevant to this field of research. ERA countries contributed to more than 3,600 of these publications (FULL; 44%). Based on fractional counting, these values are almost the same (44%; 3,500 publications FRAC), indicating that in Visual & Performing Arts collaboration rates with partners outside ERA are generally low. As in other Arts & Humanities fields, the ERA is specialised in this area of research (1.38), but has a low scientific impact as expressed by its ARC (0.78), ARIF (0.88) and share of highly cited publications (8.9%) below the world level. Due to its small publication output, hardly any indicators could be computed.

Table XII Scientific performance as measured in Scopus for the selected four ERA universities in Visual & Performing Arts (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		**8,075**	**8,075**	**n.c.**	**1.00**	**1.00**	**1.00**	**10.0**
Total ERA		**3,632**	**3,524**	**n.c.**	**1.38** ▲	**0.78** ▼	**0.88** ▼	**8.9** ▼
Gazi University	TR	98	96	0	23.71 ▲	n.c.	0.45 ▼	n.c.
University of Cambridge	GB	40	32	2	1.71 ▲	n.c.	n.c.	n.c.
UvA - University of Amsterdam	NL	36	34	0	2.88 ▲	n.c.	n.c.	n.c.
Eötvös Loránd University	HU	36	36	0	20.31 ▲	n.c.	n.c.	n.c.

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

Only four universities published at least 30 articles in Visual & Performing Arts, namely Gazi University (98 FULL; 96 FRAC), the University of Cambridge (40 FULL; 32 FRAC), the Eötvös Loránd University (36 FULL and FRAC) and UvA–University of Amsterdam (36 FULL; 34 FRAC). All these institutions are specialised in this field, but on different scales; Gazi University and Eötvös Loránd University rank first and second with SIs higher than 20 (23.71 and 20.31, respectively), which is close to 10 times the SI of UvA–University of Amsterdam (2.88) and University of Cambridge (1.71), both above the world level. Unsurprisingly, contributions from affiliated hospitals are almost nonexistent for these universities. Because of the small size of outputs in this field, no impact indicators could be computed for any university, with the exception of the ARIF for the Gazi University (0.45). It appears that the University of Gazi, as specialised as it is, does not publish the results of its research in high-impact journals.

Given the small size of this field, only four universities have an output of more than 30 publications. Gazi University and Eötvös Loránd University stand out as being hugely specialised in this field, but their overall impact could not be calculated.

3.2.3 Economic & Social Sciences

The limitations of bibliometrics in the SSH discussed in the previous section apply again in this section, but perhaps to a lesser degree in economics than in the social sciences. Please refer to Section 6.5 for a detailed description of the limitations of bibliometrics in the SSH.

Economics & Business

Close to 204,000 publications in the field of Economics & Business are indexed in the Scopus database (Table XIII). The ERA, with close to 82,000 publications using full counting, is involved in about 40% of the total output. With around 72,700 papers based on fractional counting, the ERA's share of Economics & Business publications is about 36%. Overall, the ERA's performance in this field is on par with the world level. While it is slightly specialised in the field (SI 1.11), its scientific impact is comparable with the world level (ARC of 1.06, ARIF of 0.97 and share of highly cited publications of 10.6%), all within a small range for both kinds of indicators.

Nine of the 25 universities with the largest outputs in the field based on the original selection of 303 ERA universities are located in the UK. The Netherlands is second, with six institutions, followed by Belgium and Denmark, with two universities each. With close to 1,100 publications (FULL; 584 FRAC), Erasmus University Rotterdam has the largest output. The University of Manchester and the University of Nottingham follow not far behind with, respectively, 1,040 and 930 publications based on full counting (617 and 546 FRAC). There are no changes in the ranking when using fractional counting for the top five institutions; however, several ranking changes occur for the others. Among the most important changes observed, three universities—the Vilnius Gediminas Technical

Taken all together, Copenhagen Business School and Erasmus University Rotterdam stand out among selected universities. Erasmus is specialised and has very high scientific impact. In addition, its output is the highest in the field. Copenhagen Business School is also remarkable for its extremely high levels of specialisation in Economics & Business; however, its scientific impact is more modest. Finally, the University of Oxford and the University of Nottingham are leaders based on their overall impact in this field.

University (43rd position), the University of Zaragoza (39th) and Lund University (31st)—are now part of the 25 most-publishing universities, respectively in 21st, 23rd and 25th place. Contributions by affiliated hospitals are nonexistent for 22 out of the 25 most actively publishing universities; the remaining three universities have hospital contributions of only 1% each.

Out of the 25 most actively publishing universities, 19 score above the world level for SI, two of which are highly specialised in Economics & Business: the Copenhagen Business School (20.36) and the Bucharest Academy of Economic Studies (19.89). Considering that both institutions are specifically dedicated to research in this field, this comes as no surprise. By comparison, the University of Warwick ranks third for this indicator with a score of 3.51, still much higher than the world level but much lower than the SI for these other two dedicated organisations. While the Copenhagen Business School combines high specialisation with high scientific impact, this is not the case for the Bucharest Academy of Economic Studies, which, while highly specialised, performs extremely low in terms of all citation impact indicators (i.e., an ARC of 0.17, ARIF of 0.18 and no highly cited publications).

Three universities—Erasmus, UCL and the University of Oxford—have particularly high scientific impact, being ranked among the five leaders for the three indicators presented. According to citations received, Erasmus University Rotterdam ranks first with an ARC of 2.05, obtaining 105% more citations than the average world paper. Being exactly twice as specialized as expected, Imperial College London is second (2.00), while ETH Zurich (1.81) is third. Both universities are not specialised in this field, however (respectively 0.55 and 0.99). In terms of ARIF, UCL ranks first (1.51), followed by Erasmus University Rotterdam (1.42) and the University of Oxford (1.41). Erasmus University Rotterdam also ranks among the leaders based on the percentage of its production among highly cited publications; in fact, 25.7% of its papers are among the top 10% most-cited publications, the highest score among the 25 universities, ahead of UCL (23.7%) and Imperial College London (22.5%).

Table XIII Scientific performance as measured in Scopus for the selected 25 ERA universities in Economics & Business (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		**203,945**	**203,945**	**n.c.**	**1.00**	**1.00**	**1.00**	**10.0**
Total ERA		**81,933**	**72,729**	**n.c.**	**1.11**	**1.06**	**0.97**	**10.6**
Erasmus University Rotterdam	NL	1,090	584	1	2.87	2.05	1.42	25.7
University of Manchester	GB	1,040	617	0	1.62	1.25	1.06	13.1
University of Oxford	GB	929	546	0	1.19	1.75	1.41	20.0
University of Nottingham	GB	902	544	1	2.19	1.56	1.20	19.4
University of Cambridge	GB	864	500	0	1.06	1.37	1.18	15.7
Ludwig Maximilian University of Munich	DE	824	393	0	1.35	1.45	1.17	18.5
University of Warwick	GB	777	451	0	3.51	1.56	1.22	16.8
UvA - University of Amsterdam	NL	763	426	0	1.43	1.49	1.32	19.4
VU - University Amsterdam	NL	631	343	0	2.73	1.54	1.35	19.5
University of Groningen	NL	631	373	1	1.43	1.68	1.36	19.8
Maastricht University	NL	620	334	0	2.51	1.53	1.19	15.6
TUDelft - Delft University of Technology	NL	599	406	0	1.88	1.40	0.98	14.8
Katholieke Universiteit Leuven	BE	582	332	0	0.95	1.55	1.23	16.3
Cardiff University	GB	575	366	0	2.14	1.09	1.04	9.4
University of Leeds	GB	560	355	0	1.58	1.47	1.18	17.6
University of Aarhus	DK	537	355	0	1.64	1.23	1.03	14.6
Bucharest Academy of Economic Studies	RO	534	462	0	19.89	0.17	0.18	0.0
Copenhagen Business School (CBS)	DK	485	301	0	20.36	1.44	1.27	11.7
ETHZ-Swiss Federal Inst of Tech Zurich	CH	485	287	0	0.99	1.81	1.12	20.5
Univ of London, Univ Coll London	GB	476	260	0	0.54	1.74	1.51	23.7
University of Valencia	ES	473	318	0	1.91	0.94	0.83	10.3
Université catholique de Louvain	BE	473	226	0	1.52	1.50	1.03	12.3
Univ of London, Imperial Coll London	GB	470	263	0	0.55	2.00	1.34	22.5
Alma Mater Studiorum Univ of Bologna	IT	461	272	0	1.06	1.37	1.10	13.7
Aalto University	FI	450	301	0	2.40	1.12	1.15	8.4

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

Within the overall selection of 303 ERA universities, 225 have at least 30 publications in Economics & Business using full counting. Among them, NHH–Norwegian School of Economics is the most specialised with a score of 27.7, above the Copenhagen Business School (20.36; first among the 25 most-publishing universities). According to ARC, two universities are on average more cited than Erasmus University Rotterdam: the University of Basel (2.14) and the University of Zurich (2.11). The EPFL, which is not specialised in this field (0.26) and has a modest scientific output (about 100 publications; FULL), has the highest ARIF (1.73). It is followed by four universities: the Hebrew University of Jerusalem (1.65) and a group of three universities with scores ranging from 1.54 to 1.56 (Karolinska Institute, University of Lausanne and Tel Aviv University). UCL, which had the highest ARIF among the top 25 presented above, ranks sixth in this extended selection. Finally, a group of four high-performing universities leads in terms of the percentage of their papers among the top 10% most-cited publications: Technical University of Crete (31.3%), the University of Basel (30.3%), the University of Granada (28.6%), and Vilnius Gediminas Technical University (26.1%). Considering all universities, Erasmus is in fifth place with a score of 25.7%.

Social Sciences

The field of Social Sciences is comprised of close to 257,700 publications indexed in the Scopus database (Table XIV). The ERA is involved in 37% of these publications (about 95,300) and has a share of 35% of world publications using fractional counting (about 89,500). Overall, the ERA is slightly specialised in the Social Sciences (1.08) and has a scientific impact comparable to the world (ARC of 1.06, ARIF of 1.02 and percentage of papers in the top 10% most-cited publications at 10.8).

Table XIV Scientific performance as measured in Scopus for the selected 25 ERA universities in Social Sciences (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		**257,654**	**257,654**	**n.c.**	**1.00**	**1.00**	**1.00**	**10.0**
Total ERA		**95,315**	**89,495**	**n.c.**	**1.08**	**1.06**	**1.02**	**10.8**
University of Oxford	GB	1,587	1,146	1	1.99	1.82	1.37	20.6
University of Manchester	GB	1,262	955	1	1.99	1.77	1.29	13.9
University of Cambridge	GB	1,220	936	0	1.57	1.42	1.16	18.4
Utrecht University	NL	922	599	1	1.67	1.96	1.57	25.6
UvA - University of Amsterdam	NL	900	642	1	1.72	1.81	1.52	22.4
University of Birmingham	GB	887	668	0	2.37	1.37	1.22	13.8
University of Nottingham	GB	882	624	1	2.01	1.45	1.33	17.2
University of Edinburgh	GB	841	662	0	1.90	1.26	1.19	13.5
Univ of London, Univ Coll London	GB	831	631	1	1.05	1.45	1.24	17.8
University of Sheffield	GB	783	606	0	2.12	1.32	1.21	15.6
Univ of London, King's Coll London	GB	778	568	3	1.44	1.58	1.24	18.9
Katholieke Universiteit Leuven	BE	761	522	1	1.19	1.62	1.46	19.7
University of Leeds	GB	760	586	0	2.07	1.48	1.23	15.6
University of Oslo	NO	699	516	2	1.76	1.47	1.24	19.1
University of Bristol	GB	697	517	0	1.98	1.48	1.26	15.4
University of Warwick	GB	677	523	0	3.23	1.60	1.22	17.3
Cardiff University	GB	652	476	1	2.22	1.62	1.29	17.3
Hebrew University of Jerusalem	IL	647	483	1	1.90	1.09	1.30	11.0
Leiden University	NL	607	441	1	1.80	1.78	1.42	23.2
University of Helsinki	FI	593	445	1	1.52	1.18	1.15	12.4
VU - University Amsterdam	NL	583	361	0	2.28	1.97	1.46	23.9
University of Glasgow	GB	579	428	1	1.66	1.48	1.31	17.7
Ghent University	BE	560	421	1	1.12	1.62	1.35	16.8
University of Southampton	GB	557	414	0	1.48	1.48	1.34	16.6
Tel Aviv University	IL	514	392	2	1.02	1.23	1.30	12.7

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

Sixty percent (15) of the 25 universities with the largest outputs in the Social Sciences among the 303 selected ERA universities are located in the UK. The Netherlands ranks second (with four) and Israel and Belgium each have two universities in the top 25. The three universities with the largest scientific output are located in the UK, with the University of Oxford in first place (about 1,600 based on FULL), the University of Manchester ranking second (about 1,300) and the University of Cambridge the third most active university in the Social Sciences (about 1,200). These three institutions also lead according to their number of publications using fractional counting, with around 1,150, 950 and 940 papers, respectively. Contributions from affiliated

hospitals are fairly limited in the Social Sciences, with every university in the top 25 having less than 3% of its papers being published with authors from their university hospitals.

The University of Warwick is the most specialised in the top 25, with an SI of 3.23. The University of Birmingham (2.37) and VU–University Amsterdam (2.28) follow with similar levels of specialisation. These three universities combine high specialisation with scientific impact indicators above the world level.

Being consistently in the top five based on the three impact indicators, four universities stand out, namely Utrecht University, VU–Amsterdam, UvA–University of Amsterdam and Leiden University. VU–Amsterdam has the highest ARC (1.97), but is closely followed by the Utrecht University in second place (1.96) and the University of Oxford in third place (1.82). Utrecht University achieves the highest ARIF with a score of 1.57, slightly ahead of UvA–University of Amsterdam (1.52), VU–University Amsterdam (1.46) and Katholieke Universiteit Leuven (1.46). The University of Utrecht also the highest percentage of its papers among the top 10% most-cited publications (25.6%). VU–University Amsterdam is second (23.9%) and Leiden University is third (23.2%) in terms of the latter indicator.

All 25 universities with the largest outputs in Social Sciences score on par with or above the world level according to SI. In terms of scientific impact, universities in the UK and the Netherlands rank high on the list, combining strong specialisation and some of the highest impact indicators. The University of Oxford, the University of Manchester and the University of Warwick are some of the universities that stand out in terms of SI, ARC, ARIF or the percentage of their papers among highly cited publications.

Within the entire set of 303 selected universities, 226 published at least 30 papers related to the Social Sciences. Of this list, eight universities are more specialised than any of 25 most active universities in the field. Three Scandinavian universities—i.e., Roskilde University (7.48), the Oslo and Akershus University College of Applied Sciences (7.22) and the Copenhagen Business School (6.62)—occupy the first positions. By comparison, the University of Warwick, which is ranked first for this indicator among the top 25, ranks ninth in this extended selection (3.23). The same is observed at the ARC level, with 10 universities ahead of all universities presented in the top 25 most-publishing institutions. These 10 universities are also the only ones with ARCs higher than 2 in this field. Interestingly, the two first positions in the Social Sciences are occupied by technical universities. ETH Zurich ranks first (3.14), EPFL is second (2.85) and the third position is occupied by Aalborg University (2.62). VU–University Amsterdam ranks 11th based on ARC scores. Hasselt University has the highest ARIF (2.23), indicating that its authors are able to publish in high-quality journals. The University of Crete (1.92) and the University of Thessaly (1.66) follow according to the ARIF, while Utrecht University, ranked first among the top 15, obtains the eighth highest ARIF taking all selected universities into account. With close to one-third of its papers (32.4%) in the top 10% most-cited publications, Karolinska Institute has the highest share of highly cited papers. Hasselt University (30.0%), EPFL (29.9%) and ETH Zurich (29.9%) follow with slightly fewer papers in this category. Utrecht University, which was first according to this indicator among the selection of 25 universities presented above, is now in eighth place (25.6%).

3.2.4 Health Sciences

Biomedical Research

Biomedical Research encompasses close to 576,000 publications in the Scopus database in the 2007–2011 period (Table XV). The ERA's contribution to this total is close to 235,300 publications using full counting (41%). With about 199,500 publications based on fractional counting, the ERA contributes to an overall share of 35% of all publications in Biomedical Research. It is not highly specialised in this field (1.07), and its scientific impact is slightly higher than the world level, having an ARC of 1.08, an ARIF of 1.06 and 11.2% of its publications among the top 10% most-cited publications.

Twenty-four out of the 25 most active ERA universities in Biomedical Research are specialised in this area of research. Among them, the University of Oxford, the Karolinska Institute, the University of Cambridge and the University of Copenhagen are highly specialised and perform at the strongest levels in all three scientific impact indicators.

As in most other fields of research, the UK dominates the field of Biomedical Research, as seven British universities are among the 25 most actively publishing ERA universities based on full counting, and three of them occupy the top three positions based on the size of their scientific output (FULL). French universities take four positions in this top 25, while German universities take three. The University of Oxford produces the largest number of biomedical papers (about 4,500), followed by the University of Cambridge (about 4,100) and UCL (around 3,900). These institutions keep their respective positions using fractional counting (about 2,100, 2,000 and 1,800). On average, 25% of the publications by the top 25 universities involve at least one author from affiliated hospitals. Affiliated hospitals from UvA–University of Amsterdam contributed to 70% of its publications, the highest contribution among these 25 institutions. The Paris Descartes University ranks second (52%) and the Utrecht University is in third place (50%) for hospitals' contributions.

Twenty-four out of the 25 universities are specialised in Biomedical Research. The Karolinska Institute is the most specialised (SI 2.53), followed by the Paris Descartes University (1.96), the University of Oxford (1.88) and the University of Copenhagen (1.87) with similarly high scores. The University of Oxford and Imperial College London have particularly high scientific impact, being consistently among the five leaders in terms of their ARC, ARIF and share of articles in the top 10% most-cited publications. The University of Oxford obtains the highest values in all three impact indicators (ARC of 1.72, ARIF of 1.36 and 22.5% of papers in the top 10% most-cited publications). In terms of received citations, King's College London (1.69) and Imperial College London (1.61) rank second and third, respectively. Based on ARIF, Imperial College London (1.35), the University of Cambridge (1.34) and UCL (1.34) are very close behind the University of Oxford. With 22.0% of its articles in the top 10% most-cited publications in this field, Imperial College London has the second highest percentage of highly cited papers. UvA–University of Amsterdam and Ghent University (19.5%) are both in third place, closely followed by the University of Zurich (19.4%).

Table XV Scientific performance as measured in Scopus for the selected 25 ERA universities in Biomedical Research (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		**575,816**	**575,816**	**n.c.**	**1.00**	**1.00**	**1.00**	**10.0**
Total ERA		**235,270**	**199,519**	**n.c.**	**1.07**	**1.08**	**1.06**	**11.2**
University of Oxford	GB	4,504	2,103	14	1.88	1.72	1.36	22.5
University of Cambridge	GB	4,138	2,091	17	1.83	1.59	1.34	18.1
Univ of London, Univ Coll London	GB	3,909	1,814	12	1.40	1.50	1.34	18.4
Karolinska Institute	SE	3,651	1,688	25	2.53	1.43	1.25	17.6
University of Copenhagen	DK	3,638	1,760	31	1.87	1.52	1.22	19.0
Univ of London, Imperial Coll London	GB	3,513	1,504	35	1.37	1.61	1.35	22.0
Pierre and Marie Curie University	FR	3,163	1,234	35	1.28	1.18	1.17	12.1
Ludwig Maximilian University of Munich	DE	2,714	1,268	15	1.49	1.46	1.21	17.2
Paris Descartes University	FR	2,650	964	52	1.96	1.31	1.21	14.4
Utrecht University	NL	2,635	1,131	50	1.43	1.53	1.33	17.2
University of Barcelona	ES	2,563	1,156	41	1.66	1.33	1.13	14.1
University of Manchester	GB	2,539	1,244	17	1.37	1.43	1.20	16.0
University of Helsinki	FI	2,428	1,094	17	1.76	1.41	1.23	13.9
University of Edinburgh	GB	2,416	1,165	15	1.76	1.44	1.27	17.3
University of Zurich	CH	2,391	1,093	18	1.63	1.47	1.23	19.4
Paris Diderot University	FR	2,353	922	44	1.70	1.28	1.18	12.7
Univ of London, King's Coll London	GB	2,320	1,036	26	1.46	1.69	1.27	16.8
Heidelberg University	DE	2,174	1,047	23	1.56	1.37	1.22	18.4
Charite - Universitaetsmedizin Berlin	DE	2,148	913	0	1.71	1.43	1.16	15.9
UNIMI - University of Milan	IT	2,134	962	11	1.75	1.15	1.14	12.4
Ghent University	BE	2,133	1,063	14	1.27	1.53	1.17	19.5
Katholieke Universiteit Leuven	BE	2,098	1,003	13	1.07	1.55	1.31	19.0
University of Paris XI	FR	2,081	769	24	1.44	1.39	1.18	15.2
Uppsala University	SE	2,038	1,009	8	1.83	1.39	1.22	15.1
UvA - University of Amsterdam	NL	2,024	840	70	1.35	1.49	1.28	19.5

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

Of the 303 ERA universities selected based on their overall output in Scopus, 259 published at least 30 papers in Biomedical Research. With an SI of 5.17, Riga Stradins University is the most specialised institution from this selection, ranking above the Norwegian School of Veterinary Science (4.34) and the Weizmann Institute of Science (2.69). In this extended ranking, Karolinska Institute is the fourth most specialised. At the ARC level, the leading universities are the Slovak University of Technology, which is not specialised in Biomedical Research (SI 0.37), the University of Iceland and the Université Catholique de Louvain, all with similar scores (1.81, 1.80 and 1.80, respectively). The University of Oxford, which is ranked first according to this indicator within the 25 most-publishing universities, is in fifth position. The University of Iceland leads in terms of ARIF (1.58), ahead of Maastricht University (1.38) and the University of Oxford (1.36, first in the top 25).The Johannes Kepler University of Linz has the highest percentages of articles within the top 10% most-cited publications (27.3%), ahead of the University of Oxford (22.5%), first in the selection of 25 universities.

Clinical Medicine

The field of Clinical Medicine is the largest in Scopus, with close to 2,000,000 publications (Table XVI). Of that number, the ERA was involved in about 855,600 publications (43%) and has a global share of 39% of world publications based on fractional counting (about 767,200). The ERA is specialised in Clinical Medicine (SI 1.21), but its scientific impact is on par with the world level, having an ARC of 1.03, an ARIF of 0.99 and 10.3% of its papers among the top 10% most-cited publications.

Among the 25 most actively publishing universities in Clinical Medicine, six are from the UK. The Netherlands follows with four and Germany and France each with three universities among the most active in the field. UCL has the largest output based on both full (about 16,800 publications) and fractional (about 8,800) counting. Differences between the two counting methods can be observed in the ranking. The Karolinska Institute has the second highest output using full counting (12,900), but ranks only fifth based on fractional counting (around 6,400). Imperial College London is in third position based on full counting (about 12,600) but loses one position if ranked by fractional publication counts (around 6,600). This indicates that these universities collaborate frequently with external partners. The opposite effect is shown for the University of Copenhagen, which is sixth according to full counting (about 11,600) but climbs up to second place using fractional counting (about 6,300). Another change in ranking between full and fractional counting that is worthy of mention is the Charles University of Prague, which improves from the 30th position in full counting to the 15th in fractional counting. As could be expected, contributions from affiliated hospitals are higher than in most other fields. Within the 25 most-publishing universities, Erasmus University Rotterdam has the largest share of its papers resulting from work with one of its affiliated hospitals (97%). Leiden University is second (88%), with the Paris Diderot University and UvA–University of Amsterdam following not far behind (both at 84%). The case of Charité–Universitätsmedizin Berlin is unique, as it is itself a university hospital and does not have any affiliates in the hospital sector. Consequently, this institution does not have any contributions from affiliated hospitals.

> All but one of the 25 most-publishing universities in Clinical Medicine are specialised in this field. Among them, the top performing institutions include UCL, Charité and the Karolinska Institute, which combine high specialisation with strong scientific impact.

Charité is the most specialised in this selection of 25 most active universities in Clinical Medicine, with a concentration of output in this field more than three times (SI 3.45) as high as expected given the size of the institution and the production in the field on the world level. Paris Descartes University and the Karolinska Institute have the second (3.11) and third (2.91) highest levels of specialisation. In terms of scientific impact, the two oldest universities in the UK (i.e., Oxford and Cambridge) are leaders in Clinical Medicine, scoring highest and second highest for all three citation indicators in this selection of 25 universities (ARCs of 2.23 and 2.10, ARIFs of 1.65 and 1.63, and 20.8% and 19.1% of articles in the top 10% most-cited publications, respectively). Katholieke Universiteit Leuven shares the second highest ARC with the University of Cambridge (both 2.10). They are followed by UvA–University of Amsterdam (2.03). According to ARIF, Leiden University (1.52) is in third place, followed by Imperial College London and UCL with the fourth highest score (both 1.51). In terms of the percentage of papers in the top 10% most-cited

publications, Oxford and Cambridge are followed by the Katholieke Universiteit Leuven in the third position (22.1%).

Table XVI Scientific performance as measured in Scopus for the selected 25 ERA universities in Clinical Medicine (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		**1,980,951**	**1,980,951**	**n.c.**	**1.00**	**1.00**	**1.00**	**10.0**
Total ERA		**855,632**	**767,225**	**n.c.**	**1.21**	**1.03**	**0.99**	**10.3**
Univ of London, Univ Coll London	GB	16,823	8,803	42	2.09	1.85	1.51	21.4
Karolinska Institute	SE	12,941	6,411	40	2.91	1.71	1.39	16.8
Univ of London, Imperial Coll London	GB	12,602	6,606	70	1.83	1.93	1.51	21.5
Univ of London, King's Coll London	GB	12,561	6,685	55	2.54	1.70	1.40	19.0
Charite - Universitaetsmedizin Berlin	DE	11,901	6,254	0	3.45	1.64	1.24	18.0
University of Copenhagen	DK	11,604	6,816	76	2.27	1.92	1.29	19.2
Heidelberg University	DE	10,897	5,824	45	2.52	1.45	1.19	14.3
Paris Descartes University	FR	10,852	4,982	70	3.11	1.63	1.19	15.3
Pierre and Marie Curie University	FR	10,328	4,927	79	1.60	1.51	1.16	14.7
Ludwig Maximilian University of Munich	DE	10,313	5,522	46	2.20	1.65	1.15	16.7
Erasmus University Rotterdam	NL	9,987	5,215	97	2.69	1.91	1.48	20.3
University of Oxford	GB	9,605	4,774	50	1.30	2.23	1.65	24.3
Utrecht University	NL	9,126	4,570	82	1.68	1.82	1.48	19.6
UvA - University of Amsterdam	NL	9,079	4,429	84	2.10	2.03	1.50	20.4
University of Barcelona	ES	8,759	4,405	70	1.99	1.73	1.16	16.0
Paris Diderot University	FR	8,610	4,168	84	2.20	1.68	1.22	15.8
Tel Aviv University	IL	8,433	5,305	62	2.12	1.20	1.16	10.6
University of Zurich	CH	8,411	4,481	71	1.98	1.72	1.35	19.8
University of Athens	GR	7,994	5,123	49	2.85	1.01	0.99	8.7
Katholieke Universiteit Leuven	BE	7,786	4,149	51	1.36	2.10	1.40	22.1
Autonomous University of Barcelona	ES	7,678	3,898	81	1.86	1.43	1.10	12.8
University of Manchester	GB	7,644	4,124	49	1.25	1.77	1.38	17.0
UNIMI - University of Milan	IT	7,435	3,402	21	1.89	1.42	1.24	14.9
Leiden University	NL	7,433	3,671	88	2.00	2.02	1.52	20.4
University of Cambridge	GB	7,423	3,814	54	0.99	2.10	1.63	23.2

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

Considering all of the 303 selected ERA universities, 266 published at least 30 articles in Clinical Medicine between 2007 and 2011. As indicated by an SI higher than 1.1, more than half of them (150) are specialised in this field of research. As could be expected, medical universities are among the most specialised in Clinical Medicine. It is certainly not surprising that the three universities with the highest SIs are institutions specifically dedicated to medical research. The Gulhane Military Medical Academy is the most specialised within this extended selection (3.99), almost tied with the Medical University of Lodz (3.96); however, these two institutions have low scientific impacts. The Medical University of Graz is third in terms of specialisation (3.65), and its scientific impact is slightly above the world level. Charité, the most specialised university among the 25 most-publishing universities, ranks fifth in this extended selection. The top five based on ARC including all universities remains the same as the one based on the 25 most active universities presented above. Based on the ARIF, the University of Namur and the Weizmann Institute of Science take the lead over Oxford and Cambridge, both obtaining the highest ARIF of 1.67. ETH Zurich is the university with the largest share of highly cited papers, with 26.2% of its

articles within the top 10% most-cited publications in Clinical Medicine, right ahead of the University of Oxford (24.3%) and the University of Cambridge (23.2%).

Psychology & Cognitive Science

The field of Psychology & Cognitive Science consists of approximately 150,000 publications in Scopus for the 2007–2011 period (Table XVII) and the ERA is involved in around 44% (65,400; FULL) of them. Using fractional counting, the ERA's share is reduced to 39% (about 58,300 publications FRAC), indicating that institutions from the ERA frequently collaborate with partners from outside Europe. Although the ERA is specialised in this field (1.20), its scientific impact is on par with the world level for all indicators (ARC of 0.97, ARIF of 0.95 and 9.5% of its papers in the top 10% most-cited publications). These patterns are in fact more typical of those observed in the SSH than in the Health, Natural and Applied Sciences research fields.

All 25 universities with the largest outputs in Psychology & Cognitive Sciences are specialised in this area. Combining large outputs, strong specialisation and high scientific impact, UCL and VU–University Amsterdam are some of the top-performing universities in this selection. King's College London and Utrecht University also show strong overall performances.

Among the 25 universities with the largest output in this field, 10 are located in the UK and seven in the Netherlands. Belgium and Switzerland are each represented by two universities in this selection. UCL is the university with the largest output in Psychology & Cognitive Sciences, with more than 1,800 (FULL; and close to 1,000 FRAC) publications. The difference between the two values indicates a high intra-institutional collaboration rate. This is the case for most universities in this field of research. Utrecht University ranks second for both indicators with about 1,150 (FULL; 690 FRAC) publications. King's College London (third) and the University of Oxford (fourth) are very close in terms of output, each with about 1,100 publications in full counting. When examined by fractional publication counts, the University of Oxford is slightly ahead of King's College London, with 590 publications compared to 570 from King's College London. Contributions from affiliated hospitals are all below 25% for the 25 universities and even fall below 10% for 16 of them. The University of Geneva has the highest rate of contribution from affiliated hospitals with 21%, and is followed by the University of Groningen (20%) and Tel Aviv University (16%).

Scoring an SI (4.96) much higher than other universities, VU–University Amsterdam is highly specialised in Psychology & Cognitive Sciences. Radboud University Nijmegen follows at 3.50, slightly ahead of Maastricht University (3.36). Three universities are consistently among the five leaders in terms of scientific impact: King's College London, which has the highest value for two out of three indicators, the University of Oxford and UvA–University of Amsterdam. The University of Oxford (ARC 1.61) and UvA–University of Amsterdam (1.58) have the second and third highest ARC scores, close behind King's College London (1.66). The latter also has the highest journal-based impact measure (ARIF 1.36) but is closely followed by the two universities in Amsterdam: VU–University Amsterdam (1.34) in second and UvA–University of Amsterdam (1.32) in third position. Among the 25 most active universities, the three universities with the highest share of the top 10% of most cited papers are in the UK, two of which publish more than twice as many highly cited papers as expected. The University of Oxford leads with a share of 22.5% of its

publications among the top 10% most frequently cited in the field, followed by King's College London with 22.0%. UCL ranks third according to this indicator (19.2%).

Table XVII Scientific performance as measured in Scopus for the selected 25 ERA universities in Psychology & Cognitive Sciences (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		**150,253**	**150,253**	**n.c.**	**1.00**	**1.00**	**1.00**	**10.0**
Total ERA		**65,424**	**58,262**	**n.c.**	**1.20**	**0.97**	**0.95**	**9.5**
Univ of London, Univ Coll London	GB	1,835	993	5	2.98	1.55	1.24	19.2
Utrecht University	NL	1,153	690	11	3.30	1.18	1.19	12.5
Univ of London, King's Coll London	GB	1,083	570	15	2.74	1.66	1.36	22.0
University of Oxford	GB	1,079	592	14	1.91	1.61	1.29	22.5
Radboud University Nijmegen	NL	983	547	10	3.50	1.17	1.23	12.0
UvA - University of Amsterdam	NL	954	518	8	2.48	1.58	1.32	18.9
University of Groningen	NL	929	531	20	3.07	1.26	1.25	12.6
VU - University Amsterdam	NL	882	459	0	4.96	1.37	1.34	16.1
Ghent University	BE	801	507	3	2.31	1.30	1.19	14.9
University of Cambridge	GB	798	443	4	1.35	1.33	1.24	15.1
Katholieke Universiteit Leuven	BE	743	473	2	1.84	1.14	1.10	11.2
University of Zurich	CH	733	408	13	2.30	1.27	1.07	13.2
Leiden University	NL	728	407	9	2.88	1.47	1.27	14.8
University of Manchester	GB	705	419	3	1.49	1.36	1.22	16.5
University of Edinburgh	GB	684	390	2	2.11	1.17	1.08	11.7
Ludwig Maximilian University of Munich	DE	599	336	5	1.42	1.06	1.06	10.0
Paris Descartes University	FR	583	326	13	2.21	0.66	0.70	5.0
UNIPD - University of Padua	IT	582	360	0	2.28	1.00	1.00	9.0
University of Geneva	CH	573	332	21	2.65	1.37	1.08	15.7
University of Bristol	GB	570	356	1	2.33	0.92	0.99	8.2
Maastricht University	NL	560	330	5	3.36	1.43	1.30	13.6
University of Birmingham	GB	552	345	1	2.08	0.96	1.07	10.2
University of Nottingham	GB	549	318	3	1.75	1.20	1.10	15.7
Cardiff University	GB	538	318	3	2.52	1.11	1.18	10.8
Tel Aviv University	IL	524	333	16	1.55	1.20	1.15	9.7

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

Extending the analysis to the entire selection of 303 ERA universities, two-thirds (200) have at least 30 publications in this field of research. Quite surprisingly, the IT University of Copenhagen is the most specialised institution in Psychology & Cognitive Sciences (7.94); however, it has only about 60 publications (FULL). VU–University Amsterdam still ranks highly within this selection with the second highest SI (4.96), followed by University of Fribourg third (4.28). Regarding ARC, one university, the University of Oulu in Finland (1.73), scores better than King's College London (first for this indicator within the selection of 25 universities). The University of Cologne ranks third (1.64). The Weizmann Institute of Science has the highest ARIF (1.60), leaving the University of Innsbruck (1.38) and the Innsbruck Medical University behind (1.38). However, these institutions have small outputs in this field with fewer than 70 publications (FULL) each. Considering all selected universities, King's College London has the fourth highest ARIF. The University of Cologne leads in terms of the proportion of their papers within the 10% most cited publications, with a score of 23.8%, just ahead of the University of Oxford (22.5%) and King's College London (22.0%).

Public Health & Health Services

Close to 218,000 publications in the field of Public Health & Health Services are indexed in the Scopus database (Table XVIII), with the ERA contributing to about one-third (34%; 73,400; FULL) of these. Using fractional counting, the ERA's share of the world output in this field is 30% (about 65,200 papers). The ERA is not specialised in this field (0.94) and its scientific impact is on par with the world level, as expressed by its ARC (1.00), ARIF (1.00) and proportion of papers among highly cited publications (10.1%).

Table XVIII Scientific performance as measured in Scopus for the selected 25 ERA universities in Public Health & Health Services (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		**217,839**	**217,839**	**n.c.**	**1.00**	**1.00**	**1.00**	**10.0**
Total ERA		**73,364**	**65,191**	**n.c.**	**0.94**	**1.00**	**1.00**	**10.1**
Karolinska Institute	SE	1,875	931	14	3.47	1.32	1.23	12.4
Univ of London, Univ Coll London	GB	1,764	877	18	1.77	1.35	1.18	15.0
Univ of London, King's Coll London	GB	1,454	804	22	2.54	1.32	1.20	13.4
Erasmus University Rotterdam	NL	1,186	616	80	2.90	1.52	1.23	19.6
Maastricht University	NL	1,144	570	17	4.22	1.35	1.30	15.3
Radboud University Nijmegen	NL	1,138	596	58	2.88	1.16	1.23	11.9
University of Manchester	GB	1,042	581	13	1.47	1.32	1.16	15.5
Utrecht University	NL	966	410	65	1.37	1.47	1.27	17.3
Univ of London, Imperial Coll London	GB	952	417	49	0.88	1.36	1.12	15.3
University of Oslo	NO	950	444	33	1.86	1.36	1.24	15.2
University of Copenhagen	DK	910	463	48	1.28	1.35	1.23	14.6
UvA - University of Amsterdam	NL	904	408	66	1.75	1.27	1.21	11.0
VU - University Amsterdam	NL	883	356	0	2.78	1.41	1.32	18.3
University of Sheffield	GB	881	500	15	2.15	1.39	1.21	16.0
University of Oxford	GB	859	367	15	0.81	1.32	1.18	12.3
Lund University	SE	852	458	33	1.95	1.26	1.19	13.6
University of Birmingham	GB	808	466	13	2.00	1.15	1.13	12.2
University of Gothenburg	SE	808	461	18	2.87	1.36	1.30	13.4
University of Nottingham	GB	802	468	26	2.00	1.31	1.22	14.8
University of Edinburgh	GB	793	400	16	1.43	1.40	1.22	18.3
University of Bristol	GB	754	350	5	1.66	1.45	1.24	15.5
University of Groningen	NL	743	380	71	1.98	1.27	1.27	15.2
University of Cambridge	GB	740	350	21	0.73	1.71	1.28	20.3
University of Leeds	GB	713	397	16	1.69	1.30	1.16	13.1
University of Aarhus	DK	646	336	42	1.48	1.51	1.24	17.6

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

About half (12) of the 25 universities with the highest number of publications in Public Health & Health Services are located in the UK, seven are in the Netherlands and three are in Sweden. With 1,875 publications using full counting (931 in fractional counting), the Karolinska Institute produces the most papers in the field, followed by UCL (1,764 FULL; 877 FRAC) and King's College London (1,454 FULL; 804 FRAC). Contributions by university hospitals vary greatly across institutions. For instance, though 80% (first according to hospital contributions) of Erasmus University Rotterdam's publications involved at least one author from its affiliated hospitals, there is none at VU–University Amsterdam and the share is as low as 5% for the University of Bristol.

The University of Groningen has the second highest share of hospital contributions (71%), followed by UvA–University of Amsterdam (66%) and Utrecht University (65%).

Maastricht University is the most specialised within this selection of 25 universities (SI 4.22), ahead of the Karolinska Institute with the second highest SI (3.47). Erasmus University Rotterdam (2.90) and Radboud University Nijmegen (2.88) follow with similar specialisation levels. Overall, only three universities score lower than the world level for this indicator. The University of Cambridge, which is one of the three universities not specialised in Public Health & Health Services (0.73), is the only one found among the five leaders for the three scientific impact indicators presented in this report. It obtains the highest ARC (1.71), followed by Erasmus University Rotterdam (1.52) and the University of Aarhus (1.51), both with similar citation scores. Regarding ARIF, VU–University Amsterdam ranks high with the highest score (1.32) in this selection. However, the University of Gothenburg (1.30), Maastricht University (1.30) and the University of Cambridge (1.28) publish in journals with similarly high impact. With 18 other institutions scoring ARIFs above 1.20, many universities can aspire to top positions. Based on the proportion of a university's output that falls within highly cited publications, the University of Cambridge ranks first (20.3%), followed by Erasmus University Rotterdam (19.6%) in second place and the University of Edinburgh and VU–University of Amsterdam both in third position with a share of 18.3%.

> Overall, most of the top publishing universities in Public Health & Health Services are specialised in this field. The Karolinska Institute is noticeable for its high output and strong impact, as are Maastricht University and Erasmus University Rotterdam, with some of the highest scores for all three impact indicators.

About 64% (195) of the 303 ERA universities published at least 30 papers in Public Health & Health Services. Among them, the Oslo and Akershus University College of Applied Sciences achieves the highest SI, with a concentration of output in this field more than nine times as high as expected (9.40). Maastricht University ranks second (4.22) and the University of Tampere third most specialised (4.18) within the extended selection. Nine universities have an ARC higher than the University of Cambridge (1.71, 10th instead of first as among the top 25), but with somewhat similar scores between 1.71 and 2.01. The University of Oulu and the University of Milan obtain the highest citation scores (2.01), followed by the University of Florence (1.84) and Charité–Universitätsmedizin Berlin (1.80). In terms of ARIF, there are 35 universities that score better than VU–University Amsterdam (first among the 25 most active universities presented above). UNIPA–University of Palermo and UNIPG–University of Perugia have the highest ARIF scores (both 1.58), just above ETH Zurich (1.57). At 1.51, The Polytechnic University of Milan achieves the third highest ARIF. Finally, for the proportion of its papers in the top 10% most-cited publications, Cambridge is now in 12th instead of first position. The share of publications in this field in the top 10% most-cited articles is higher than or equal to 20% for 14 institutions. The UNIMI–University of Milan (29.5%), which is not specialised in the field, the University of Jyväskylä (27.3%) and the University of Iceland are the three leaders.

3.2.5 Natural Sciences

Biology

About 325,000 publications indexed in Scopus fall in the field of Biology (Table XIX). The ERA was involved in about 121,400 of these publications (37%) and has a share of 31% of world publications in this field using fractional counting (102,300). Although the ERA is not specialised in Biology (0.96), its scientific impact is above the world level irrespective of the impact indicator used; it scores an ARC of 1.21, an ARIF of 1.16 and a proportion of highly cited publications in the top 10% most-cited publications at 13.4%.

Of the 25 universities with the largest scientific production among the selected 303 ERA universities, five are from the UK and four are from Sweden. Four countries are tied for third position with two universities each: Denmark, France, Belgium, and Switzerland. WUR–Wageningen University and Research Centre has the largest output using both full (2,465) and fractional (1,282) counting. The University of Copenhagen is the second largest contributor, with more than 1,600 (FULL; 750 FRAC) publications, closely followed by the Swedish University of Agricultural Sciences (1,548 FULL; 762 FRAC). Overall, contributions from affiliated hospitals are fairly limited within this selection, generally with less than 3% of a university's publications involving university hospitals. The exception is the University of Zagreb, which has co-authored 8% of its publications in Biology with at least one author from affiliated hospitals.

WUR–Wageningen University and Research Centre and the Swedish University of Agricultural Science perform strongly in Biology based on their large outputs, heavy specialisation and overall strong impact. The University of Edinburgh is also notable for its high scientific impact.

Fifteen of the 25 universities are specialised in Biology (60%). The Swedish University of Agricultural Sciences is the most specialised, publishing more than seven times as much as expected (SI 7.21). WUR–Wageningen University and Research Centre ranks second (6.01), far ahead of Montpellier 2 University (2.39). In terms of scientific impact, the University of Edinburgh and the University of Zurich are consistently found among the five leaders. The University of Edinburgh ranks first according to ARC (2.08), with its papers having received more than twice as many citations as the average world paper. The University of Zurich (1.93), the University of Oxford (1.91) and the Swedish University of Agricultural Sciences (1.91) follow with similar scores. Considering the ARIF, the University of Sheffield scores best with 1.67, closely followed by the University of Zurich (1.65) and the University of Cambridge (1.64). Eighteen universities in this selection have at least 20% of their articles in Biology among the top 10% most-cited articles. Pierre and Marie Curie University has the highest share (PMCU; 25.5%), followed by ETH Zurich and the University of Edinburgh (both 25.3%) in second place, while the University of Sheffield ranks third (24.8%).

Table XIX Scientific performance as measured in Scopus for the selected 25 ERA universities in Biology (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		**325,063**	**325,063**	**n.c.**	**1.00**	**1.00**	**1.00**	**10.0**
Total ERA		**121,373**	**102,300**	**n.c.**	**0.96**	**1.21**	**1.16**	**13.4**
WUR - Wageningen Univ and Res Centre	NL	2,465	1,282	0	6.01	1.64	1.36	20.0
University of Copenhagen	DK	1,633	766	0	1.30	1.75	1.44	23.2
Swedish Univ of Agricultural Sciences	SE	1,548	762	0	7.21	1.91	1.55	21.4
University of Helsinki	FI	1,519	759	0	2.01	1.42	1.36	14.8
Ghent University	BE	1,398	684	0	1.42	1.67	1.49	20.6
University of Oxford	GB	1,391	622	1	0.84	1.91	1.60	22.9
University of Cambridge	GB	1,220	539	1	0.72	1.65	1.64	22.1
University of Aarhus	DK	1,211	552	1	1.58	1.72	1.37	21.5
Pierre and Marie Curie University	FR	1,166	506	1	0.91	1.76	1.55	25.5
University of Zurich	CH	1,095	472	0	1.21	1.93	1.65	24.3
University of Göttingen	DE	998	494	0	2.03	1.84	1.39	23.2
Univ of London, Imperial Coll London	GB	971	385	3	0.58	1.75	1.60	22.0
University of Sheffield	GB	957	423	0	1.15	1.76	1.67	24.8
ETHZ-Swiss Federal Inst of Tech Zurich	CH	956	429	0	0.91	1.85	1.62	25.3
University of Barcelona	ES	950	470	0	1.08	1.49	1.28	17.1
University of Edinburgh	GB	930	411	1	0.93	2.08	1.61	25.3
Uppsala University	SE	899	425	1	1.34	1.51	1.40	20.4
Lund University	SE	879	474	1	1.13	1.70	1.46	23.3
University of Vienna	AT	857	413	0	2.16	1.34	1.32	16.5
Charles University in Prague	CZ	851	355	1	0.89	1.34	1.17	11.8
Montpellier 2 University	FR	833	345	0	2.39	1.89	1.56	20.5
Stockholm University	SE	827	396	0	2.16	1.77	1.48	21.9
Katholieke Universiteit Leuven	BE	766	402	1	0.71	1.48	1.27	18.0
University of Oslo	NO	755	335	0	0.88	1.35	1.40	16.1
University of Zagreb	HR	703	477	8	1.59	0.35	0.45	0.8

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

When extending the analysis to include the entire selection of 303 ERA universities, 232 published at least 30 publications relevant to the field of Biology. Among them, many are highly specialised in this field, although four stand out with especially high SI scores: Daugavpils University (11.74), the University of Dubrovnik (11.42), the Szent István University (11.22) and the Estonian University of Life Sciences (10.13). These institutions are heavily specialised in Biology, but they have relatively small outputs compared to the other leading universities. Their publication output in the field ranges from 75 to 610 papers using full counting. The Swedish University of Agricultural Sciences, first among the 25 most-publishing universities, is outdone by six universities with smaller output. In terms of scientific impact, universities with smaller output also take the lead. Fourteen of them obtain higher ARCs than the University of Edinburgh (first in the selection of 25 universities). With an ARC of 3.98, EPFL ranks far ahead of the others. It is followed by the Weizmann Institute of Science (2.78) and Joseph Fourier University (2.68). Based on ARIF, 23 universities published on average in journals with higher impact than the University of Sheffield (ARIF 1.67). The Weizmann Institute of Science obtains the highest journal-based score (2.27), ahead of the University of Cologne (2.05) and the Medical University of Vienna (1.99). The Weizmann Institute of Science (39.1%) publishes the highest percentage of papers in the top 10% most-cited publications in Biology, followed by the University of Freiburg (34.2%)

and Joseph Fourier University (34.0%). PMCU, first among the 25 most-publishing universities, drops to the 21st place regarding its share of highly cited papers.

Chemistry

The field of Chemistry is almost twice as large as the field of Biology, with close to 615,000 publications in Scopus between 2007 and 2011 (Table XX). The ERA's contribution to this field is more than 208,100 publications using full counting (34%) and about 30% based on fractional counting (close to 183,700). Although the ERA is not specialised in Chemistry (0.91), its research impact is higher than the world level, with an ARC of 1.12, an ARIF of 1.17 and a proportion of 11.1% of its papers in the top 10% most-cited publications.

Table XX Scientific performance as measured in Scopus for the selected 25 ERA universities in Chemistry (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		**614,826**	**614,826**	**n.c.**	**1.00**	**1.00**	**1.00**	**10.0**
Total ERA		**208,141**	**183,671**	**n.c.**	**0.91**	**1.12**	**1.17**	**11.1**
ETHZ-Swiss Federal Inst of Tech Zurich	CH	2,210	1,422	0	1.60	1.55	1.46	19.8
University of Oxford	GB	2,013	1,265	1	0.91	1.49	1.45	17.4
University of Barcelona	ES	1,973	999	2	1.22	1.41	1.37	13.6
Pierre and Marie Curie University	FR	1,849	921	1	0.83	1.23	1.39	12.8
University of Strasbourg	FR	1,760	1,011	0	2.39	1.50	1.42	15.4
Katholieke Universiteit Leuven	BE	1,742	965	1	0.91	1.31	1.33	14.2
University of Manchester	GB	1,676	1,024	1	0.89	1.23	1.41	12.3
University of Cambridge	GB	1,650	970	2	0.69	2.03	1.58	21.5
Claude Bernard University Lyon 1	FR	1,628	875	1	1.60	1.29	1.26	13.4
Ludwig Maximilian University of Munich	DE	1,573	1,093	2	1.10	1.41	1.26	18.1
Alma Mater Studiorum Univ of Bologna	IT	1,561	970	1	1.23	1.34	1.40	13.7
University of Münster	DE	1,547	1,041	2	2.30	1.47	1.29	16.1
École polytechnique fédérale de Lausanne	CH	1,435	806	0	1.41	2.27	1.53	28.3
University of Valencia	ES	1,402	778	2	1.53	1.55	1.41	18.2
Charles University in Prague	CZ	1,396	719	4	1.02	1.03	0.99	10.2
Univ of London, Imperial Coll London	GB	1,366	785	7	0.56	1.90	1.47	24.4
University of Porto	PT	1,356	831	0	1.72	1.25	1.19	11.8
Technical University Munich	DE	1,354	840	2	0.93	1.30	1.42	13.0
UNIROMA1 - Sapienza University of Rome	IT	1,282	735	1	0.86	1.00	1.26	10.0
UNIFI - University of Florence	IT	1,261	690	0	1.39	1.52	1.40	19.3
University of Paris XI	FR	1,240	609	1	0.99	1.22	1.32	13.6
UNIMI - University of Milan	IT	1,230	671	2	1.07	1.36	1.34	12.6
University of Erlangen-Nuremberg	DE	1,205	753	1	1.26	1.55	1.45	17.8
RWTH Aachen University	DE	1,193	798	1	1.22	1.67	1.34	18.0
Univ of Bordeaux 1 Sci Tech	FR	1,180	625	0	2.49	1.79	1.41	23.4

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

Of the 25 universities with the largest outputs in Chemistry, five are located in France and five are located in Germany. Italy and the UK follow with four universities each. At the university level, ETH Zurich ranks first with more than 2,200 (FULL) publications (about 1,400 FRAC). The University of Oxford (2,013 FULL) published the second highest number of publications based on full counting. These two universities are the only ones that published more than 2,000 articles in

Chemistry during the period analysed (2007–2011). Ten universities contributed between 1,500 and 1,999 articles in chemistry. The University of Barcelona is the third most active counting each article once but is seventh based on fractional counting (1,973 FULL; 999 FRAC). This implies that the University of Barcelona publishes a large share of its papers in collaboration with other institutions. Other changes are observed when the ranking is based on fractional counting. The University of Oxford is still the second most active (1,265 FRAC), but the third place is occupied by the Ludwig Maximilian University of Munich (1,093 FRAC), much higher than its 10th position based on full counting (about 1,573). The University of Münster also improve its ranking, improving by eight ranks to the fourth position (1,547 FULL; 1,041 FRAC). Overall, research in Chemistry is mostly performed on main university campuses, with small or nonexistent contributions from affiliated hospitals. Imperial College London is the only university within this selection with contributions from its affiliated hospitals slightly higher than 5% (7%).

Overall, the University of Strasbourg and ETH Zurich are among the top performing universities in Chemistry, combining large outputs, high specialisation and strong impact. The University of Münster and the University of Bordeaux 1 Science and Technology also combine specialisation and high scientific impact. Their outputs, however, are somewhat lower. EPFL is also worthy of mention for its particularly high scientific impact.

The University of Bordeaux 1 Science and Technology is the most specialised university among the top 25 (SI 2.49). The University of Strasbourg (2.39) and the University of Münster (2.30) are second and third, respectively. In terms of scientific impact, École polytechnique fédérale de Lausanne (EPFL), the University of Cambridge and Imperial College London are in the lead for all three impact indicators (top five). EPFL has the highest ARC (2.27) followed by the University of Cambridge (2.03) and Imperial College London (1.90). The University of Cambridge also performs strongly according to ARIF with a score of 1.58 and is followed by EPFL (1.53) in second and and Imperial College London (1.47) in third place. EPFL takes the lead in terms of highly cited publications, with a score of 28.3%, leaving Imperial College London (24.4%) and the University of Bordeaux 1 Science and Technology (23.4%) as second and third most-cited universities. Interestingly, the EPFL is specialised in this field (SI 1.41), while Imperial College London is not (0.56).

Among the 303 ERA universities, 266 have at least 30 publications in Chemistry. Fifteen universities are more specialised than any of the most-publishing universities in the field. The Institute of Chemical Technology Prague and the University of Chemical Technology and Metallurgy in Bulgaria achieve the highest SI of this selection (5.12 and 5.08, respectively). Considering their obvious dedication to Chemistry, these high score are not surprising. The Polish Adam Mickiewicz University (3.96) follows as the third most specialised. In terms of ARC, EPFL is still in the lead within this extended selection (2.27), followed by the University of Mons (2.22) and the University of Fribourg (1.90). The Radboud University Nijmegen has the highest ARIF (1.84), followed by the National University of Ireland in Maynooth (1.78) and the Weizmann Institute of Science (1.77). The University of Cambridge, first among the most-publishing universities, is now in ninth position. Finally, regarding highly cited publications, Innsbruck Medical University is the only university with almost one-third of its articles among the top 10% most-cited publications (32.4%). The University of West Bohemia (28.9%) ranks second and

Trinity College Dublin (28.6%) third, both slightly ahead of EPFL (first in the top 25 presented above with 28.4%).

Earth & Environmental Sciences

Earth & Environmental Sciences account for close to 244,000 publications in the Scopus database (Table XXI). The ERA contributed to more than 95,600 of these publications (39% FULL) and has a share of about one-third of world papers using fractional counting (about 79,700). The ERA is not specialised in this field since the concentration of its output is the same as that observed at the world level (SI 1.00). Overall, the ERA has a high scientific impact as expressed by its ARC (1.21), ARIF (1.15) and proportion of its papers among highly cited publications (12.7%).

Nine universities out of the 25 with the largest outputs in this field are located in the UK. The Netherlands is second most strongly represented with four universities, followed by Denmark and France, each with three universities. Among the most active ERA universities, ETH Zurich ranks first, with about 2,300 publications based on full counting and 1,060 publications based on fractional counting. Pierre and Marie Curie University follows as second strongest for both indicators (respectively 1,645 and 600). Changes observed between both counting methods modify the list of universities presented in the top 25. The University of Leeds is third using full (1,174 FULL) but in sixth position using fractional counting (472 articles). TU Delft ranks third most active university in the Earth & Environmental Sciences based on fractional counting (525 articles). As expected, contributions from affiliated hospitals are negligible in Earth & Environmental Sciences. Affiliated hospitals do not contribute to publications in this field, with the exception of hospitals affiliated to the University of Copenhagen and the University of Manchester; however, their contributions are, respectively, 2% and 1%.

ETH Zurich is one of the top performing universities in Earth and Environmental Sciences, combining the largest output, the highest level of specialisation and some of the strongest scores in impact indicators. Stockholm University also ranks highly with smaller outputs, but high specialisation and high scientific impact.

ETH Zurich, which has the largest output, is also the most specialised university in this group (3.02), ahead of Stockholm University (2.67) and WUR–Wageningen University and Research Centre (2.35). The scientific impact of the University of Bristol is particularly high, as it is the only one consistently positioned in the top five. Being cited more than twice as much as expected, Stockholm University has the highest ARC (2.25), followed by the University of Bristol (2.11) and ETH Zurich (2.06). Four universities are in the lead with similar impact based on ARIF: the University of Oxford (1.58), VU–University Amsterdam (1.55), the University of Bristol (1.51) and Stockholm University (1.50). With 28% of its articles within the top 10% most-cited publications in Earth & Environmental Sciences, the University of Bristol ranks first, with the Joseph Fourier University in second (27.3%) and the University of Cambridge in third place (26.9%) according the share of 10% most frequently cited publications.

Table XXI Scientific performance as measured in Scopus for the selected 25 ERA universities in Earth & Environmental Sciences (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		**243,942**	**243,942**	**n.c.**	**1.00**	**1.00**	**1.00**	**10.0**
Total ERA		**95,604**	**79,664**	**n.c.**	**1.00**	**1.21**	**1.15**	**12.7**
ETHZ-Swiss Federal Inst of Tech Zurich	CH	2,335	1,063	0	3.02	2.06	1.44	26.3
Pierre and Marie Curie University	FR	1,645	600	0	1.44	1.81	1.35	23.9
University of Leeds	GB	1,174	472	0	1.73	1.64	1.33	20.6
University of Southampton	GB	1,129	519	0	1.95	1.42	1.34	15.7
Utrecht University	NL	1,113	518	0	1.50	1.70	1.47	20.1
Univ of London, Imperial Coll London	GB	1,099	465	0	0.80	1.51	1.23	20.2
University of Cambridge	GB	1,062	459	0	0.80	1.90	1.40	26.9
Paul Sabatier University	FR	1,033	346	0	1.73	1.46	1.29	17.7
TUDelft - Delft University of Technology	NL	965	525	0	2.01	0.92	0.93	9.9
University of Oslo	NO	959	404	0	1.42	1.66	1.31	20.5
University of Bristol	GB	908	384	0	1.52	2.11	1.51	28.1
University of Helsinki	FI	902	374	0	1.33	1.70	1.24	23.3
University of Edinburgh	GB	863	335	0	1.00	1.71	1.40	19.6
Stockholm University	SE	836	367	0	2.67	2.25	1.50	25.8
WUR - Wageningen Univ and Res Centre	NL	821	375	0	2.35	1.66	1.48	18.9
University of Oxford	GB	820	351	0	0.63	1.96	1.58	25.9
University of Copenhagen	DK	812	332	2	0.76	1.64	1.35	17.4
Joseph Fourier University	FR	793	329	0	1.89	1.98	1.35	27.3
Univ of London, Univ Coll London	GB	783	314	0	0.54	1.38	1.24	18.8
University of Bergen	NO	714	272	0	2.05	1.83	1.31	18.3
DTU-Technical University of Denmark	DK	672	345	0	1.80	1.55	1.16	19.9
University of Aarhus	DK	663	268	0	1.03	1.75	1.39	22.1
University of Bern	CH	647	232	0	1.22	2.03	1.43	25.7
University of Manchester	GB	643	279	1	0.61	1.55	1.33	17.4
VU - University Amsterdam	NL	637	258	0	1.69	1.95	1.55	23.2

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

Out of the 303 ERA universities, 235 have at least 30 publications using full counting in this field. The Dublin Institute for Advanced Studies is the most specialised among all selected ERA universities (SI 5.19), publishing more than five times as many publications in Earth & Environmental Sciences as expected, and is positioned ahead of the University of Miskolc (4.01) and the University of Algarve (3.67), the second and third most specialised universities in the field. Using this extended selection, ETH Zurich, most specialised among the most active, is in sixth position according to SI. As indicated by the ARC, three universities are more cited than Stockholm University (first among the 25 most-publishing universities), namely the University of Antwerp (2.96), followed by the University of Geneva (2.51) and the University of Southern Denmark (2.27). According to ARIF, the Norwegian School of Veterinary Science ranks first with a score of 2.07, which indicates that in general it publishes in journals with impact factors twice as high as the average. However, its output is only 30 articles in full counting and 10 using fractional counting. The University of Antwerp has the second highest ARIF (1.80) and the Karolinska Institute follows with an ARIF of 1.68. While the output of the latter is low as well (43 FULL; 14 FRAC), the University of Antwerp published exactly 10 times as many papers as the Norwegian School of Veterinary Science (300 FULL; 140 FRAC). Four universities have more than 30% of their publications in Earth & Environmental Sciences among the top 10% most-cited in the field

worldwide. Similarly to the rankings based on ARC, the University of Antwerp ranks first according to this indicator (38.2%), ahead of the University of Southern Denmark (36.1%), the University of Johannes Gutenberg University of Mainz (32.5%) and University College Cork (30.1%). The University of Bristol, first in the selection of 25 universities, is now in seventh place (28.1%).

Mathematics & Statistics

More than 197,000 publications relevant to Mathematics & Statistics are indexed in the Scopus database (Table XXII). The ERA contributed to about 83,300 of these papers (42%) and has a slightly lower share of the world output of about 36% using fractional counting (about 71,700). The ERA is specialised in Mathematics & Statistics (SI 1.11), but its scientific impact is near the world level as expressed by its ARC (1.05), ARIF (1.08) and percentage of papers among highly cited publications (10.6%).

Among the 25 universities with largest outputs in Mathematics & Statistics, six are located in Spain and six in France, three of which are among the five leaders in terms of publications. The UK follows with five universities. The two most active universities in Mathematics & Statistics are French. With close to 1,800 publications using full counting (1,051 in fractional counting), Pierre and Marie Curie University ranks first, followed by the Paris Diderot University, although with much fewer papers (956 FULL; 579 FRAC), as second and UNIROMA1–Sapienza University of Rome, the University of Paris XI, the Katholieke Universiteit Leuven and the University of Cambridge as third to sixth most active in the field, all with more than 700 publications (FULL; between 425 and 465 based on FRAC). Contributions from affiliated hospitals are limited in Mathematics & Statistics.

In addition to having the largest output and the strongest specialisation among the 25 most-publishing universities in Mathematics and Statistics, the Pierre and Marie Curie University also has high scientific impact. The Paris Diderot University, the University of Granada, and the University of Paris XI also perform strongly, being highly specialised and having more impact than the world generally.

Nineteen out of these 25 universities are specialised in Mathematics & Statistics and the most active is also the most specialised university: Pierre and Marie Curie University has the highest SI (3.17) and is closely followed by the second most active, Paris Diderot University (3.06). The University of Granada is the third most specialised (2.98) among the most active universities in the field. Three universities—the University of Cambridge, ETH Zurich, and Imperial College London—have particularly strong scientific impact, being among the top five leaders for the three citation indicators. The Autonomous University of Barcelona scores best in terms of ARC (1.86), ahead of ETH Zurich in second (1.65) and the University of Cambridge in third (1.51). In terms of ARIF, the University of Cambridge moves up to take the lead with a score of 1.42, almost tied with ETH Zurich (1.40). The University of Paris XI (1.37), Imperial College London (1.34) and the University of Warwick (1.32) follow with similar results. Imperial College London takes the lead according to highly cited publications (19.2%). The University of Cambridge (17.7%), the Katholieke Universiteit Leuven (17.6%) and the University of Paris XI (17.0%) have the second, third and fourth highest shares of highly cited publications.

Table XXII Scientific performance as measured in Scopus for the selected 25 ERA universities in Mathematics & Statistics (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		**197,223**	**197,223**	**n.c.**	**1.00**	**1.00**	**1.00**	**10.0**
Total ERA		**83,300**	**71,719**	**n.c.**	**1.11**	**1.05**	**1.08**	**10.6**
Pierre and Marie Curie University	FR	1,788	1,051	0	3.17	1.17	1.22	12.8
Paris Diderot University	FR	956	579	2	3.06	1.21	1.24	11.6
University of Oxford	GB	772	465	0	1.03	1.33	1.31	13.8
UNIROMA1 - Sapienza University of Rome	IT	749	463	0	1.69	0.85	1.11	7.8
University of Paris XI	FR	731	439	0	2.18	1.31	1.37	17.0
Katholieke Universiteit Leuven	BE	705	433	0	1.26	1.34	1.21	17.6
University of Cambridge	GB	703	426	1	0.93	1.51	1.42	17.7
Univ of London, Imperial Coll London	GB	646	402	1	0.85	1.46	1.34	19.2
University of Manchester	GB	642	415	0	1.10	0.84	1.04	8.7
University of Granada	ES	631	425	0	2.98	1.14	1.09	11.7
Complutense University of Madrid	ES	625	370	0	1.75	0.80	1.10	7.2
Paul Sabatier University	FR	613	356	0	2.16	1.27	1.24	14.5
Aix-Marseille Université	FR	604	356	0	1.85	1.26	1.23	13.2
Charles University in Prague	CZ	595	354	0	1.46	0.99	0.96	7.8
Technical University of Lisbon	PT	585	371	0	2.84	1.08	1.15	10.0
Claude Bernard University Lyon 1	FR	559	332	0	1.93	1.36	1.13	14.7
ETHZ-Swiss Federal Inst of Tech Zurich	CH	549	362	0	1.27	1.65	1.40	16.7
Technion Israel Institute of Technology	IL	545	375	0	2.12	0.94	1.15	11.0
University of Seville	ES	539	333	0	2.41	1.10	1.10	11.4
Technical University of Catalonia	ES	536	370	0	2.55	1.22	1.19	13.0
UNIPD - University of Padua	IT	518	343	0	1.64	0.93	1.05	7.4
Tel Aviv University	IL	513	329	2	1.09	0.93	1.30	12.2
University of Warwick	GB	508	304	0	2.40	1.10	1.32	12.1
Polytechnic University of Valencia	ES	508	352	0	2.62	1.06	1.03	11.1
Autonomous University of Barcelona	ES	499	267	0	1.05	1.86	1.22	11.3

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

Out of the 303 ERA universities, 250 were involved in at least 30 publications in Mathematics & Statistics. Many of these are highly specialised. Indeed, Pierre and Marie Curie University, which ranked first according to specialisation among the 25 most actively publishing universities, loses 18 ranks to less active universities in this extended selection. Plovdiv University ranks first (7.17), ahead of Babes-Bolyai University (6.03) and Hasselt University (5.51). Seven universities are ahead of or tied with the Autonomous University of Barcelona (first in the top 25 most-publishing universities) in terms of ARC. Trinity College Dublin is first, with an ARC of 2.77, followed by the University of Craiova (2.41) and the University of Bristol (2.15). On average, the Karolinska Institute publishes in the most frequently cited journals (ARIF 1.65), while the University of Limerick has the second (1.56) and the University of Bristol the third highest ARIF (1.47). The University of Cambridge, which had the highest ARIF among the 25 most active universities, holds fourth place in this extended selection (1.42). Based on highly cited publications, Imperial College London, first among the 25 universities, drops from the first to the 14th place. With 28.3% of its articles within the top 10% most-cited publications, the University of Freiburg has the highest share of highly cited papers in this field. The University of Craiova is second (27.2%) slightly ahead of the University of Bristol (27.1%).

Physics & Astronomy

With more than 880,000 publications from 2007 to 2011, Physics & Astronomy is one of the largest fields in the Scopus database (Table XXIII). Overall, the ERA was involved in close to 352,800 publications in this area of research (40%) and has a share of about 33% of world publications using fractional counting (about 293,100). Although the ERA is not specialised in Physics & Astronomy (1.02), its scientific impact is above the world level, with an ARC of 1.14, an ARIF of 1.10 and 11.8% of its papers in the top 10% most-cited publications.

Out of the 25 universities with the highest output in this field, seven each are from the UK and France and four are from Germany. Three of the five leaders in the number of publications are from the UK; the two others are from France. The University of Cambridge is the most active university in Physics & Astronomy with close to 7,000 publications using full counting (about 3,550 FRAC). Pierre and Marie Curie University follows closely behind with 6,800 publications (FULL; about 2,550 FRAC) and the University of Paris XI is in third place with about 6,200 publications (FULL; around 2,450 FRAC). The large differences between and full and fractional counting emphasise the high collaboration level in Physics & Astronomy. Contributions from affiliated hospitals in Physics & Astronomy within the selection of 25 universities stand at 1% or less for all institutions, indicating that their hospitals are not involved, which is to be expected in the field of Physics & Astronomy.

The University of Cambridge, the University of Paris XI, the Paris Institute of Technology and Pierre and Marie Curie University all perform strongly in Physics & Astronomy, with large outputs, high specialisation and overall high scientific impact. Ludwig Maximilian University Munich also ranks high, combining the three highest impact scores within the selection of the 25 most-publishing universities. However, it is not specialised in this field.

Universities from France are the most specialised within this selection. The Paris Institute of Technology is the most specialised institution (SI 4.31), while the University of Paris XI ranks second (2.86) and Joseph Fourier University third (2.85) for this indicator. The Ludwig Maximilian University of Munich and the University of Edinburgh have particularly high scientific impact in Physics & Astronomy in this selection of 25 universities, being first and second respectively in terms of ARC (2.40 and 2.04), ARIF (1.54 and 1.47) and proportion of papers among the most-cited articles (25.1% and 24.7). However, none of these two universities are specialised in the field (SIs of 0.70 and 0.72, respectively). Heidelberg University and Imperial College London, neither of which are specialised in Physics & Astronomy (SIs of 1.01 and 0.98, respectively), are also consistently found among the five leaders according to the three scientific impact indicators. Heidelberg University has the third highest ARC (2.03), very close to the University of Edinburgh (2.04) in second place. In terms of ARIF, the Paris Institute of Technology occupies third place (1.46) almost tied with the University of Edinburgh (1.47). Imperial College London (1.43), Heidelberg University (1.42) and the University of Manchester (1.40) follow with similar performances to those of the leaders. Having a slightly smaller share of the top 10% most-cited papers than Ludwig Maximilian University of Munich (25.1%) and the University of Edinburgh (24.7%), EPFL (23.3%) completes the top three in terms of highly cited publications.

Table XXIII Scientific performance as measured in Scopus for the selected 25 ERA universities in Physics & Astronomy (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		**880,467**	**880,467**	**n.c.**	**1.00**	**1.00**	**1.00**	**10.0**
Total ERA		**352,826**	**293,102**	**n.c.**	**1.02**	**1.14**	**1.10**	**11.8**
University of Cambridge	GB	6,986	3,546	0	1.71	1.76	1.32	21.2
Pierre and Marie Curie University	FR	6,789	2,551	0	1.61	1.68	1.35	19.3
University of Paris XI	FR	6,173	2,456	0	2.86	1.80	1.37	18.6
University of Oxford	GB	4,922	1,974	0	0.98	1.81	1.39	21.1
Univ of London, Imperial Coll London	GB	4,828	2,061	1	0.98	1.96	1.43	22.7
ETHZ-Swiss Federal Inst of Tech Zurich	CH	4,553	2,164	0	1.69	1.73	1.35	21.0
UNIROMA1 - Sapienza University of Rome	IT	4,379	1,569	0	1.28	1.46	1.37	15.4
Joseph Fourier University	FR	4,084	1,568	0	2.85	1.57	1.34	16.4
Paris Diderot University	FR	3,973	1,319	0	1.34	1.84	1.33	19.8
Univ of London, Univ Coll London	GB	3,801	1,396	1	0.66	1.72	1.36	18.2
University of Manchester	GB	3,686	1,473	1	0.88	1.60	1.40	15.9
École polytechnique fédérale de Lausanne	CH	3,641	1,752	0	2.14	1.91	1.33	23.3
Royal Institute of Technology	SE	3,527	1,581	0	2.31	1.43	1.21	15.4
Technical University Munich	DE	3,389	1,536	1	1.17	1.80	1.28	19.6
UNIPD - University of Padua	IT	3,307	954	0	1.02	1.74	1.33	20.0
Heidelberg University	DE	3,249	1,167	1	1.01	2.03	1.42	22.8
Katholieke Universiteit Leuven	BE	3,169	1,254	0	0.82	1.22	1.15	12.6
Paris Institute of Technology	FR	3,125	1,123	0	4.31	1.97	1.46	21.6
Aix-Marseille Université	FR	2,869	1,078	0	1.27	1.79	1.35	19.7
Paul Sabatier University	FR	2,815	1,078	0	1.47	1.31	1.13	13.1
Alma Mater Studiorum Univ of Bologna	IT	2,787	945	1	0.84	1.46	1.26	14.3
University of Southampton	GB	2,733	1,483	0	1.51	1.49	1.28	16.1
Ruhr University Bochum	DE	2,644	1,130	0	1.65	1.53	1.32	18.6
Ludwig Maximilian University of Munich	DE	2,626	1,000	0	0.70	2.40	1.54	25.1
University of Edinburgh	GB	2,613	867	1	0.72	2.04	1.47	24.7

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

Extending the above selection to all 303 ERA universities, 269 published at least 30 publications in Physics & Astronomy. The Dublin Institute for Advanced Studies is the most specialised institution in this extended selection, with an SI of 7.72. The Paris Institute of Technology, first among the top 25, now ranks second (4.31), followed by the Macedonian Academy of Sciences and Arts, the third most specialised (3.47). Based on the, five universities are ahead of the Ludwig Maximilian University of Munich (now in sixth place). The University of Lugano, which is not specialised at all in this field of research (0.53), achieves the highest score (3.07), ahead of the University of Nova Gorica (2.80) and Radboud University Nijmegen (2.72). The University of Nova Gorica also publishes articles in high-impact journals, as expressed by its ARIF of 1.95, the strongest within this selection. It is followed by the University of Cyprus (1.80), University College Dublin (1.76), the University of Lugano (1.75) and the University of Bergen (1.75). The Ludwig Maximilian University of Munich drops to 19th place in this extended selection. Looking at the share of highly cited publications, Roskilde University is the only one with more than 30% of their papers falling within the top 10% most-cited publications (32.4%). The University of Lugano has the second highest percentage (29.5%), ahead of the University of Nova Gorica (28.9%). The Ludwig Maximilian University of Munich is in 10th place.

3.2.6 General Fields

General Arts, Humanities & Social Sciences

The General Arts, Humanities & Social Sciences represent a fairly small field, with only 9,900 publications indexed in Scopus for the 2007–2011 period (Table XXIV). It includes all journals publishing General Arts, Humanities & Social Sciences papers that cannot be assigned to one of the research fields described above. Researchers from the ERA were involved in about 3,200 of these publications (32%; FULL). Based on fractional counting, the ERA's share is 30% with about 3,000 publications. The ERA is not specialised publishing in these General Arts, Humanities & Social Sciences journals, as expressed by its SI of 0.94, and its scientific impact is on par with or slightly below the world level irrespective of the indicator used. In fact, it has an ARC of 1.06, an ARIF of 1.08 and only 11% of its papers are in the top 10% most-cited publications.

With only eight universities above the threshold of 30 papers, it is difficult to present a deep analysis of this field. Nevertheless, six of the eight universities are in the UK, and for the majority of those for which impact indicators could be computed (ARIF only), the scores were above the world level. Also, with only 33 publications using fractional counting, the University of Tartu is still heavily specialised in this area.

Table XXIV Scientific performance as measured in Scopus for the selected eight ERA universities in General Arts, Humanities & Social Sciences (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		**9,896**	**9,896**	**n.c.**	**1.00**	**1.00**	**1.00**	**10.0**
Total ERA		**3,202**	**2,989**	**n.c.**	**0.94**	**1.06**	**1.08**	**11.0**
University of Oxford	GB	70	45	1	2.03 ▲	n.c.	1.20 ▲	n.c.
University of Manchester	GB	62	44	1	2.38 ▲	n.c.	1.32 ▲	n.c.
Univ of London, Univ Coll London	GB	43	33	1	1.51 ▲	n.c.	1.29 ▲	n.c.
University of Tartu	EE	39	33	0	14.34 ▲	n.c.	n.c.	n.c.
University of Leeds	GB	35	30	0	2.73 ▲	n.c.	0.87 ▼	n.c.
University of Sheffield	GB	32	24	0	2.21 ▲	n.c.	0.94	n.c.
University of Cambridge	GB	32	24	0	1.04	n.c.	n.c.	n.c.
Ludwig Maximilian University of Munich	DE	31	23	0	1.59 ▲	n.c.	2.51 ▲	n.c.

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

Only eight universities have at least 30 publications using full counting in this field. Six of them are located in the UK, the remaining ones being in Estonia and Germany. (The limitations discussed above for the SSH apply.) The University of Oxford has the largest output, with 70 publications (FULL), followed by the University of Manchester (62 FULL) and UCL (43 FULL). The ranking remains the same using fractional counting. Seven of these eight institutions are specialised in this field. The University of Tartu stands out with a score of 14.34, much higher than the University of Manchester in second place (2.38) and the University of Sheffield in third place (2.21). Contributions from affiliated hospitals represent 1% or less of the total output for all eight universities. Because of the small size of outputs, the only impact indicator that could be computed is the ARIF. Ludwig Maximilian University of Munich published on average in journals

with higher impact factors (ARIF 2.51). The University of Manchester (1.32) and UCL (1.29) follow.

General Science & Technology

About 124,000 publications indexed in Scopus fall in the field of General Science & Technology (Table XXV). This field includes general science journals that publish papers of various disciplines and cannot be assigned to one of the research fields described above. *Science* and *Nature* are prominent examples of journals assigned to this category. The ERA contributed to close to 36,800 of these publications (30%) and has a share of 23% of world publications based on fractional counting (about 28,100 papers). The ERA is not specialised in this field (0.70), but it has a high scientific impact with an ARC of 1.70, an ARIF of 1.46 and 17.5% of its papers falling within the top 10% most-cited publications.

Among the 25 universities with the largest output in this field (within the selection of 303 ERA universities in Scopus overall), eight are from the UK. Germany and France both have have four institutions in this selection, while the Netherlands, Sweden and Switzerland have two each. The University of Oxford publishes the most papers (1,350 FULL). It is followed by the University of Cambridge (about 1,250) and UCL (around 980). Using fractional counting these three institutions maintain the same positions, with approximately 570, 560 and 430 publications, respectively. Contributions from affiliated hospitals vary widely across the 25 most actively publishing universities, indicating a high heterogeneity of medical and non-medical topics in this category. The highest score of 51% is obtained by UvA–University of Amsterdam; Utrecht University is second (45%), followed by the Paris Descartes University (39%) and the University of Copenhagen (30%).

Overall, few ERA universities are specialised in General Science & Technology (33 institutions have SI higher than 1.1). Among them, the University of Oxford and the University of Cambridge are among the most specialised and perform research that has high scientific impact. Other notable cases are those of UCL and Imperial College London, which are slightly less specialised but also have high output and high scientific impact.

The University of Oxford is not only the most active but also most specialised (SI 2.26) among the 25 universities, followed by the University of Cambridge (2.16) and the Karolinska Institute (1.98). The scores for ARC are relatively high compared to other fields, the University of Manchester ranking first with a score of 4.03, meaning that this organisation's papers received, on average, more than four times the number of citations compared to the world average publication. The University of Copenhagen has the second highest ARC (3.51), followed by the University of Helsinki (3.29). According to ARIF, ETH Zurich ranks first (2.35), with the University of Cambridge (2.04) in second position. The University of Oxford and the University of Edinburgh share the third place (1.92). Finally, 23 universities in this selection have more than 20% of their papers in the top 10% most-cited publications. They include ETH Zurich (36.5%) and Ludwig Maximilian University of Munich (35.6%), the only two with a share higher than 30%. King's College London follows with a score of 29.1%.

Table XXV Scientific performance as measured in Scopus for the selected 25 ERA universities in General Science & Technology (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		**123,938**	**123,938**	**n.c.**	**1.00**	**1.00**	**1.00**	**10.0**
Total ERA		**36,807**	**28,126**	**n.c.**	**0.70**	**1.70**	**1.46**	**17.5**
University of Oxford	GB	1,361	572	11	2.26	3.09	1.92	24.5
University of Cambridge	GB	1,251	560	9	2.16	3.18	2.04	26.5
Univ of London, Univ Coll London	GB	980	428	4	1.56	2.29	1.76	25.4
Univ of London, Imperial Coll London	GB	883	350	23	1.49	3.23	1.78	25.8
Pierre and Marie Curie University	FR	700	218	21	1.03	1.99	1.74	22.3
Karolinska Institute	SE	666	293	20	1.98	2.68	1.49	25.0
University of Edinburgh	GB	622	276	6	1.86	2.55	1.92	27.9
University of Copenhagen	DK	607	238	30	1.16	3.51	1.77	28.4
University of Zurich	CH	563	217	25	1.51	2.53	1.91	27.7
ETHZ-Swiss Federal Inst of Tech Zurich	CH	541	231	0	1.30	2.84	2.35	36.5
Ludwig Maximilian University of Munich	DE	520	206	14	1.11	3.12	1.76	35.6
Utrecht University	NL	484	196	45	1.13	2.17	1.74	26.3
Paris Descartes University	FR	459	142	39	1.34	1.51	1.40	14.4
Aix-Marseille Université	FR	422	170	10	1.48	1.88	1.68	25.3
Paris Diderot University	FR	416	128	29	1.01	2.54	1.91	26.6
Uppsala University	SE	414	168	7	1.44	3.25	1.79	22.9
Tel Aviv University	IL	411	201	26	1.12	1.70	1.47	18.7
Heidelberg University	DE	402	153	16	1.05	2.20	1.80	22.1
University of Bristol	GB	399	169	0	1.39	2.67	1.87	26.3
UvA - University of Amsterdam	NL	399	150	61	1.10	2.26	1.49	21.9
University of Manchester	GB	385	169	6	0.81	4.03	1.69	26.0
Univ of London, King's Coll London	GB	377	159	28	1.01	2.95	1.45	29.1
Charite - Universitaetsmedizin Berlin	DE	373	134	0	1.16	2.42	1.40	22.8
Technical University Munich	DE	367	139	16	0.87	2.27	1.75	25.7
University of Helsinki	FI	366	144	16	1.05	3.29	1.69	25.3

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

About two-thirds (188) of the 303 universities have at least 30 publications in the field of General Science & Technology. Only 33 are specialised in this area of research (SI higher than 1.1). Most specialised is Sofia Medical University (9.03), followed by Sofia University (4.03) and the Weizmann Institute of Science (3.36). The University of Oxford, the most specialised university in the top 25 presented above, follows in fourth position. According to the ARC, four universities have a higher citation impact than the University of Manchester (first in the top 25 most-publishing institutions). The University of Leicester is first (6.08), followed by Cardiff University (5.41), Ghent University (4.65) and the University of Vienna (4.24). None of these universities are specialised in this field, although the University of Vienna is on par with the world level. The Paris Institute of Technology, the University of Innsbruck and the University of Iceland lead in terms of ARIF with scores of 2.92, 2.65 and 2.50, respectively. ETH Zurich ranks seventh in this extended selection. As for the percentage of highly cited publications, several universities have more than one-third of their publications among the top 10%. Ghent University leads with a very high share of 41.3%; the University of Vienna (39.3%) and WUR (39.3%) follow, while ETH Zurich is now in eighth position.

3.3 FP7 THEMATIC PRIORITY

The first Framework Programme for Research and Technological Development (FP1) was launched by the European Union (EU) in 1984 for a five-year term to support and promote research and development (R&D) through the funding of R&D projects throughout the ERA. One of the key aspects of FPs is to encourage cross-border partnerships across the ERA so as to embrace the benefits of international collaboration. As it is increasingly difficult for individual nations to lead in many research areas in the face of increased competition arising from globalisation, international cooperation is viewed as a potent approach to sharing expertise and resources in order to remain competitive in a diverse set of research fields and reap the socio-economic benefits resulting from this R&D. In particular, the FPs are viewed as key instruments for achieving the goals set forth in the Lisbon Framework and the post-Lisbon Strategy for the ERA.

The EU is currently conducting its seventh Framework Programme (FP7), which is the first FP to run for a seven-year period (2007–2013). Although there is a continuum in the R&D priorities of the FPs, the specific objectives vary between FPs in response to the evolving needs of the EU, as well as the evolving context within which the EU operates. This section presents a profile of the scientific performance of the selected ERA universities in the FP7 thematic priorities in general (grouped), as well as within each of the following thematic priorities (see Section 6.4 for a detailed description of the approach used in mapping scientific publications to these priority areas):

1. Health;
2a. Food, Agriculture & Fisheries;
2b. Biotechnology;
3. Information & Communication Technologies;
4a. Nanosciences & Nanotechnologies;
4b. Materials (excluding Nanotechnologies);
4c. New Production Technologies;
4d. Construction & Construction Technologies;
5. Energy;
6. Environment (including Climate Change);
7a. Aeronautics;
7b. Automobiles;
7c. Other Transport Technologies;
8a. Socio-Economic Sciences;
8b. Humanities;
9. Space; and
10. Security.

The analyses presented in this report will in part support the European Commission in planning the Eighth Framework Programme (FP8; 2014-2020). Please note that in all of the following tables, the values shown for the world and total ERA encompass all publications in the database as opposed to publications produced by universities only.

FP7 Thematic Priorities (grouped)

Publications within the FP7 thematic priorities (grouped) represent approximately 70% of all publications in Scopus for the world as well as for the ERA countries (Table XXVI). Globally, ERA countries published more than one-third of the world's FP7-related publications (FRAC). Note that the ERA as a whole is comparable to the world in terms of the intensity of its research activity

within FP7 thematic priorities (SI 1.02); it does not devote a greater share of its total production to these areas (when taken as a whole) than is the case at the world level. Its performance in terms of scientific impact is also similar to the world average in terms of ARC and ARIF (ARC 1.10, ARIF 1.05) but is slightly above the world in terms of the percentage of papers in the top 10% most-cited publications (11.3%).

The performance of the most-publishing ERA universities in the FP7 thematic priorities (grouped) is similar to what was observed in Scopus overall (Section 3.1). This is not surprising, considering that the FP7 thematic priorities account for about 70% of all publications in Scopus. Six of the seven most actively publishing universities are from the UK, with UCL (31,300 publications FULL; 16,500 FRAC), Imperial College London (26,200 FULL; 13,700 FRAC) and the University of Oxford (25,200 FULL; 13,300 FRAC) occupying the three first positions. UCL is the only university which published more than 30,000 articles (FULL) in the FP7 thematic priorities (overall). Note that the UK is the ERA country with the highest FP7-related output.[10] While Germany is the second most active country, its most actively publishing university, the Ludwig Maximilian University of Munich, ranks 12th. Among the differences that are worthy of mention, the fifth rank of the most actively publishing universities is now occupied by the University of Copenhagen, which switched ranks with PMCU, now ranking eighth among the most actively publishing ERA universities in these areas (FULL counting).

Half of the 25 most actively publishing universities always scored higher than the world for their specialisation and impact indicators in FP7 thematic priorities (grouped). UCL is a particularly strong performer, having the highest FP7-related output and remaining close to the leader in terms of specialisation and scientific impact. Imperial College London and the University of Oxford also often appeared in the top positions for some indicators.

On average, approximately one-third of the publications of the 25 most actively publishing universities can be attributed to affiliated hospitals, and only one university, Charité–Universitätsmedizin Berlin, has no affiliated hospital. In fact, this institution is a teaching hospital on its own, and it is not affiliated with other hospitals. The affiliated hospitals of Erasmus University Rotterdam play a prominent role in its production within the FP7 thematic priorities, having contributed to close to 80% of the university's publications. This can be explained by the fact that the medical faculty of this university is also a medical centre and is therefore considered as an affiliated hospital. Three other universities have a contribution by their affiliated hospitals higher than 50% of their total scientific publications: Paris Descartes University (60%), the University of Amsterdam (53%) and the University of Copenhagen (51%).

When looking at the SI scores, half of the 25 most actively publishing universities among the 303 selected are specialised in the FP7 priorities. The most specialised are Erasmus University Rotterdam (SI 1.33), Charité (SI 1.33) and the Karolinska Institute (SI 1.31), all with similar

[10] Campbell, D., Picard-Aitken, M., Côté, G., Ventimiglia, A., Roberge, G., and Archambault, É. (2012). *Analysis and Regular Update of Bibliometric Indicators: Country and Regional Scientific Production Profiles (Analytical Report 2.3.1).* Report prepared by Science-Metrix for the European Commission Directorate-General for Research, 120 pages.

scores. In terms of scientific impact, the performance of the 25 most-publishing universities is above the world level, irrespective of the indicator used (ARC, ARIF and percentage in the top 10% most-cited publications). Among these 25 universities, the scientific impacts of the University of Oxford and the University of Cambridge are particularly high, these two institutions being respectively first and second in terms of all impact indicators (ARC, ARIF and proportion of papers in the top 10% most-cited publications). Imperial College London and Erasmus University Rotterdam are also worth mentioning, being consistently among the five leaders. Publications from the University of Oxford are, on average, the most cited, with an ARC of 1.97. Five other universities follow with ARC scores between 1.84 and 1.81, namely the University of Cambridge (1.84), Katholieke Universiteit Leuven (1.83), Erasmus University Rotterdam (1.82), Imperial College London (1.82) and UvA–University of Amsterdam (1.81). Three British universities—the University of Oxford, the University of Cambridge and Imperial College London—published, on average, in the highest impact journals (ARIFs of 1.5, 1.48 and 1.46) and also have the highest proportion of their FP7-related articles within the top 10% most-cited publications (22.3%, 20.8% and 20.7%).

Table XXVI Scientific performance as measured in Scopus for the selected 25 ERA universities in the FP7 thematic priorities (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		6,387,506	6,387,506	n.c.	1.00	1.00	1.00	10.0
Total ERA		2,357,967	2,094,535	n.c.	1.02	1.10	1.05	11.3
Univ of London, Univ Coll London	GB	31,262	16,537	25	1.16	1.71	1.43	20.0
Univ of London, Imperial Coll London	GB	26,154	13,772	40	1.04	1.82	1.46	20.7
University of Oxford	GB	25,179	13,327	22	1.00	1.97	1.50	22.3
University of Cambridge	GB	23,267	12,782	20	0.92	1.84	1.48	20.8
University of Copenhagen	DK	21,527	12,025	51	1.16	1.75	1.29	18.7
University of Manchester	GB	20,869	12,163	19	1.07	1.62	1.31	16.2
Univ of London, King's Coll London	GB	20,858	11,252	38	1.28	1.65	1.35	18.4
Pierre and Marie Curie University	FR	20,539	9,468	49	0.89	1.44	1.22	14.8
Utrecht University	NL	20,019	10,350	46	1.17	1.74	1.41	19.0
Katholieke Universiteit Leuven	BE	19,721	11,203	21	1.06	1.83	1.35	19.4
Karolinska Institute	SE	19,693	9,606	33	1.31	1.61	1.35	16.6
Ludwig Maximilian University of Munich	DE	18,242	9,635	29	1.07	1.57	1.17	17.1
UvA - University of Amsterdam	NL	17,596	9,129	53	1.19	1.81	1.42	19.4
Erasmus University Rotterdam	NL	16,150	8,425	79	1.33	1.82	1.43	20.4
Ghent University	BE	16,139	9,707	17	1.05	1.65	1.28	18.4
Heidelberg University	DE	15,950	8,457	36	1.10	1.43	1.20	15.3
Tel Aviv University	IL	15,783	9,831	38	1.12	1.29	1.25	12.8
University of Edinburgh	GB	15,769	8,800	19	1.09	1.61	1.39	18.7
University of Barcelona	ES	15,756	7,950	47	1.02	1.52	1.16	14.9
University of Zurich	CH	15,639	8,243	44	1.11	1.67	1.31	19.8
Paris Descartes University	FR	15,486	6,974	60	1.29	1.47	1.16	14.3
Charite - Universitaetsmedizin Berlin	DE	15,318	7,825	0	1.33	1.60	1.22	17.7
University of Helsinki	FI	15,256	7,583	28	1.10	1.65	1.36	17.4
Autonomous University of Barcelona	ES	15,231	8,074	47	1.08	1.34	1.16	13.3
UNIROMA1 - Sapienza University of Rome	IT	14,769	7,957	13	0.97	1.30	1.13	12.4

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

When examining the 303 selected ERA universities, only two universities did not reach the threshold of 30 publications between 2007 and 2011. Seven are more specialised than Erasmus University Rotterdam and Charité (SIs higher than 1.33), all of them having a relatively small number of publications. The most specialised university is the University of Liechtenstein (SI 1.38), even though it has only 67 publications (FULL). Several universities are almost as specialised, two with more than 3,500 publications: Gulhane Military Medical Academy (SI 1.37)

and the Medical University of Graz (SI 1.36). Seventy-seven universities are less specialised than the world, six of them having an SI lower than 0.5. Close to one-fourth of the selected universities have an ARC higher than or equal to 1.5. EPFL and ETH Zurich are the universities with the highest impact (ARCs of 2.07 and 2.05) and the only universities with an ARC higher than 2, both above the first among the top 25 universities. One-fifth of the 303 selected ERA universities have lower impact than the world, 11 of them with ARC scores lower than 0.5. The Weizmann Institute of Science and EPFL are the only universities with ARIF scores (1.59 and 1.52) higher than the University of Oxford (first position among the 25 most-publishing universities with an ARIF of 1.50). Close to two-thirds of the 303 selected ERA universities have a higher percentage of their publications in the top 10% most-cited publications than expected. Nine of them have more than 20% of their FP7-related publications within the top 10% most-cited publications. The University of Mons and ETH Zurich achieved the highest proportion with 23.5% and 22.7%, respectively, both with a higher proportion than the University of Oxford (first among the 25 most-publishing universities).

Health

Bibliometric indicators for the FP7 thematic priority of Health are presented in Table XXVII for the 2007–2011 period. This area represents close to 3 million publications at the world level and more than 1.2 million at the ERA level (FULL). ERA countries participated in one-third of the world publication in Health (37%; FRAC). Altogether, ERA countries are slightly specialised in Health, with an SI of 1.16. However, the scientific impact of the ERA is on par with the world level (ARC 1.03; ARIF 1.00; 10.4% in top 10%).

British universities are among those with the largest scientific production in Health research; six of them rank among the 25 most actively publishing universities in Health, three of which occupy the top four positions. The Netherlands is also well represented, with five universities in the top 25. UCL is far ahead of its nearest competitor, with close to 25,000 publications (FULL; 12,700 based on fractional counting). The Karolinska Institute (19,000 FULL; 9,300 FRAC), Imperial College London (17,800 FULL; 8,900 FRAC) and King's College London (17,600 FULL; 9,200 FRAC) also have large productions in Health research. When universities are ranked based on fractional counting, Tel Aviv University's position improves, moving from the 22nd to the 10th place. This can be attributed to the fact that the proportion of Tel Aviv University's output that is authored in inter-institutional collaboration is lower than for the other universities in the 25 most actively publishing universities (63% compared to an average of 75%, data not shown).

As expected, the contribution of authors from affiliated hospitals to a university's health-related publications is very high; on average (for the top 25), about 54% of a university's papers in this thematic priority involve at least one author from affiliated hospitals. As in all FP7-related priorities, Erasmus University Rotterdam has the highest hospital contribution (93%), and Charité is the only institution without an affiliated hospital due to its special status. The contribution of university hospitals is also high for Leiden University (78%), Paris Diderot University (76%) and the University of Amsterdam (75%).

Twenty-three of the 25 selected universities are above the world level for SI and all three indicators of scientific impact. UCL and the Karolinska Institute are particularly strong performers, being first and second in terms of number of publications (FULL and FRAC). Both universities are also very specialised in Health and have high scores in the impact indicators. Charité is also worth mentioning, particularly for its high level of specialisation in Health.

With the exception of the University of Cambridge—which is not specialised in Health research, devoting about the same fraction of its scientific effort to this area as the world in general (SI 1.05)—all other universities among the 25 most actively publishing are specialised; several of them are medical universities or universities highly focused on Health research, such as the Karolinska Institute. The most specialised of them are Charité (2.77) and the Karolinska Institute (2.72). In terms of scientific impact, the University of Oxford and the University of Cambridge are leaders in this selection, Oxford ranking first for all indicators (ARC of 1.99, ARIF of 1.51 and 22.87% of its papers in Health among the most cited articles), and the University of Cambridge being consistently in second or third place. According to ARC, all the 25 most actively publishing universities have published papers that are, on average, more cited than the average world paper. The University of Oxford's publications in Health are the most cited on average, with an ARC of 1.99, indicating that its publications are, on average, almost cited twice as much as the average world paper. Katholieke Universiteit Leuven and the University of Cambridge follow with ARCs of 1.89 and 1.87, respectively. Only one university among the 25 most active in Health, the Autonomous University of Barcelona, published in journals with lower impact than the average world papers (ARIF below 1). The University of Oxford and the University of Cambridge published, on average, their Health research publications in high-impact journals, ranking first and second with ARIFs of 1.51 and 1.50, respectively; Leiden University and Imperial College London both follow in third position (ARIF 1.45). In terms of the proportion of Health research output within the top 10% most-cited publications, all universities within the 25 most-publishing universities in Health are above the world level. The University of Oxford, Imperial College London and the University of Cambridge have the highest proportion of their articles within highly cited publications (22.9%, 21% and 20.8%, respectively).

When extending the analysis to the 303 universities, 285 institutions published at least 30 articles in Health. About half of these are more specialised than the world in Health research, four of which are more specialised than Charité (first within the top 25 most-publishing universities). These universities include Gulhane Military Medical Academy (SI 2.9), the Medical University of Graz (2.81), Innsbruck Medical University (2.78) and the Medical University of Lodz (2.78). In terms of ARC, the leading institutions are the same as in the selection of 25 universities. The University of Oxford and the University of Cambridge still have the first and second highest ARIFs; the Weizmann Institute of Science is in third place (18.43%). Among other universities of interest, the Johannes Kepler University of Linz (24.6%) and the Dublin Institute of Technology (23.6%) lead in terms of the highest proportion of Health articles among the top 10% most-cited publications with scores above the University of Oxford (22.87%); however, the research intensity of these two universities in Health is very low (SIs of 0.17 and 0.38, respectively).

Table XXVII Scientific performance as measured in Scopus for the selected 25 ERA universities in Health (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		2,994,163	2,994,163	n.c.	1.00	1.00	1.00	10.0
Total ERA		1,255,516	1,112,623	n.c.	1.16	1.03	1.00	10.4
Univ of London, Univ Coll London	GB	24,694	12,701	32	1.91	1.74	1.44	20.3
Karolinska Institute	SE	19,006	9,295	34	2.72	1.62	1.35	16.6
Univ of London, Imperial Coll London	GB	17,765	8,914	61	1.45	1.82	1.45	21.1
Univ of London, King's Coll London	GB	17,569	9,167	46	2.24	1.66	1.36	18.4
University of Copenhagen	DK	16,506	9,245	65	1.91	1.78	1.27	18.7
University of Oxford	GB	16,305	7,983	35	1.29	1.99	1.51	22.9
Charite - Universitaetsmedizin Berlin	DE	14,897	7,625	0	2.77	1.60	1.22	17.7
Paris Descartes University	FR	14,670	6,551	64	2.61	1.50	1.16	14.5
Pierre and Marie Curie University	FR	14,361	6,553	70	1.32	1.40	1.15	13.8
Ludwig Maximilian University of Munich	DE	14,140	7,351	38	1.75	1.58	1.16	16.6
Heidelberg University	DE	13,995	7,368	41	2.05	1.42	1.19	14.9
Utrecht University	NL	13,986	6,864	68	1.66	1.69	1.41	18.5
Erasmus University Rotterdam	NL	13,618	6,984	93	2.37	1.81	1.43	19.9
University of Cambridge	GB	13,274	6,798	37	1.05	1.87	1.50	20.8
UvA - University of Amsterdam	NL	13,107	6,274	75	1.75	1.86	1.43	19.5
University of Barcelona	ES	12,409	6,080	61	1.68	1.59	1.14	15.0
University of Zurich	CH	12,126	6,253	57	1.81	1.64	1.30	19.3
University of Manchester	GB	12,113	6,494	36	1.22	1.63	1.31	16.6
Paris Diderot University	FR	11,498	5,391	76	1.81	1.55	1.19	14.7
Radboud University Nijmegen	NL	11,455	5,871	73	2.10	1.65	1.38	17.4
Katholieke Universiteit Leuven	BE	11,397	6,053	38	1.23	1.89	1.36	20.5
Tel Aviv University	IL	11,395	6,996	53	1.70	1.22	1.17	11.3
Autonomous University of Barcelona	ES	10,455	5,130	72	1.47	1.33	1.08	12.1
Leiden University	NL	10,432	5,130	78	1.83	1.86	1.45	19.6
University of Oslo	NO	10,155	5,356	59	1.67	1.56	1.25	15.4

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

Food, Agriculture & Fisheries

As shown in Table XXVIII, close to 274,000 scientific articles were published in Food, Agriculture& Fisheries; close to 101,000 were in ERA countries, representing more than one-third of the world publication in this area (FRAC).[11] Taken all together, the research intensity of ERA countries in this priority area is equivalent to that of the world, but their scientific impact is slightly higher than the world level.

At the university level, three universities within the selection of 25 universities are from Denmark, and five countries have two institutions (Germany, Belgium, Switzerland, Italy and the Netherlands). Only seven ERA universities published more than 1,000 articles (FULL). The Wageningen University and Research Centre (WUR) has the highest output among selected ERA universities

When bibliometric indicators are examined globally, WUR and the Swedish University of Agriculture Sciences are particularly strong performers in the area of Food, Agriculture & Fisheries. They are first and second in terms of scientific output, they are highly specialised and their impact is considerably higher than the world level.

11 The Food, Agriculture & Fisheries FP7 thematic priority is closely related to the scientific field of Agriculture, Fisheries & Forestry, within the Applied Sciences domain. Therefore, the results presented here are the same as those presented in Section 3.2.1.

based on both counting methods (2,500 FULL; 1,400 FRAC) and is followed by the Swedish University of Agriculture Sciences, Ghent University and the University of Copenhagen. Denmark has two universities among the five most actively publishing universities in this area. As expected, the contribution of hospitals to publications in Food, Agriculture & Fisheries research is very low. The relative intensity of research in this area is very high among the 25 most actively publishing universities presented in Table XXVIII, as indicated by an average SI of 4. The most specialised organisation is Mendel University Brno (22.37). However, it has a very low scientific impact, as shown by a low ARC (0.35), a small ARIF (0.41) and a low percentage of articles within the top 10% most-cited publications (1.8%). Two other universities have specialisation indices higher than 10—the Swedish University of Agricultural Sciences (SI 12.28) and the Norwegian University of Life Sciences (10.8)—and only one university, Katholieke Universiteit Leuven, is at the world level (SI 1.04). The Autonomous University of Barcelona, WUR and Katholieke Universiteit Leuven have high scientific impact, being consistently among the five leaders for the three indicators (ARC, ARIF and % in top 10%). The scientific impact of four universities is below or near the world level for the three indicators. Publications from the Autonomous University of Barcelona, WUR, Utrecht University and Katholieke Universiteit Leuven are, on average, the most-cited (ARCs of 2.04, 1.83, 1.8 and 1.8, respectively). The Autonomous University of Barcelona is also first in terms of its publications in the most highly cited journals (ARIF 1.61) and in terms of the highest percentage of its articles in the 10% most cited publications (28.2%).

If the analysis is expanded to all 303 selected universities (not just those presented in Table XXVIII), 220 universities published more than 30 articles in the field. Sixty universities are more specialised and have higher scientific impact (according to the three citation indicators) than the world. Among them, the Norwegian School of Veterinary Science and the University of Trás-os-Montes and Alto Douro are particularly noteworthy for their high specialisation in this field (SIs of 15.3 and 6.6) and their high scientific impact (ARC > 1.75, ARIF > 1.37, top 10% > 22.1%). The Mendel University of Brno remains the most specialised among all selected ERA universities (SI 22.37), Trakia University is second (16.64) and the Norwegian School of Veterinary Science (15.29) is third. Publications from the University of Warwick have the highest average citation score (ARC 2.34), closely followed by those of Umeå University (2.3) and the University of Groningen (2.22). The Autonomous University of Barcelona, first among the selection of 25 universities presented above, drops to seventh place. Nineteen universities among the 303 selected, led by the University of Neuchâtel (ARIF of 1.88), published on average in higher impact journals than any of the 25 most actively publishing universities presented in Table XXVIII (ARIF $\geq$ 1.61). However, with the exception of ETH Zurich, which published 500 articles, all of these universities published fewer than 130 articles in this area. Finally, six universities have more than 30% of their articles in this area among the top 10% most-cited publications. However, these six universities only published between 87 and 127 scientific papers during this period. Umeå University is particularly strong, with a score of 39%, followed by the University of Warwick (35.09%) and UvA–University of Amsterdam (34.29%). The Autonomous University of Barcelona is in ninth place.

Table XXVIII Scientific performance as measured in Scopus for the selected 25 ERA universities in Food, Agriculture and Fisheries (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		**273,887**	**273,887**	**n.c.**	**1.00**	**1.00**	**1.00**	**10.0**
Total ERA		**100,996**	**90,452**	**n.c.**	**1.02**	**1.19**	**1.13**	**13.1**
WUR - Wageningen Univ and Res Centre	NL	2,460	1,395	0	7.82	1.83	1.51	22.5
Swedish Univ of Agricultural Sciences	SE	1,888	1,110	0	12.09	1.64	1.48	19.2
Ghent University	BE	1,653	1,087	1	2.70	1.47	1.30	17.7
University of Copenhagen	DK	1,453	790	1	1.61	1.61	1.47	15.9
University of Aarhus	DK	1,162	677	1	2.32	1.53	1.53	18.3
Mendel University Brno	CZ	1,131	907	0	22.37	0.35	0.41	1.8
University College Dublin	IE	1,056	594	0	3.15	1.66	1.38	19.6
University of Helsinki	FI	957	494	0	1.57	1.64	1.47	19.8
Utrecht University	NL	900	494	4	1.29	1.80	1.45	21.1
University of Zagreb	HR	879	615	0	2.44	0.55	0.60	3.6
UNIMI - University of Milan	IT	873	557	0	1.99	1.17	1.22	13.4
University of Zurich	CH	858	525	2	1.61	1.46	1.23	17.5
University of Edinburgh	GB	816	398	1	1.07	1.60	1.48	18.0
Katholieke Universiteit Leuven	BE	795	472	0	1.00	1.80	1.49	23.3
Alma Mater Studiorum Univ of Bologna	IT	794	498	1	1.44	1.23	1.22	14.2
Ankara University	TR	778	449	0	3.65	0.67	0.74	5.3
UMV - Norwegian Univ of Life Sciences	NO	768	377	0	10.80	1.49	1.36	15.8
Autonomous University of Barcelona	ES	746	428	1	1.22	2.04	1.61	28.2
University of Göttingen	DE	726	401	1	1.97	1.73	1.50	21.1
Technical University Munich	DE	714	410	2	1.02	1.59	1.34	20.0
DTU-Technical University of Denmark	DK	708	372	0	1.74	1.66	1.43	15.6
University of Ljubljana	SI	668	483	0	2.41	0.92	0.99	10.2
University of Bern	CH	662	363	1	1.71	1.36	1.35	16.6
Aristotle University of Thessaloniki	GR	659	446	0	1.85	1.26	1.22	12.8
BOKU-Univ of Nat Res and Appl Life Sci	AT	622	352	0	7.23	1.76	1.28	21.9

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

Biotechnology

Table XXIX presents the scientific performance of ERA universities in the FP7 thematic priority of Biotechnology (2007–2011). Close to 106,000 publications were produced in this area at the world level (FULL), one-fourth of which was produced by ERA countries (31,900 FULL; 27,500 FRAC). Although ERA countries devote a smaller fraction of their total scientific output to Biotechnology than the world in general (SI 0.8), their scientific impact is above the world level, irrespective of the impact indicator used.

At the university level, the British universities are among the leaders, with four universities in the top five and six in the top 16. Germany and Portugal have three institutions within the top 25; Switzerland, Denmark and Belgium have two. Four ERA universities published more than 400 articles (FULL) in this thematic priority. The University of Cambridge is first with 468 articles (FULL) and is followed by the University of Oxford, UCL, and WUR-Wageningen University and Research Centre. Note that less than 35 articles separate the first and fourth position. The publication score obtained using fractional counting leads to slightly different rankings for the 25 most actively publishing universities presented in Table XXIX. University College London, WUR

and Oxford are the most active universities in Biotechnology based on fractional publication counts. The contribution of affiliated hospitals to a university's publications in Biotechnology generally ranges between 0% and 15%. Within the 25 most-publishing universities in Biotechnology, hospitals affiliated with Heidelberg University (15%), the University of Copenhagen (14%) and the University of Cambridge (13%; Table XXIX) contributed the most to the production of their corresponding universities.

Table XXIX Scientific performance as measured in Scopus for the selected 25 ERA universities in Biotechnology (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		105,871	105,871	n.c.	1.00	1.00	1.00	10.0
Total ERA		31,867	27,529	n.c.	0.80	1.23	1.16	12.9
University of Cambridge	GB	468	214	13	0.92	2.44	1.49	29.8
University of Oxford	GB	455	230	7	1.03	1.52	1.40	21.2
Univ of London, Univ Coll London	GB	449	260	3	1.09	1.73	1.48	18.5
WUR - Wageningen Univ and Res Centre	NL	434	244	0	3.52	1.66	1.34	17.2
Univ of London, Imperial Coll London	GB	391	202	11	0.91	1.41	1.37	15.5
DTU-Technical University of Denmark	DK	391	223	0	2.68	2.39	1.34	27.5
University of Manchester	GB	351	182	4	0.95	1.57	1.27	14.6
ETHZ-Swiss Federal Inst of Tech Zurich	CH	349	195	0	1.28	2.06	1.54	22.0
Lund University	SE	346	216	4	1.74	2.41	1.31	29.5
Ghent University	BE	330	200	2	1.28	2.15	1.40	19.4
University of Copenhagen	DK	294	139	14	0.80	2.21	1.46	28.4
University of Helsinki	FI	288	157	7	1.35	1.92	1.26	15.9
Technical University Munich	DE	284	142	6	1.01	1.27	1.23	11.9
Tel Aviv University	IL	281	166	4	1.12	1.59	1.39	19.5
Autonomous University of Barcelona	ES	268	163	11	1.29	1.35	1.27	15.2
University of Edinburgh	GB	254	118	6	0.86	1.91	1.48	27.7
Katholieke Universiteit Leuven	BE	246	143	1	0.81	1.78	1.35	19.2
Ludwig Maximilian University of Munich	DE	230	120	8	0.79	1.72	1.41	23.4
Heidelberg University	DE	218	101	15	0.78	1.11	1.44	10.2
New University of Lisbon	PT	211	110	0	2.87	1.45	1.32	12.3
BOKU-Univ of Nat Res and Appl Life Sci	AT	210	115	0	6.05	1.44	1.28	16.2
Pierre and Marie Curie University	FR	209	80	7	0.45	1.30	1.24	13.1
Technical University of Lisbon	PT	207	137	0	1.97	1.18	1.25	6.8
University of Minho	PT	204	126	0	3.53	1.00	1.23	8.2
École polytechnique fédérale de Lausanne	CH	203	109	0	1.12	1.94	1.44	22.5

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

As observed within ERA countries globally, half of the 25 most active universities are specialised in Biotechnology, having an SI between 1.1 and 6.05. BOKU is by far the most specialised (SI 6.05), followed by the University of Minho (3.53) and WUR (3.52). As shown by their high scores for the ARC, ARIF and percentage of their papers in the top 10% most-cited publications, the scientific impact of the most actively publishing universities is generally higher than the world level. Only one university has a score equivalent to the world level for the ARC, and three have scores equivalent to or below the world level in terms of the percentage of papers in highly cited publications. The University of Cambridge and the University of Copenhagen are among the leaders (top five) for these three indicators. The University of Cambridge, Lund University and DTU produced papers that received, on average, more citations than the average world paper, with ARC scores of 2.44, 2.41 and 2.39, respectively. ETH Zurich has the highest ARIF (1.54) and is followed by the University of Cambridge (1.49), the University of Edinburgh (1.48) and UCL (1.48).The University of Cambridge, Lund University, and the University of Copenhagen lead according to their percentage of Biotechnology articles in the top 10% most-cited publications; all of them have a proportion close to 30%.

Two-thirds of the 303 selected ERA universities (205) published more than 30 articles in the field, but many bibliometric indicators could not be produced for several of them. Among universities that are not presented in Table XXIX, the University of Food Technologies–Plovdiv is strongly specialised in Biotechnology, with an SI higher than 19. With 36 publications during the 2007 to 2011 period, however, the output of this university is relatively small. Publications from the University of Strasbourg, Utrecht University and the University College of Dublin were, on average, the most cited (ARCs of 3.86, 3.80 and 3.54, respectively). These three universities are the only ones with an ARC higher than 3. The University of Cambridge, first in the selection of 25 universities, ranks seventh in the extended selection. Eight universities published in journals with higher impact than universities from the top 25. University College Cork and Queen Mary University of London obtain the highest ARIF scores (1.67 and 1.66, respectively). Finally, two universities, Radboud University Nijmegen (34.29%) and the University of Geneva (31.43%), have more than 30% of their articles in Biotechnology among the top 10% most-cited publications. The University of Cambridge (29.82%), first among the top 25, is in third place.

The University of Cambridge may be seen as the best performing ERA university in Biotechnology. It has the largest scientific output in the field and a high scientific impact for the three indicators presented. DTU, WUR and BOKU are also noteworthy, as they combine high specialisation with high impact. However, BOKU's output is smaller.

Information & Communication Technologies

The performances of universities in the thematic priority of Information & Communication Technologies (ICT) are shown in Table XXX. For the period examined, 2007 to 2011, the world output in this area consisted of a total of about 850,000 publications, with the ERA producing close to one-third of these papers (FULL 276,100; FRAC 248,000). The ERA is not specialised in ICT (SI 0.9), and its scientific impact is slightly higher than the world average (two indicators out of three are slightly above the world level).

Within the top 25, five universities are from UK and three from Italy. Five countries—Belgium, Israel, Germany, Switzerland, and Spain—share the third place with two universities each. As expected, several universities presented among the 25 most active in the field of ICT are technical universities or polytechnics. The Technical University of Catalonia (3,000 FULL; 1,900 FRAC) in Spain is first. Switzerland has two institutions among the five most actively publishing universities: EPFL is second (2,700 FULL; 1,700 FRAC) and ETH Zurich is fifth (2,600 FULL; 1,600 FRAC). While the Technical University of Munich is third and TU Delft is fourth, the difference between the third and fifth position is relatively small (less than 100 papers FULL). These positions differ when examined in fractional counting; only the Technical University of Catalonia keeps the same place. Overall, affiliated hospitals do not participate in publications in ICT.

When all indicators are analysed simultaneously, the universities with the highest performance in ICT-related research are EPFL, the Technical University of Catalonia, Aalto University and the Vienna University of Technology. Second in terms of scientific production, EPFL has particularly high scientific impact in this area of research, and is also very specialised.

Table XXX Scientific performance as measured in Scopus for the selected 25 ERA universities in Information and Communication Technologies (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		846,511	846,511	n.c.	1.00	1.00	1.00	10.0
Total ERA		276,125	247,973	n.c.	0.90	1.17	1.05	12.0
Technical University of Catalonia	ES	3,011	1,861	0	3.01	1.10	1.11	12.4
École polytechnique fédérale de Lausanne	CH	2,711	1,665	0	2.13	2.58	1.53	25.7
Technical University Munich	DE	2,661	1,847	1	1.65	1.19	0.95	10.8
TUDelft - Delft University of Technology	NL	2,650	1,764	0	1.95	1.16	1.06	12.2
ETHZ-Swiss Federal Inst of Tech Zurich	CH	2,558	1,628	0	1.34	2.69	1.39	20.5
Vienna University of Technology	AT	2,479	1,720	0	3.15	1.38	0.93	12.3
Aalto University	FI	2,252	1,638	0	3.20	1.41	1.16	15.8
Univ of London, Imperial Coll London	GB	2,122	1,443	2	0.82	1.93	1.34	17.9
Katholieke Universiteit Leuven	BE	2,046	1,311	2	0.93	2.26	1.27	18.5
Technion Israel Institute of Technology	IL	2,020	1,318	0	1.83	2.04	1.87	21.1
Polytechnic University of Valencia	ES	2,013	1,481	0	2.69	1.09	1.03	11.5
RWTH Aachen University	DE	1,985	1,480	1	1.70	1.27	0.93	13.5
Ghent University	BE	1,848	1,398	1	1.13	1.80	1.38	19.9
Polytechnic University of Milan	IT	1,825	1,278	0	2.14	1.46	1.10	15.9
Alma Mater Studiorum Univ of Bologna	IT	1,784	1,192	0	1.18	1.65	1.23	19.5
University of Manchester	GB	1,747	1,178	1	0.77	1.58	1.30	18.2
Pierre and Marie Curie University	FR	1,736	1,003	1	0.70	0.86	1.00	8.3
University of Edinburgh	GB	1,686	1,069	1	0.99	1.70	1.32	16.7
Tel Aviv University	IL	1,686	1,073	1	0.91	1.58	1.53	19.8
Royal Institute of Technology	SE	1,674	1,097	0	1.68	1.14	1.15	11.8
Univ of London, Univ Coll London	GB	1,651	958	2	0.50	1.65	1.40	17.5
Technical University of Lisbon	PT	1,617	1,103	0	1.98	1.17	1.01	8.6
University of Cambridge	GB	1,600	998	1	0.54	2.17	1.53	20.3
Polytechnic University of Turin	IT	1,565	1,035	0	2.26	1.76	1.34	17.5
NTUA - Natl Tech University of Athens	GR	1,530	1,095	0	2.64	1.01	1.27	12.8

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

Seventeen of the 25 most actively publishing universities have an SI between 1.1 and 3.2, indicating a certain level of specialisation for the majority of these institutions. Aalto University, the Vienna University of Technology and the Technical University of Catalonia are the most specialised in ICT (SIs of 3.20, 3.15 and 3.01, respectively). In terms of scientific impact, only EPFL is among the leaders for the three bibliometric indicators (ARC, ARIF and % in top 10%). ETH Zurich is the most cited university in ICT research (ARC 2.69). EPFL (2.58) and Katholieke Universiteit Leuven (2.26) follow in second and third place. As indicated by an ARIF of 1.87, Technion published, on average, more ICT-related research output in highly cited journals. EPFL, the University of Cambridge and Tel Aviv University (all with ARIFs of 1.53) follow with lower scores still high above world level. EPFL, Technion and ETH Zurich have the highest proportions of their publications in the top 10% most-cited articles (25.7%, 21.1% and 20.5%, respectively).

About 90% of the 303 universities (273) published more than 30 articles. Several universities are more specialised or have higher scientific impact than the 25 most actively publishing universities. Whereas the highest SI score among the 25 most active was 3.1, 17 universities that published less in ICT are more specialised, nine of them with SI scores higher than 4. The South East European University is the most specialised of all universities presented (SI 8.07) but has only 55 papers. The IT University of Copenhagen (SI 7.67), Reykjavik University (6.75) and the University of Lugano (6.55) are also highly specialised and published between 300 and 620 articles. In all cases, their scientific impact is moderate, being slightly higher or lower than the world level. The universities that were the most cited, on average, are the University of Warsaw (ARC 3.12), the University of Tartu (3.04), the Weizmann Institute of Science (2.86) and the

University of Oxford (2.81), all achieving a score higher than ETH Zurich, which was first in the top 25 (2.69). In terms of output published in highly cited journals, only one, namely Gazi University, has a better score than the first in the top 25 (ARIF of 1.93 vs. Technion 1.87). The University of Tartu (31.6%) and the Weizmann Institute of Science (30.41%) have more than 30% of their ICT publications within the top 10% most-cited publications. EPFL follows in third place according to its share of highly cited papers (25.67%).

Nanosciences & Nanotechnologies

The FP7 thematic area of Nanosciences & Nanotechnologies is a relatively small research field, with only 70,000 publications produced worldwide between 2007 and 2011 (Table XXXI). ERA countries participated in one-fourth of the world publications (20,000 FULL; 17,000 FRAC). Although, with an SI of 0.75, the ERA is not specialised in this area, its scientific impact is slightly higher than the world level irrespective of the impact indicator considered.

Six of the 25 most actively publishing universities in this research area are from the UK. Germany and France are respectively in second and third place, being represented by five and four universities among the most active in Nanosciences & Nanotechnologies. Only seven universities produced more than 300 publications (FULL). The British universities are particularly strong, with the University of Cambridge in first place (524 FULL; 271 FRAC) and Imperial College ranked fifth (339 FULL; 194 FRAC). Switzerland is also well represented with two universities among the top five universities: EPFL is second (436 FULL; 233 FRAC) and ETH Zurich is third (412 FULL; 252 FRAC). Whether full or fractional counting is used, the ranking remains mostly the same. As this research field is not directly health-related, the contribution of affiliated hospitals is generally low.

Three of the 25 universities presented do not specialise in nanotechnologies (SI below 0.9), and two have an SI on par with the world level. The highest relative research intensities in the field are observed in the University of Freiburg (SI 3.73), EPFL (3.62) and Trinity College Dublin (3.09). Despite its high specialisation, the University of Freiburg's publications have very low scientific impact. On the other hand, the Ludwig Maximilian University of Munich and the University of Cambridge are consistently among the five leaders of this selection for the three scientific impact indicators. The University of Manchester is first in terms of ARC (7.23), far above any other universities. With RWTH Aachen University (2.55) and the Ludwig Maximilian University of Munich (2.42), two German universities follow in the second and third position. The Ludwig Maximilian University of Munich, the Technical University Munich and UCL published, on average, in high-impact journals, having the highest ARIF scores (1.76, 1.64 and 1.60, respectively). The Ludwig Maximilian University of Munich is also notable for its extremely high proportion of articles (45%) in the top 10% most-cited publications in this FP7 thematic priority. In fact, this is by far the highest share of highly cited papers for a university in any of the thematic priorities. Technical University

When analysing the overall performance of the 25 most actively publishing universities, the University of Cambridge performs strongly in the field of Nanosciences and Nanotechnologies. EPFL and ETH Zurich are also strong performers. The Ludwig Maximilian University of Munich is worthy of mention for its high impact, particularly in terms of ARIF and proportion of articles in Nanosciences and Nanotechnologies among the top 10% most-cited publications.

Munich, the University of Cambridge and the RWTH Aachen University also score high for this indicator (≥25%).

Table XXXI Scientific performance as measured in Scopus for the selected 25 ERA universities in Nanosciences & Nanotechnologies (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		69,732	69,732	n.c.	1.00	1.00	1.00	10.0
Total ERA		20,087	17,053	n.c.	0.75	1.20	1.16	12.2
University of Cambridge	GB	524	271	0	1.77	2.22	1.58	25.6
École polytechnique fédérale de Lausanne	CH	436	233	0	3.62	1.52	1.37	17.0
ETHZ-Swiss Federal Inst of Tech Zurich	CH	412	252	0	2.51	1.32	1.29	15.5
University of Freiburg	DE	345	215	1	3.73	0.75	0.72	7.4
Univ of London, Imperial Coll London	GB	339	194	1	1.33	1.89	1.57	23.9
TUDelft - Delft University of Technology	NL	331	215	0	2.88	1.41	1.29	11.9
University of Oxford	GB	309	168	0	1.15	1.77	1.44	13.6
Katholieke Universiteit Leuven	BE	253	128	1	1.10	1.09	0.94	13.9
DTU-Technical University of Denmark	DK	225	140	0	2.57	1.14	1.10	11.3
Autonomous University of Barcelona	ES	214	109	1	1.33	1.33	1.32	8.8
Trinity College Dublin	IE	213	125	0	3.09	2.07	1.37	21.9
Univ of London, Univ Coll London	GB	211	114	2	0.73	1.15	1.60	12.3
Pierre and Marie Curie University	FR	207	83	1	0.70	1.37	1.38	12.7
Dresden University of Technology	DE	204	92	1	1.68	1.51	1.43	17.0
Royal Institute of Technology	SE	201	123	0	2.29	0.96	0.99	15.0
Aalto University	FI	200	104	0	2.46	0.98	1.20	10.0
Joseph Fourier University	FR	192	83	1	1.78	1.71	1.33	11.1
Ludwig Maximilian University of Munich	DE	191	100	1	1.01	2.42	1.76	45.1
University of Manchester	GB	191	110	1	0.87	7.23	1.38	24.7
University of Strasbourg	FR	182	82	1	1.74	1.42	1.46	19.2
Technical University Munich	DE	179	83	1	0.90	1.71	1.64	25.8
Lund University	SE	175	96	0	1.17	1.34	1.49	17.0
University of Paris XI	FR	173	74	0	1.11	1.43	1.24	13.6
University of Southampton	GB	169	99	1	1.33	1.23	1.18	5.0
RWTH Aachen University	DE	165	93	2	1.29	2.55	1.47	25.0

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

Among the 303 selected ERA universities, 153 published more than 30 articles in Nanosciences & Nanotechnologies. The most specialised in this thematic priority are the Johannes Kepler University of Linz (SI 4.49), FUNDP–University of Namur (SI 4.45) and the University of Mons (3.78), all scoring higher than the University of Freiburg (first in the top 25, now in fourth). However, these three universities did not publish more than 120 articles between 2007 and 2011. In terms of impact, very few universities have better scores than those presented among the 25 most-publishing universities. The University of Manchester still has the highest ARC, with the University of Groningen (3.32) in second position and RWTH Aachen University following in third place (2.55). However, seven universities have higher ARIFs than the first university in the top 25 (ARIF > 1.76). The University of Göttingen is first with an ARIF of 2.11, followed by Utrecht University (2.04) and the Weizmann Institute of Science (1.86). Five universities have at least 30% of their articles among the 10% most-cited publications in the field. Ludwig Maximilian University of Munich is still in first place, ahead of the University of Groningen (32.35%), the University of London at Queen Mary (32.26%), the University of Hamburg (30.3%) and the University of Aarhus (30.0%). Note that impact indicators could not be computed for several universities in this extended selection, as the number of papers was often too small.

Materials (excluding Nanotechnologies)

Table XXXII presents the scientific performance of ERA universities in the FP7 thematic area of Materials (excluding Nanotechnologies), which comprises a total of about 360,000 publications for the 2007–2011 period at the world level. One-fifth of these articles were published by ERA countries. This proportion is slightly lower than what is observed in Scopus as a whole and in several FP7 thematic areas. (The share usually ranges between 25% and 35% of the world output.) Despite not being specialised in this area (SI of 0.61), the scientific impact of the ERA is above the world level, irrespective of the indicator used.

Five universities within the 25 most active in the Materials thematic priority are from the UK. France and Germany are in second and third place with, respectively, four and three universities in this selection. Based on full counting, RWTH Aachen University is the university with the highest number of publications (1,000 papers), followed by TU Delft (893) and the University of Cambridge (823). The rankings of universities based on fractional counting differ somewhat from those based on full counting for some institutions. In particular, Istanbul Technical University climbs from the eighth position to third, and Dresden University of Technology drops from seventh to 18th place when using fractional counting. An increase in institutional ranking between full and fractional counting is usually indicative of a low propensity to collaborate (i.e., a high proportion of exclusively intra-university publications), whereas a decrease usually reflects high collaboration rates (i.e., a low proportion of exclusively intra-university publications). When compared to other universities in Table XXXII, Istanbul Technical University collaborates less (least collaborative of the 25, with 51.1% of exclusively intra-university publications; data not shown), whereas Dresden University of Technology collaborates much more (fifth most collaborative with 21.5% exclusively intra-university publications). As expected for the field of Materials science, affiliated hospitals did not contribute much to the publication output of universities.

Among the 25 most actively publishing universities, the university with the greatest focus on Materials is Istanbul Technical University (SI 3.88). The University of Aveiro (SI 2.49), the AGH University of Science & Technology (SI 2.48) and the University of Minho (SI 2.40) follow. Eleven of the selected universities are not specialised or are at the world level in terms of research intensity. Regarding scientific impact, the top positions are shared by a handful of institutions. Pierre and Marie Curie University, the University of Cambridge and ETH Zurich are consistently among the five leaders of this selection according to the three indicators. Pierre and Marie Curie University (PMCU), Imperial College London, and the University of Cambridge have the highest scores based on ARC (2.50, 2.29 and 1.94, respectively). ETH Zurich has the highest ARIF, with a score of 2.22, and is followed by the University of Cambridge (2.19) and Imperial College London (2.14) in second and third place. The highest proportion of Materials-related output in the top

The Istanbul Technical University and the University of Aveiro are among the best performing ERA universities in Materials research when all indicators are considered. This may come as a surprise, as these two universities were only mentioned once for the presented indicators. Their high specialisation and generally high scientific impact, combined with an output of an appreciable size (8th and 11th place, respectively) explain why they are highlighted here.

10% most-cited publications is obtained by PMCU (25.9%), the University of Aveiro (24%), the University of Cambridge (23.4%) and ETH Zurich (23.2%) not far behind.

Table XXXII Scientific performance as measured in Scopus for the selected 25 ERA universities in Materials (excluding Nanotechnologies) (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World	(blank)	361,522	361,522	n.c.	1.00	1.00	1.00	10.0
Total ERA	(blank)	82,595	72,426	n.c.	0.61	1.21	1.37	12.5
RWTH Aachen University	DE	1,042	742	0	1.98	1.02	1.26	12.4
TUDelft - Delft University of Technology	NL	893	537	0	1.38	1.31	1.41	15.0
University of Cambridge	GB	823	465	1	0.58	1.94	2.19	23.4
University of Manchester	GB	772	477	0	0.73	1.34	1.58	15.7
Univ of London, Imperial Coll London	GB	733	419	0	0.55	2.29	2.14	22.2
Katholieke Universiteit Leuven	BE	728	440	0	0.73	1.51	1.55	16.1
Dresden University of Technology	DE	701	337	0	1.18	1.22	1.70	13.1
Istanbul Technical University	TR	691	520	0	3.88	1.46	1.05	15.7
Royal Institute of Technology	SE	661	415	0	1.48	1.63	1.68	18.0
University of Sheffield	GB	656	388	0	0.98	1.50	1.58	16.9
University of Aveiro	PT	653	363	0	2.49	1.80	1.69	24.0
University of Erlangen-Nuremberg	DE	613	419	0	1.21	1.35	1.33	10.9
ETHZ-Swiss Federal Inst of Tech Zurich	CH	606	357	0	0.68	1.91	2.22	23.2
École polytechnique fédérale de Lausanne	CH	602	390	0	1.16	1.87	2.11	21.7
Claude Bernard University Lyon 1	FR	601	308	0	0.99	1.66	1.69	17.6
Polytechnic University of Turin	IT	568	361	0	1.83	1.71	1.24	21.7
Joseph Fourier University	FR	549	256	0	1.05	1.56	1.75	16.5
Technical University of Catalonia	ES	546	354	0	1.33	1.03	1.27	8.6
DTU-Technical University of Denmark	DK	542	351	0	1.23	1.79	1.71	18.2
University of Birmingham	GB	534	312	0	0.80	1.37	1.39	16.0
AGH Univ of Science and Technology	PL	518	346	0	2.48	0.69	1.05	3.7
Pierre and Marie Curie University	FR	516	249	0	0.41	2.50	2.09	25.9
Ghent University	BE	504	285	0	0.53	1.32	1.46	14.5
University of Minho	PT	471	294	0	2.40	0.94	1.17	10.0
Montpellier 2 University	FR	455	232	0	1.35	1.82	1.98	23.2

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

When extending the analysis to include all 303 selected ERA universities, 228 published at least 30 articles in the field of Materials. Three universities are more specialised than the universities presented in Table XXXII. The University of Žilina, the University of Miskolc and the University of Chemical Technology and Metallurgy–Sofia are very specialised, with SIs of 9.44, 6.62 and 3.97, respectively; however, their scientific impact is very low. Eleven universities have higher ARC values than PMCU, the first among the 25 most-publishing universities. The universities with the highest ARC values (above 3) include the Ludwig Maximilian University of Munich (3.71), Hasselt University (3.5) and Radboud University Nijmegen (3.49). In terms of ARIF, 38 universities published in journals with higher impact during the 2007 to 2011 period. The Weizmann Institute of Science (ARIF 3.64), the Ludwig Maximilian University of Munich (3.28), and the University of Würzburg (3.18) occupy the first three positions. The proportion of articles in the 10% most-cited publications is very high for several universities: 56 universities have 20% or more of their publications within the 10% most-cited publications; 22 have a higher proportion than the PMCU, the first university mentioned in the top 25 most-publishing universities. The Ludwig Maximilian University of Munich (39.8%), the University of Mons (39%) and the University of London, Queen Mary (35.7%) have the highest shares of highly cited papers.

New Production Technologies

The scientific performance of ERA universities for the 2007–2011 period in the thematic priority of New Production Technologies is presented in Table XXXIII. At the world level close to 183,000 papers were published during the period, close to one-fourth of which were produced by ERA countries (50,100 FULL; 44,000 FRAC). The ERA is not specialised in research relating to New Production Technologies (SI 0.74), but its scientific impact is slightly above the world level irrespective of the indicator used.

At the institutional level, six of the most-publishing universities are from Italy. Spain and the UK each have three universities in the top 25; Switzerland and Germany have two. All ERA universities published fewer than 650 articles (FULL) in this area. The two universities with the largest output are Technical University Munich and TU Delft (both in FULL and FRAC). These two universities are the only ones with more than 600 papers in this area (631 and 621, respectively). As expected, affiliated hospitals do not contribute much to the publications of universities in the area of New Production Technologies.

Table XXXIII Scientific performance as measured in Scopus for the selected 25 ERA universities in New Production Technologies (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		182,788	182,788	n.c.	1.00	1.00	1.00	10.0
Total ERA		50,152	44,031	n.c.	0.74	1.29	1.15	13.7
Technical University Munich	DE	631	480	1	2.00	1.23	1.07	11.0
TUDelft - Delft University of Technology	NL	621	432	0	2.22	1.71	1.26	20.3
Polytechnic University of Milan	IT	562	398	0	3.10	1.21	1.16	14.0
ETHZ-Swiss Federal Inst of Tech Zurich	CH	551	369	0	1.41	2.61	1.57	26.5
Technical University of Catalonia	ES	528	376	0	2.83	1.28	1.41	12.9
NTNU - Norwegian Univ of Sci and Tech	NO	472	276	0	1.99	1.71	1.40	22.2
Royal Institute of Technology	SE	469	295	0	2.10	2.14	1.44	23.6
Univ of London, Imperial Coll London	GB	444	242	1	0.64	1.92	1.51	20.4
Katholieke Universiteit Leuven	BE	442	312	0	1.03	2.34	1.34	33.3
University of Manchester	GB	439	281	0	0.86	1.52	1.33	19.3
Technical University of Lisbon	PT	407	278	0	2.33	1.60	1.13	17.1
University of Seville	ES	401	267	0	2.14	1.35	1.38	15.0
UNIPD - University of Padua	IT	370	253	0	1.32	1.90	1.47	15.8
Vienna University of Technology	AT	369	262	0	2.23	0.85	0.92	5.9
Polytechnic University of Turin	IT	363	268	0	2.72	1.62	1.43	18.4
RWTH Aachen University	DE	360	250	0	1.33	1.43	0.96	14.3
Technion Israel Institute of Technology	IL	356	233	0	1.50	1.79	1.58	16.8
University of Southampton	GB	351	202	0	1.04	1.40	1.20	18.5
École polytechnique fédérale de Lausanne	CH	350	232	0	1.38	2.14	1.46	21.9
University of Zagreb	HR	341	265	0	1.63	0.50	0.49	5.2
Alma Mater Studiorum Univ of Bologna	IT	338	233	0	1.07	1.38	1.28	15.3
UNIROMA1 - Sapienza University of Rome	IT	333	209	0	0.89	1.79	1.29	18.3
Budapest Univ of Tech and Economics	HU	315	229	0	3.20	0.76	0.76	7.7
Polytechnic University of Valencia	ES	308	231	0	1.94	1.53	1.23	15.9
UNIROMA2 - Univ of Rome Tor Vergata	IT	300	174	1	1.77	1.62	1.53	18.7

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

Six of the 25 selected universities are not specialised in this thematic priority or are at the world level. The Budapest University of Technology and Economics (SI 3.2), the Polytechnic University of Milan (3.1) and the Technical University of Catalonia (2.83) are the most specialised. When looking at the three indicators of scientific impact, ETH Zurich is repeatedly among the top three. The publications from ETH Zurich, Katholieke Universiteit Leuven, the Royal Institute of

Technology and EPFL were the most-cited on average (ARCs of 2.61, 2.34, 2.14 and 2.14, respectively), whereas Technion Israel Institute of Technology (ARIF of 1.58), ETH Zurich (1.57) and the University of Rome Tor Vergata (UNIROMA2; 1.53) were the universities that published in particularly high-impact journals. Finally, the universities with the highest proportion of articles related to New Production Technologies within the top 10% most-cited publications include Katholieke Universiteit Leuven, ETH Zurich and the Royal Institute of Technology (33.3%, 26.5% and 23.6%, respectively).

A total of 188 universities out of the 303 selected published at least 30 articles. Although the Budapest University of Technology and Economics ranked first for specialisation in this area among the 25 most actively publishing universities, six universities were more specialised when extending the dataset to include all 303 selected ERA universities. Among them, the university with the highest score (SI 5.66) is the J.J. Strossmayera University of Osijek. However, this university has very low scientific impact. Publications from four universities are, on average, more cited than the first-place university in terms of ARC among the 25 most-publishing universities. The University of Liège is the only one to score an ARC higher than 4 (4.29). In terms of the journal-based impact measure, eight universities are in a better position than Technion (first in the top 25). The National University of Ireland (Maynooth), Uppsala University, the University of Glasgow and King's College London occupy the first four positions, with ARIFs higher than or equal to 1.7. Thirty-two universities have 20% or more of their papers relating to New Production Technologies within the top 10% most-cited publications. The University of Zaragota is far above the others, with 39% of its papers among the top 10% most-cited publications. The University of Liège (33.9%) follows, just above Katholieke Universiteit Leuven (first in the top 25).

Construction & Construction Technologies

The FP7 thematic priority of Construction & Construction Technologies is a small research field that comprises a total of about 60,000 publications for the years 2007 to 2011 (Table XXXIV). ERA countries contributed to one-third of these publications (23,500 FULL; 21,500 FRAC). Globally, ERA countries are aligned with the overall research trend in this field at the world level, having an SI slightly above (1.12) and a scientific impact close to the world level.

Six of the 25 most active universities in terms of publication output are from the UK. Turkey and Italy are both represented by three institutions in this selection and Switzerland, Germany and Belgium by two each. All of the selected universities published fewer than 650 scientific papers. TU Delft leads in terms of the size of its output in this area using either of the two counting methods (635 FULL; 484 FRAC). Gazi University and DTU are second and third, respectively. Unsurprisingly, hospitals do not contribute to the university publications in the thematic priority of Construction & Construction Technologies. All of the 25 most active universities are specialised in this area with the exception of the University of Cambridge. The SI scores of Gazi University (7.74), TU Delft (7.65) and Istanbul Technical University (6.11) are particularly high.

TU Delft may be seen as the best performing university in Construction and Construction Technologies when analysing all indicators simultaneously. Its scientific output is more than twice the output of the institution in second place, and its SI in the field is very high. Nevertheless, its scientific impact is equal to the world level. DTU and Istanbul Technical University also perform well and have high scores for all of the presented indicators except for the size of its research output, which is quite low.

Being consistently among the top three according to the three citation indicators, EPFL and DTU's scientific impact is particularly high. EPFL, DTU and Technion Israel have the highest ARC values (2.08, 2.02 and 2.01, respectively). They are also the only universities with relative citation scores higher than 2 among the top 25 universities. DTU and Ghent University are in first place in terms of the journal-based ARIF (1.49), just above EPFL (1.48). EPFL, DTU and the University of Manchester are the three universities among the 25 most actively publishing in this area that have the highest proportion of their articles within the top 10% most-cited publications, with shares of 23.2%%, 22.7%% and 22.4%, respectively.

Table XXXIV Scientific performance as measured in Scopus for the selected 25 ERA universities in Construction & Construction Technologies (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		59,835	59,835	n.c.	1.00	1.00	1.00	10.0
Total ERA		23,510	21,526	n.c.	1.12	1.08	1.05	11.3
TUDelft - Delft University of Technology	NL	635	484	0	7.65	1.11	1.03	10.3
Gazi University	TR	301	234	0	7.74	0.34	0.36	0.8
DTU-Technical University of Denmark	DK	269	177	0	3.82	2.02	1.49	22.7
Univ of London, Univ Coll London	GB	267	203	0	1.53	1.12	0.95	13.5
Polytechnic University of Milan	IT	254	192	0	4.59	0.88	0.85	8.4
Cardiff University	GB	224	166	0	3.37	1.11	1.14	12.5
Katholieke Universiteit Leuven	BE	216	135	0	1.37	0.99	1.46	11.8
École polytechnique fédérale de Lausanne	CH	204	132	0	2.41	2.08	1.48	23.2
University of Cambridge	GB	194	132	0	1.02	1.47	1.19	15.5
Polytechnic University of Turin	IT	194	148	0	4.63	0.98	1.35	9.4
Technical University of Catalonia	ES	192	132	0	3.05	1.15	1.24	14.1
University of Manchester	GB	192	132	0	1.24	1.89	1.12	22.4
University of Sheffield	GB	191	140	0	2.16	1.79	1.34	21.5
ETHZ-Swiss Federal Inst of Tech Zurich	CH	180	117	0	1.37	1.17	1.24	19.5
Aalto University	FI	179	124	0	3.47	1.62	1.23	18.0
Royal Institute of Technology	SE	178	128	0	2.81	0.96	1.11	9.3
Technical University Munich	DE	177	133	1	1.71	1.25	1.01	12.0
Istanbul Technical University	TR	176	133	0	6.11	1.50	1.13	19.1
Ghent University	BE	169	115	0	1.32	1.92	1.49	19.3
Newcastle University (UK)	GB	166	121	0	2.55	0.89	1.01	7.6
Middle East Technical University	TR	159	115	0	4.33	1.27	1.20	13.8
Technion Israel Institute of Technology	IL	156	115	0	2.27	2.01	1.40	18.3
Alma Mater Studiorum Univ of Bologna	IT	150	106	0	1.49	1.13	1.14	11.4
Technical University of Lisbon	PT	148	100	0	2.57	1.31	1.45	11.5
RWTH Aachen University	DE	144	103	0	1.69	0.48	0.57	2.3

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

Among the remaining universities in the selection of 303 126 published at least 30 articles. Vilnius Gediminas Technical University is remarkable for its high specialisation in this area (SI 12.93; 119 publications), the only university achieving a higher score than the universities presented in the top 25. However, as for several other universities, the three impact indicators are very low. Aalborg University and Ege University have higher ARCs than EPFL (2.29 and 2.15, respectively). These two universities are above the world level for all indicators examined (SI, ARC, ARIF and top 10% most-cited articles). As indicated by the ARIF, six universities published in journals with higher impact than the universities presented in the ranking of the 25 most active in Construction & Construction Technologies. Uppsala University, WUR, and Umeå University compose the top three according to the ARIF with scores of 1.75, 1.58 and 1.57, respectively. With the exception of WUR, all these universities published fewer than 100 papers during the period. Finally, two universities also had a higher proportion of their articles in this field among

the top 10% most-cited publications than the 25 most-publishing universities. The University of Ege is also the university with the highest share of highly cited papers (32.5%), while UvA–University of Amsterdam's share (24.2%) is close to that of the first-place EPFL (23.2%) among the most active universities in the thematic priority.

Energy

Research related to the thematic priority of Energy represents more than 237,300 publications in the Scopus database from 2007 to 2011 (Table XXXV). The ERA, which was involved in about 59,000 of these publications (25%) and has a share of 22% of the total output in this field (about 51,800 publications based on FRAC), is, however, not specialised in this area of research (SI 0.68). The ERA has a high scientific impact as expressed by its ARC (1.4), ARIF (1.33) and percentage of papers within the top 10% most-cited publications (14.6%).

The UK has four institutions in the 25 most-publishing universities. Italy and Sweden follow with three universities each in the top 25. Imperial College London has the largest output in this area, with 889 publications (FULL; 579 FRAC). The Technical University of Denmark (DTU) is the second (783 FULL; 540 FRAC) and TU Delft the third most active university in the Energy priority (702 FULL; 461 FRAC). Affiliated hospitals did not contribute to the output of their universities in this area (at least for the top 25).

DTU–Technical University of Denmark is the top-performing university in the area of Energy research, combining one of the largest outputs, the highest specialisation and the highest scientific impact. Other notable performers are Chalmers University of Technology and NTUA–National Technical University of Athens. Both have strong scores overall, but particularly for SI.

With an SI score of 3.54, the Politehnica University of Bucharest is the most specialised in this selection, ranking above Chalmers University of Technology (3.01) and the National Technical University of Athens (3.01). DTU and the University of Cambridge have high scientific impact, being among the five leaders of this selection in terms of the three citation indicators. DTU ranks highly according to the ARC, with the strongest score (2.82), far ahead of Chalmers University of Technology (2.39) and Joseph Fourier University (2.3). The University of Cambridge (1.78), Uppsala University (1.71), DTU (1.69) and NTUA–National Technical University of Athens (1.69) have the highest ARIF scores. Of these, only DTU and NTUA are clearly specialised in Energy research (based on SI). With 30.4% of its publications within the 10% most-cited publications in Energy research, DTU ranks first according to share of highly cited papers, followed by UNIROMA1 (28.6%) and ETH Zurich (27.1%).

Among the 303 listed universities, there are 206 that published at least 30 articles. Four universities are more specialised in Energy than the Politehnica University of Bucarest (first among the top 25). The University of Stavanger is the most specialised institution, with a score of 5.25, ranking above the University of Chemical Technology and Metallurgy in Sofia (3.99) and the Tallinn University of Technology (3.61). According to ARC, three universities are ahead of DTU: the Complutense University of Madrid has the highest ARC (4.02), the University of Erlangen-Nuremberg is second (3.23) and Newcastle University (UK) is the third (2.89) most-cited university according to ARC. Regarding ARIF, there are as many as 45 universities that published on average in journals with higher impact than the University of Cambridge (first in the top 25);

FUNDP–University of Namur ranks first (2.40), the University of London, Queen Mary is second (2.38) and the University of Copenhagen is third (2.23). Finally, three universities are above DTU in terms of the percentage of their articles in the top 10% most-cited publications in Energy. The share of the University of Aveiro is particularly high (39.4%). It is followed by the University of Erlangen-Nuremberg (34.8%) and University College Dublin (30.6%).

Table XXXV Scientific performance as measured in Scopus for the selected 25 ERA universities in Energy (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		237,368	237,368	n.c.	1.00	1.00	1.00	10.0
Total ERA		58,969	51,788	n.c.	0.68	1.40	1.33	14.6
Univ of London, Imperial Coll London	GB	889	579	0	1.19	1.68	1.45	17.0
DTU-Technical University of Denmark	DK	783	540	0	2.96	2.82	1.69	30.4
TUDelft - Delft University of Technology	NL	702	461	0	1.85	0.75	1.19	7.9
Royal Institute of Technology	SE	692	426	0	2.38	1.42	1.44	16.4
University of Manchester	GB	643	409	0	0.98	1.68	1.44	14.0
NTNU - Norwegian Univ of Sci and Tech	NO	564	345	0	1.95	1.45	1.28	13.5
École polytechnique fédérale de Lausanne	CH	551	292	0	1.36	1.83	1.47	19.0
Chalmers University of Technology	SE	512	328	0	3.01	2.39	1.62	23.8
Polytechnic University of Milan	IT	509	359	0	2.19	1.15	1.16	11.9
Politehnica University of Bucharest	RO	493	368	0	3.54	0.42	0.46	2.1
Katholieke Universiteit Leuven	BE	471	193	0	0.50	1.37	1.18	11.1
NTUA - Natl Tech University of Athens	GR	462	343	0	3.01	1.85	1.69	16.1
ETHZ-Swiss Federal Inst of Tech Zurich	CH	439	245	0	0.73	2.05	1.55	27.1
University of Cambridge	GB	410	267	0	0.52	2.28	1.78	25.8
Polytechnic University of Turin	IT	408	278	0	2.20	1.21	1.28	10.5
Technical University of Lisbon	PT	404	215	0	1.41	1.90	1.44	25.1
Pierre and Marie Curie University	FR	388	179	0	0.46	1.55	1.67	17.1
Polytechnic University of Valencia	ES	368	269	0	1.78	1.27	1.50	10.3
Aristotle University of Thessaloniki	GR	332	228	0	1.16	1.71	1.51	21.5
RWTH Aachen University	DE	329	190	0	0.79	1.19	1.42	11.9
UNIROMA1 - Sapienza University of Rome	IT	319	191	0	0.63	2.02	1.66	28.6
University of Leeds	GB	287	195	0	0.78	1.91	1.55	19.7
Uppsala University	SE	283	171	0	0.77	1.77	1.71	20.9
Aalto University	FI	282	178	0	1.26	1.77	1.56	18.7
Joseph Fourier University	FR	281	159	0	1.02	2.30	1.66	26.4

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

Environment (including Climate Change & Earth Sciences)

Research in the thematic priority of Environment (including Climate Change & Earth Sciences) is comprised of more than 257,700 publications in the Scopus database (Table XXXVI). Of these, more than 138,500 had a contribution from at least one researcher from the ERA (39%). The ERA contributes to one-third of the total output in this field based on fractional counting (about 116,500 papers). The ERA does not devote a greater fraction of its total scientific production to this thematic area than the world in general, having an SI of exactly 1.00. The ERA generally has more impact than the world, with an ARC of 1.22, an ARIF of 1.15 and a percentage of papers within highly cited publications of 13%.

Among the 25 universities with the highest scientific production among the 303 selected ERA universities, eight are located in the UK and three each are in the Netherlands, France, Denmark and Sweden. Twenty out of the 25 most-publishing universities presented are located in these five countries. ETH Zurich is the most active in the thematic priority of Environment, with more than 2,900 publications using full counting (around 1,300 in fractional counting). Pierre and Marie

Curie University (2,000 FULL; 700 FRAC) and WUR–Wageningen University and Research Centre (1,800 FULL; 800 FRAC) follow. Unsurprisingly, university hospitals are not very active in this field—their contributions were identified for only two universities in the top 25, namely Lund University (2%) and the University of Copenhagen (1%).

Overall, the 25 most actively publishing universities in Environmental Sciences have high scientific impact, with scores above the world level irrespective of the impact indicator used. Among these institutions, ETH Zurich stands out as the top-performing university in Environment, being among the leaders for all indicators. WUR and Stockholm University are also notable for their overall performance, particularly regarding specialisation and scientific impact. Finally, the University of Bristol is worthy of mention for its high impact, being among the top three for the three indicators.

The Swedish University of Agricultural Sciences achieves the highest SI within this top 25 with a score of 3.72. WUR ranks second for this indicator (3.59) and Stockholm University is third (2.84). Stockholm University, the University of Bristol, and ETH Zurich are consistently among the five leaders for the three scientific impact indicators presented in this report. Overall, all 25 universities score above the respective world levels in terms of the ARC and ARIF. Stockholm University and the University of Bristol are first according to the ARC with a score of 2.18, slightly better than Joseph Fourier University (2.16). Based on the ARIF, the University of Oxford (1.59) ranks first and is followed by Stockholm University and the University of Bristol (both with ARIFs of 1.52). In terms of highly cited publications, Joseph Fourier University is in first place (28.7%), the University of Bristol is in second (27%) and ETH Zurich is in third (26.5%).

When extending the analysis to cover all 303 ERA universities, 250 meet the threshold of 30 articles between 2007 and 2011. Within this selection, three universities are more specialised in Environment than the Swedish University of Agricultural Sciences (first among the top 25). Among them, the Daugavpils University ranks first in terms of the SI, with a score of 9.14, more than twice the score of the Gheorghe Asachi Technical University in second place (4.33), and UMW–Norwegian University of Life Sciences follows in third place according to SI (3.85). Four universities are more cited on average than Stockholm University (highest ARC in the top 25): the University of Lausanne ranks first with a score of 2.45, above the University of Geneva (2.38), the University of Antwerp (2.33) and the Johannes Gutenberg University of Mainz (2.20). Top performers in terms of ARIF are the Norwegian School of Veterinary Science (1.79), the University of Antwerp (1.69), the Karolinska Institute (1.65), the Umeå University (1.65) and the Radboud University of Nijmegen (1.62). These five universities have higher ARIF scores than the University of Oxford (first among the 25 most-publishing universities).The University of Pannonia comes in first place for highly cited publications, with a particularly high share of 39.3% of its papers among the most-cited in the field. The University in Hungary is followed by the Johannes Gutenberg University of Mainz (32.7%), the University of Southern Denmark (31%), the University College of Cork (30.8%) and the University of Lausanne (28.9%).

Table XXXVI Scientific performance as measured in Scopus for the selected 25 ERA universities in Environment (including Climate Change & Earth Sciences) (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		357,787	357,787	n.c.	1.00	1.00	1.00	10.0
Total ERA		138,526	116,524	n.c.	1.00	1.22	1.15	13.0
ETHZ-Swiss Federal Inst of Tech Zurich	CH	2,934	1,326	0	2.57	2.08	1.46	26.5
Pierre and Marie Curie University	FR	1,954	726	0	1.20	1.82	1.39	23.8
WUR - Wageningen Univ and Res Centre	NL	1,800	840	0	3.59	1.72	1.44	20.1
Univ of London, Imperial Coll London	GB	1,580	680	0	0.91	1.64	1.36	21.8
TUDelft - Delft University of Technology	NL	1,500	746	0	1.95	1.23	1.12	13.2
University of Leeds	GB	1,486	606	0	1.56	1.73	1.39	22.2
University of Cambridge	GB	1,461	611	0	0.78	1.83	1.44	25.7
Utrecht University	NL	1,440	669	0	1.33	1.70	1.46	19.5
University of Helsinki	FI	1,405	607	0	1.55	1.72	1.36	21.9
University of Oxford	GB	1,339	567	0	0.75	2.00	1.59	25.3
University of Oslo	NO	1,273	534	0	1.37	1.63	1.34	20.3
University of Southampton	GB	1,272	586	0	1.54	1.39	1.33	15.5
Paul Sabatier University	FR	1,253	428	0	1.48	1.46	1.34	17.3
University of Copenhagen	DK	1,218	516	1	0.88	1.66	1.36	19.1
Stockholm University	SE	1,196	541	0	2.84	2.18	1.52	25.9
University of Edinburgh	GB	1,170	457	0	0.99	1.75	1.46	22.3
University of Bristol	GB	1,150	492	0	1.39	2.18	1.52	28.7
Ghent University	BE	1,034	526	0	1.00	1.78	1.36	23.2
University of Aarhus	DK	1,034	444	0	1.17	1.84	1.42	23.7
Joseph Fourier University	FR	1,004	407	0	1.69	2.16	1.42	28.7
Lund University	SE	981	438	2	1.04	1.87	1.39	24.2
University of Bern	CH	935	367	0	1.45	1.91	1.47	24.0
Univ of London, Univ Coll London	GB	934	375	0	0.46	1.45	1.26	19.4
DTU-Technical University of Denmark	DK	921	470	0	1.67	1.76	1.24	23.3
Swedish Univ of Agricultural Sciences	SE	894	441	0	3.72	1.79	1.43	20.9

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

Aeronautics or Space

The thematic areas of Aeronautics or Space account for close to 49,100 publications in the Scopus database (Table XXXVII). The ERA was involved in more than 10,500 publications (21%), and its share of the total output computed using fractional counting of publications amounts to 18% of the world output (4,400 publications out of a total of the 24,500 papers based on FRAC). Because the scientific productions in Aeronautics or Space consist of the same set of publications—both thematic priorities were matched to the same scientific field (see Section 6.4)—the same results apply to both areas. In order to ensure the Commission's request that the sum of fractioned output across thematic areas equal the total based on full counting, each paper assigned to Aeronautics or Space is divided by two; in other words, the world total based on FRAC is half the total based on FULL for these two areas. The relationship between full and fractional counts should thus not be compared to that of other thematic priorities.

The ERA is not specialised in Aeronautics/Space (0.56) but has high scientific impact, with an ARC (1.25), ARIF (1.42) and percentage of its papers among highly cited publications (13.8%) clearly above the world level.

Among the 25 most-publishing universities, nine are from the UK and seven are from Italy. TU Delft is the most active university, with more than 500 publications using full counting. UNIROMA1–Sapienza University of Rome is second according to both full (240) and fractional

publication counts and the Technion Israel Institute of Technology is third (around 190 FULL). As is to be expected for these thematic priorities, affiliated hospitals did not contribute to the production of universities in the top 25.

Table XXXVII Scientific performance as measured in Scopus for the selected 25 ERA universities in Aeronautics or Space (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		49,109	24,555	n.c.	1.00	1.00	1.00	10.0
Total ERA		10,545	4,417	n.c.	0.56	1.25	1.42	13.8
TUDelft - Delft University of Technology	NL	514	152	0	5.87	1.44	1.23	13.2
UNIROMA1 - Sapienza University of Rome	IT	237	73	0	2.33	0.83	1.33	7.8
Technion Israel Institute of Technology	IL	192	55	0	2.69	1.92	1.89	24.2
University of Southampton	GB	191	62	0	2.39	1.56	1.79	24.1
University of Cambridge	GB	179	53	0	1.00	1.52	1.70	18.2
University of Glasgow	GB	167	48	0	2.02	1.41	1.41	19.2
University of Bristol	GB	153	47	0	1.95	1.19	1.05	15.0
Polytechnic University of Milan	IT	135	38	0	2.24	0.87	1.32	9.7
Polytechnic University of Turin	IT	134	38	0	2.93	1.47	1.80	11.8
University of Liverpool	GB	127	39	0	2.03	1.14	1.26	17.5
Technical University Munich	DE	123	36	0	1.12	0.80	1.19	9.2
University of Manchester	GB	123	40	0	0.92	1.03	1.60	12.4
Univ of London, Imperial Coll London	GB	107	24	0	0.48	2.16	1.56	27.3
UNIPI - University of Pisa	IT	99	28	0	1.49	2.02	2.20	17.4
Royal Institute of Technology	SE	91	24	0	1.31	1.34	1.73	17.7
Middle East Technical University	TR	91	29	0	2.63	0.54	1.55	2.7
UNINA - University of Naples Federico II	IT	85	21	0	1.02	2.46	1.60	21.1
Technical University of Catalonia	ES	80	26	0	1.45	1.69	1.11	18.8
University of Sheffield	GB	70	21	0	0.80	3.08	1.50	29.0
RWTH Aachen University	DE	65	21	0	0.86	n.c.	1.43	n.c.
UNIPD - University of Padua	IT	63	19	0	0.74	1.70	1.51	21.4
Alma Mater Studiorum Univ of Bologna	IT	62	15	0	0.53	1.49	1.78	10.6
Istanbul Technical University	TR	61	22	0	2.51	0.97	n.c.	12.2
Univ of London, Univ Coll London	GB	58	14	0	0.26	n.c.	1.85	n.c.
Chalmers University of Technology	SE	55	12	0	1.03	n.c.	1.48	n.c.

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

Based on SI, TU Delft ranks first with a score of 5.87. With SI scores of 2.93 and 2.69, respectively, the Polytechnic University of Turin and Technion are also highly specialised and come in second and third place among the 25 most active universities. Technion is the only university within that selection of 25 that scores among the top five leaders regarding all scientific indicators presented. The University of Sheffield ranks first in terms of ARC; its papers have received, on average, about three times the number of citations as the world average paper (ARC 3.08). The University of Naples Federico II (UNINA; 2.46), and Imperial College London (2.16) follow with the second and third highest ARCs. UNIPI–University of Pisa is notable for having the highest ARIF among this selection (2.20), followed by Technion (1.89) and UCL (1.85). Six universities have at least 20% of their articles in the 10% most-cited publications in these areas: the University of Sheffield (29%), Imperial College London (27.3%), Technion (24.2%), the University of Southampton (24.1%), the University of Padua (21.4%) and UNINA (21.1%).

TU Delft is a strong player in Aeronautics/Space, with the largest scientific output, the highest specialisation index and scores above the world averages for both the ARC and ARIF indicators. The Technion Israel Institute of Technology and the University of Southampton can also be considered leaders based on the overall quality of their research and its impact on the scientific community.

Overall, only 41 other universities outside of this top 25 produced at least 30 publications in Aeronautics/Space and none of them were more specialised or more frequently cited than the first positions among the top 25 for the presented indicators (SI, ARC, ARIF and top 10% most-cited articles).

Automobiles

About 10,300 publications in the Scopus database are relevant to Automobiles (Table XXXVIII). The ERA contributed to close to 4,000 of these publications (38%) and has a share of about 35% of the total output based on fractional counting (about 3,600 papers FRAC). Overall, the ERA is not specialised in this thematic area (1.07) and its impact is relatively low, with an ARC of 0.94, ARIF of 0.88 and fewer papers within the top 10% most-cited than expected (9.5%).

The 25 most-publishing universities in Automobiles published between 23 and 206 articles between 2007 and 2011. Of these, five are located in the UK. With three universities each, Germany, Spain and Sweden follow. The most active university in Automobiles is the University of Southampton with 206 publications (FULL) (around 190 using fractional counting). Aalborg University and RWTH Aachen University are respectively in second and third place based on full counting (110 and 80 publications), but their position is inverted using fractional counting (66 and 67 publications, respectively). Unsurprisingly, affiliated hospitals did not contribute to the output of universities in this area.

Aalborg University is the most specialised of this selection, with an SI of 19.60, ahead of the University of Southampton (17.0). Producing respectively almost 20 and 17 times as much in the field of Automobiles as expected given their overall output, these two are especially specialised universities. The Budapest University of Technology and Economics is the third most specialised, with an SI of 9.77. Because of the small size of this research area, the ARC and the percentage of a university's papers among highly cited publications could only be computed for Aalborg University and the University of Southampton. Aalborg University scores above the world level for both indicators, with an ARC of 1.60 and 21% of its papers in the top 10% most-cited publications. This is not the case for the University of Southampton, which scores below the world level for both indicators (0.63 and 3.6%, respectively). According to ARIF, six universities are above the world level: King's College London (ARIF 1.72), the University of Edinburgh (1.36) and the University of Southampton (1.21) occupy the first three places.

Overall, only a few universities (21) are active in the thematic area of Automobiles, indicated by at least 30 publications between 2007 and 2011. Two of these universities, the University of Southampton and Aalborg University, are heavily specialised in this thematic priority. Aalborg University also has a high scientific impact based on received citations and highly cited articles, but publishes in journals of lower impact than is generally the case at the world level. The University of Edinburgh also performs strongly, being highly specialised and achieving the highest ARIF.

Table XXXVIII Scientific performance as measured in Scopus for the selected 25 ERA universities in Automobiles (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		10,287	10,287	n.c.	1.00	1.00	1.00	10.0
Total ERA		3,958	3,582	n.c.	1.07	0.94	0.88	9.5
University of Southampton	GB	206	187	0	16.98	0.63	1.21	3.6
Aalborg University	DK	110	67	0	19.60	1.49	0.50	20.5
RWTH Aachen University	DE	80	66	0	6.23	n.c.	0.42	n.c.
Royal Institute of Technology	SE	60	38	0	4.72	n.c.	1.05	n.c.
Aalto University	FI	58	32	0	5.19	n.c.	0.88	n.c.
Polytechnic University of Milan	IT	53	40	0	5.44	n.c.	0.80	n.c.
Budapest Univ of Tech and Economics	HU	47	40	0	9.77	n.c.	0.35	n.c.
University of Edinburgh	GB	47	32	0	2.39	n.c.	1.36	n.c.
University Of Oulu	FI	47	30	0	6.96	n.c.	1.10	n.c.
Chalmers University of Technology	SE	44	28	0	5.86	n.c.	0.70	n.c.
Technical University Munich	DE	42	26	0	1.90	n.c.	0.55	n.c.
University of Bristol	GB	41	35	0	3.47	n.c.	0.94	n.c.
Technical University of Catalonia	ES	39	31	0	4.13	n.c.	0.84	n.c.
Alma Mater Studiorum Univ of Bologna	IT	38	25	0	2.03	n.c.	1.14	n.c.
Dresden University of Technology	DE	36	34	0	4.18	n.c.	0.33	n.c.
Polytechnic University of Valencia	ES	35	27	0	4.07	n.c.	0.97	n.c.
Vienna University of Technology	AT	35	22	0	3.28	n.c.	0.86	n.c.
Lund University	SE	33	17	0	1.37	n.c.	0.94	n.c.
Technical University of Lisbon	PT	33	24	0	3.60	n.c.	0.76	n.c.
Univ of London, King's Coll London	GB	32	22	0	1.57	n.c.	1.72	n.c.
University of Cambridge	GB	30	23	0	1.00	n.c.	1.15	n.c.
TUDelft - Delft University of Technology	NL	28	21	0	n.c.	n.c.	n.c.	n.c.
NTUA - Natl Tech University of Athens	GR	25	20	0	n.c.	n.c.	n.c.	n.c.
University of Zaragoza	ES	24	24	0	n.c.	n.c.	n.c.	n.c.
Université catholique de Louvain	BE	23	10	0	n.c.	n.c.	n.c.	n.c.

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

Other Transport Technologies

The thematic priority of Other Transport Technologies accounts for 207,400 publications in the Scopus database (Table XXXIX). The ERA was involved in 23% of these publications (about 47,600), and its share of the total output in this thematic area is approximately 21% (about 42,700 publications FRAC). The ERA is not specialised at all in this area (0.64), but its contributions have high scientific impact, as expressed by its ARC (1.38) and percentage of papers in highly cited publications (15.5%). ERA researchers generally publish in high-impact journals, as indicated by an ARIF of 1.4.

Within the 25 universities with the largest scientific productions in this area, seven are located in the UK and three are in Italy. Ranking first is TU Delft, which is involved in about 920 publications (616 using fractional counting). Imperial College London is the second most active ERA university, with close to 820 publications (532 FRAC), and NTNU–Norwegian University of Science and Technology follows in third position with about 645 publications using full counting (450 FRAC). Affiliated hospitals did not contribute to the output of the top 25 universities in this area.

Overall, Lithuania has a strong presence in Other Transport Technologies. Vilnius Gediminas Technical University is the best performing university based on the size of its scientific output, its heavy specialisation and some of the highest impact scores overall. It is joined by Kaunas University of Technology because of its high level of specialisation, which is combined with a strong ARIF. TU Delft is also among the leaders, with an overall strong performance across indicators.

Two of the 25 most actively publishing universities are heavily specialised in Other Transport Technologies, namely Vilnius Gediminas Technical University (13.55) and Kaunas University of Technology (10.78), both located in Lithuania. NTUA–National Technical University of Athens ranks third with an SI of 3.85. École polytechnique fédérale de Lausanne (EPFL) and DTU are among the five leaders in the three scientific impact indicators. Vilnius Gediminas Technical University is not only the most specialised but, with an ARC of 2.91, also the most highly cited university in the thematic priority of Other Transport Technologies. EPFL (2.83) and the Polytechnic University of Turin (2.21) rank second and third according to ARC. With an ARIF score of 1.96, DTU–Technical University of Denmark performs best in terms of the average 'quality' of the journals in which its papers were published, followed by EPFL (1.95) and the Technion Israel Institute of Technology (1.89). With one-third of its articles within the 10% most cited publications in this field, the EPFL ranks first in terms of highly cited publications, ahead of the Polytechnic University of Turin (26.4%) and the Vilnius Gediminas Technical University (25.9%).

Table XXXIX Scientific performance as measured in Scopus for the selected 25 ERA universities in Other Transport Technologies (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		207,400	207,400	n.c.	1.00	1.00	1.00	10.0
Total ERA		47,617	42,676	n.c.	0.64	1.38	1.40	15.5
TUDelft - Delft University of Technology	NL	918	616	0	2.79	1.52	1.27	18.2
Univ of London, Imperial Coll London	GB	817	532	0	1.23	1.87	1.41	23.5
NTNU - Norwegian Univ of Sci and Tech	NO	645	450	0	2.86	1.69	1.21	21.4
Vilnius Gediminas Technical University	LT	568	478	0	13.55	2.91	1.44	25.9
Kaunas University of Technology	LT	542	444	0	10.78	0.83	1.17	7.1
Technical University of Lisbon	PT	525	370	0	2.72	1.68	1.39	20.2
NTUA - Natl Tech University of Athens	GR	496	391	0	3.85	1.65	1.61	16.2
University of Cambridge	GB	470	312	0	0.69	1.76	1.56	21.2
Polytechnic University of Milan	IT	470	357	0	2.44	1.16	1.54	13.3
Technion Israel Institute of Technology	IL	456	348	0	1.98	1.70	1.89	21.0
University of Leeds	GB	432	300	0	1.34	1.88	1.38	19.6
University of Manchester	GB	420	263	0	0.71	1.42	1.47	16.5
Royal Institute of Technology	SE	388	276	0	1.73	1.45	1.67	17.0
University of Oxford	GB	385	238	0	0.55	1.75	1.67	21.6
ETHZ-Swiss Federal Inst of Tech Zurich	CH	376	234	0	0.79	1.89	1.60	20.6
DTU-Technical University of Denmark	DK	376	262	0	1.62	2.04	1.96	24.3
Politehnica University of Bucharest	RO	375	291	0	3.15	0.31	0.41	1.7
Polytechnic University of Turin	IT	370	280	0	2.50	2.21	1.57	26.4
University of Southampton	GB	362	254	0	1.16	1.07	1.25	11.1
University of Sheffield	GB	343	228	0	1.01	1.76	1.64	21.5
Chalmers University of Technology	SE	319	207	0	2.14	1.34	1.55	13.8
École polytechnique fédérale de Lausanne	CH	298	200	0	1.05	2.83	1.95	33.0
UNINA - University of Naples Federico II	IT	294	222	0	1.25	1.48	1.76	18.7
Istanbul Technical University	TR	292	220	0	2.88	1.29	1.54	12.9
Technical University of Catalonia	ES	285	209	0	1.38	1.87	1.81	25.3

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

When extending the analysis to all 303 ERA universities selected in this study, 157 meet the threshold of 30 publications in Other Transport Technologies. Among them, Vilnius Gediminas Technical University (15.67) and Kaunas University of Technology (12.52) are again the most specialised institutions, but the third place is now occupied by Riga Technical University (4.52). Including the less active universities, University of Pavia (3.81) and the Gazi University (3.02) are more frequently cited than the output of Vilnius Gediminas Technical University (2.91), which has the highest ARC among the 25 most active universities in this thematic priority. Unlike Vilnius

Gediminas Technical University, neither Pavia nor Gazi are specialised in Other Transport Technologies. According to ARIF, 18 universities published on average in journals with higher impact than DTU, which had the highest ARIF score among the top 25. The Hebrew University of Jerusalem (2.63), the Université Catholique de Louvain (2.6) and the University of Granada (2.52) are in the lead, but they produced only 45 to 74 publications each. Based on the share of highly cited papers as a measure of excellence, six universities have more articles in the top 10% most-cited publications in Other Transport Technologies than EPFL. The University of Pavia is worthy of mention, with an extremely high share of more than 40% of its publications in this field. The University of Catania and the University of Padua are in second and third place (37.7% and 36.4%, respectively).

Socio-Economic Sciences

The thematic priority of Socio-Economic Sciences accounts for close to 440,000 publications in Scopus (Table XL). The ERA was involved in approximately 169,600 of these publications (38%) and has a share of 35% of world publications in this area (155,200 publications FRAC). The ERA is slightly specialised in the Socio-Economic Sciences (1.1) and its scientific impact is more or less on par with the world level, as expressed by its ARC (1.05), ARIF (0.99) and percentage of papers among highly cited publications (10.5%).

More than 50% (13) of the 25 universities with the largest outputs in this field are located in the UK, followed by the Netherlands with six and Belgium with two. Leading the ranking of most active universities in the Socio-Economic Sciences is the University of Oxford, with about 2,400 publications (FULL; about 1,600 FRAC). It is nearly tied with the University of Manchester, with almost 2,300 papers (FULL; 1600 FRAC). The University of Cambridge ranks third with 2,000 papers (FULL; 1,400 FRAC). Note that the limitations related to the application of bibliometrics to the SSH apply, and these limitations might favour the UK (see Section 6.5). Overall, affiliated hospitals contributed a negligible margin of their universities' output in this area. Indeed, only seven universities have contributions from their affiliated hospitals, accounting for less than 3% of the output.

Overall, the University of Oxford, the University of Warwick, the University of Manchester, UvA–University of Amsterdam and Erasmus University Rotterdam are the five top-performing institutions in Socio-Economic Sciences. These universities each published more than 1,400 articles, are specialised in this area and have high scientific impact based on all three indicators.

Among the top 25, the University of Warwick achieves the highest SI (3.52). VU–University of Amsterdam ranks second (2.56), followed by the Cardiff University (2.34). Only three of the 25 universities are not specialised in Socio-Economic Sciences. Erasmus University Rotterdam and Utrecht University have the most important impact based on the three indicators, ranking first and second for all of them. VU–University of Amsterdam and UvA–University of Amsterdam are also consistently among the five leaders. Erasmus University Rotterdam received twice as many citations as the average with an ARC of 2.04; Utrecht University receives a score of 1.96. VU–University of Amsterdam is third with an ARC of 1.75. According to ARIF, the Hebrew University of Jerusalem (1.43) ranks behind Erasmus University Rotterdam (1.48) and Utrecht University (1.43). UvA–University of Amsterdam (1.42) and VU–University of Amsterdam (1.4) are not far behind. More than one-fourth of Erasmus University Rotterdam's articles in Socio-Economic

Sciences (26.2%) are among the top 10% most-cited publications. Utrecht University (23.2%) and VU–University of Amsterdam (21.2%) are, respectively, second and third.

Among the 303 examined universities, 253 published at least 30 articles in the field. Ten of them are more specialised in Socio-Economic Sciences than the University of Warwick, which ranked first according to SI among the most active universities. Unsurprisingly, those dedicated to economic issues achieve the highest SIs, with the NHH–Norwegian School of Economics coming first (13.73), followed by the Copenhagen Business School (13.17) and the Bucharest Academy of Economic Studies (9.99). According to ARC, five universities outperform Erasmus University Rotterdam (first in the top 25). The three universities with the highest score are from Switzerland: ETH Zurich ranks first (ARC 2.44), EPFL is second and the University of Zurich is third (2.2). In terms of ARIF, only Hasselt University (ARIF 1.82) and EPFL (1.57) are above Erasmus University Rotterdam. With more than 30% of its articles falling in the top 10% most-cited publications in this field, Karolinska University is the only university ahead of Erasmus University Rotterdam for the proportion of its articles in the field among the top 10% most-cited publications.

Table XL Scientific performance as measured in Scopus for the selected 25 ERA universities in Socio-Economic Sciences (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		439,825	439,825	n.c.	1.00	1.00	1.00	10.0
Total ERA		169,626	155,234	n.c.	1.10	1.05	0.99	10.5
University of Oxford	GB	2,384	1,579	0	1.73	1.72	1.38	20.0
University of Manchester	GB	2,277	1,555	1	1.99	1.48	1.16	13.1
University of Cambridge	GB	2,007	1,371	0	1.44	1.40	1.16	17.2
UvA - University of Amsterdam	NL	1,781	1,160	0	2.20	1.62	1.42	20.6
University of Nottingham	GB	1,692	1,096	1	2.17	1.54	1.27	19.0
Erasmus University Rotterdam	NL	1,520	864	2	2.00	2.04	1.48	26.2
University of Warwick	GB	1,441	966	0	3.52	1.57	1.21	17.3
Katholieke Universiteit Leuven	BE	1,323	839	0	1.16	1.57	1.34	18.4
Utrecht University	NL	1,319	813	1	1.34	1.96	1.43	23.2
University of Birmingham	GB	1,293	902	0	1.93	1.31	1.14	12.5
Cardiff University	GB	1,229	846	0	2.34	1.33	1.15	13.4
Univ of London, Univ Coll London	GB	1,220	823	0	0.84	1.58	1.35	20.3
University of Sheffield	GB	1,207	854	0	1.79	1.40	1.15	16.3
VU - University Amsterdam	NL	1,182	685	0	2.56	1.75	1.40	21.2
University of Leeds	GB	1,164	831	0	1.77	1.41	1.20	15.7
Ludwig Maximilian University of Munich	DE	1,124	600	0	0.97	1.53	1.20	20.0
University of Edinburgh	GB	1,043	767	0	1.38	1.15	1.13	11.3
University of Groningen	NL	1,020	647	2	1.44	1.60	1.39	19.2
Univ of London, King's Coll London	GB	997	687	3	1.14	1.59	1.21	18.7
University of Oslo	NO	982	694	2	1.47	1.43	1.19	17.9
University of Aarhus	DK	964	684	0	1.49	1.27	1.12	13.6
Hebrew University of Jerusalem	IL	958	659	0	1.56	1.21	1.43	12.5
Maastricht University	NL	935	527	0	1.95	1.47	1.27	16.4
Ghent University	BE	924	646	0	1.01	1.51	1.28	15.6
University of Bristol	GB	862	623	0	1.45	1.43	1.25	15.0

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

Humanities

Research in the Humanities accounts for about 154,000 publications in the Scopus database (Table XLI). The ERA was involved in the publication of about half of them (75,600 FULL; 49%) and has a share of 46% of the total output based on fractional counting (about 71,200 papers

FRAC). The ERA is highly specialised in the Humanities (SI 1.43), but its scientific impact is on par with the world level, with an ARC of 0.97, an ARIF of 0.93 and exactly as many papers in the top 10% most-cited publications as expected.

Almost half (12) of the 25 most actively publishing universities based on scientific output are located in the UK. The Netherlands and Spain follow, each with three universities in this selection. Three universities published more than 1,000 articles in Humanities between 2007 and 2011, namely the University of Oxford with more than 1,100 publications (FULL; 873 FRAC), followed by the University of Cambridge (1,150 FULL; 841 FRAC) and UCL (1,019 FULL; 672 FRAC). Though contributions from affiliated hospitals are fairly limited for most universities in this field, there is one exception; with 45% of its output in the Humanities involving at least one author from affiliated hospitals, the University of Zagreb stands out in this respect. In comparison, Utrecht University and Leiden University rank second for this indicator, with only 3% of their papers having a contribution from affiliated hospitals.

Table XLI Scientific performance as measured in Scopus for the selected 25 ERA universities in Humanities (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		153,951	153,951	n.c.	1.00	1.00	1.00	10.0
Total ERA		75,556	71,163	n.c.	1.43	0.97	0.93	10.0
University of Oxford	GB	1,233	873	0	2.72	1.84	1.35	22.4
University of Cambridge	GB	1,150	841	0	2.51	1.58	1.27	18.1
Univ of London, Univ Coll London	GB	1,019	672	1	1.95	1.68	1.37	21.6
University of Zagreb	HR	809	537	45	3.95	0.74	0.71	4.7
Katholieke Universiteit Leuven	BE	789	628	0	2.46	1.07	0.97	9.9
Ghent University	BE	728	553	0	2.47	1.49	1.09	15.4
Complutense University of Madrid	ES	715	540	0	3.36	0.89	0.80	8.2
University of Manchester	GB	677	565	0	2.06	1.46	1.21	15.1
University of Edinburgh	GB	677	529	0	2.70	1.54	1.18	16.0
Utrecht University	NL	655	433	3	2.03	1.86	1.32	23.3
University of Copenhagen	DK	580	402	0	1.60	1.82	1.17	25.3
University of Bristol	GB	545	361	0	2.39	2.16	1.36	25.8
UvA - University of Amsterdam	NL	533	430	2	2.32	1.24	1.17	13.2
Hebrew University of Jerusalem	IL	514	412	1	2.78	1.26	1.38	15.4
University of Nottingham	GB	499	388	1	2.18	1.40	1.32	16.0
University of Leeds	GB	498	405	1	2.45	1.79	1.30	21.9
University of Birmingham	GB	456	345	1	2.10	1.44	1.34	13.2
Autonomous University of Barcelona	ES	453	315	0	1.75	0.90	1.05	10.0
Leiden University	NL	451	346	3	2.38	1.29	1.11	14.9
University of Helsinki	FI	451	343	0	2.06	0.97	1.11	11.2
Stockholm University	SE	443	293	0	3.61	1.67	1.37	22.5
University of Glasgow	GB	435	349	1	2.32	1.12	1.09	11.7
University of Sheffield	GB	428	303	1	1.81	1.54	1.32	18.1
University of Southampton	GB	424	278	0	1.71	1.38	1.32	16.8
University of Barcelona	ES	417	292	1	1.56	0.94	1.06	14.3

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

Overall, all 25 universities are specialised in the Humanities; among these the University of Zagreb is the most specialised, with an SI of 3.95. Is is followed by Stockholm University (3.61) and Complutense University of Madrid (3.36). The University of Oxford is the only university consistently among the five leaders in terms of scientific impact. According to the relative citation rate measured by the ARC, the University of Bristol is first (2.16), with Utrecht University coming in second place (1.86) and the University of Oxford (1.84) in third place. According to ARIF, 11 universities are at the top, with scores between 1.38 and 1.30; the Hebrew University of

Jerusalem (1.38), UCL (1.37) and Stockholm University (1.37) occupy the first three places. Regarding highly cited publications, the University of Bristol ranks first, with 25.8% of its papers within the top 10% most-cited publications, slightly ahead of the University of Copenhagen (25.3%) and Utrecht University (23.3%).

Overall, 217 out of the 303 ERA universities selected in this study contribute to at least 30 publications in the Humanities. Among them, 13 are more specialised than the University of Zagreb (first in the top 25). The University of Rijeka achieves the highest SI at 10.2, followed by the University of Primorska (7.9) and the J.J. Strossmayera University of Osijek (6.37). None of these universities have scientific impact above the world level. ETH Zurich, which is not specialised in the Humanities, and the University of Bern are above the University of Bristol (now third) based on received citations, with ARCs of 2.47 and 2.29, respectively. Fourteen universities published on average in journals with higher impact than the Hebrew University of Jerusalem (first in the top 25). The Weizmann Institute of Science, which is not specialised (0.36) and has a relatively small output in this field, leads in terms of ARIF with a score of 1.68. It is followed by Aalto University (1.58) and the University of Warwick (1.48). The University of Bern has the highest percentage of articles within the top 10% most-cited publications in the Humanities, with 30.9% of its papers in the top 10%, followed by Imperial College London (28.1%) and VU–University of Amsterdam (27.0%). Six universities have a greater proportion in the top 10% most-cited publications than the University of Bristol.

Overall, the 25 most actively publishing universities in the Humanities are specialised in this thematic area. The University of Oxford and the University of Cambridge are among the top performing universities, with large outputs, high specialisation levels and high scientific impact overall. UCL, Stockholm University and the University of Bristol also perform strongly, with smaller outputs but some of the highest impact scores and strong SIs.

Security

Overall, close to 37,500 publications relevant to the thematic priority of Security are indexed in the Scopus database (Table XLII). The ERA was involved in more than 12,300 of these publications (33%) and has a share of about 30% of the world output based on fractional counting (about 11,100 FRAC). The ERA is not specialised in Security (0.92), but it has a higher scientific impact when compared to the world, with an ARC of 1.18 and 11.6% of its papers among the top 10% most-cited publications. Its ARIF is also slightly above the world level.

Among the 25 universities with the highest numbers of publications in this area, the UK and Italy lead with four universities each. Greece and Norway follow, each represented by three institutions. Only 12 universities published more than 100 articles in Security between 2007 and 2011. With 143 publications (FULL), the Polytechnic University of Milan ranks first and the University of Stavanger is second (134 articles FULL), while NTNU–Norwegian University of Science and Technology follows in third place (125 publications) based on full counting. The ranking is slightly different when examined based on fractional counting. Overall, contributions from affiliated hospitals within the selected universities are almost nonexistent, with the exception of four universities. The Tel Aviv University has a particularly high proportion of its output coming from associated hospitals (22%), and the University of Oslo is second, with about 4% of its output involving authors from affiliated hospitals.

Table XLII Scientific performance as measured in Scopus for the selected 25 ERA universities in Security (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		37,470	37,470	n.c.	1.00	1.00	1.00	10.0
Total ERA		12,322	11,121	n.c.	0.92	1.18	1.09	11.6
Polytechnic University of Milan	IT	143	95	0	3.60	0.91	1.12	3.6
University of Stavanger	NO	134	98	0	30.39	0.56	1.16	6.3
NTNU - Norwegian Univ of Sci and Tech	NO	125	76	0	2.67	1.20	1.08	9.6
Univ of London, King's Coll London	GB	122	98	0	1.90	0.90	0.51	8.8
ETHZ-Swiss Federal Inst of Tech Zurich	CH	118	84	0	1.57	1.82	1.11	24.4
NTUA - Natl Tech University of Athens	GR	113	86	0	4.73	1.42	1.19	14.7
TUDelft - Delft University of Technology	NL	111	64	0	1.61	0.80	1.13	5.2
Aristotle University of Thessaloniki	GR	110	78	0	2.48	1.95	1.19	28.4
UNINA - University of Naples Federico II	IT	110	77	0	2.41	0.96	1.11	6.3
UNIROMA1 - Sapienza University of Rome	IT	107	68	0	1.42	n.c.	1.16	n.c.
Technical University of Catalonia	ES	105	64	0	2.35	1.84	1.23	16.7
Alma Mater Studiorum Univ of Bologna	IT	103	65	0	1.47	0.87	1.19	8.8
Istanbul Technical University	TR	94	70	0	5.09	1.22	1.11	8.0
Middle East Technical University	TR	85	62	0	3.69	n.c.	1.04	n.c.
University of Patras	GR	84	56	0	3.02	n.c.	1.17	n.c.
University of Porto	PT	84	48	0	1.67	n.c.	1.48	n.c.
WUR - Wageningen Univ and Res Centre	NL	81	48	0	1.96	2.29	1.30	33.3
University of Oslo	NO	80	36	4	0.90	n.c.	1.01	n.c.
University of Oxford	GB	76	52	0	0.67	1.46	0.70	21.2
Univ of London, Imperial Coll London	GB	75	42	1	0.54	1.66	1.13	15.7
University of Granada	ES	74	51	0	1.94	n.c.	1.19	n.c.
Katholieke Universiteit Leuven	BE	73	43	1	0.69	n.c.	1.33	n.c.
Ghent University	BE	69	45	0	0.82	n.c.	1.26	n.c.
Tel Aviv University	IL	69	43	22	0.83	0.39	0.73	3.1
University of Cambridge	GB	69	46	0	0.56	1.15	0.98	13.3

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

The University of Stavanger is far more specialised than all other universities in the top 25, publishing 30 times as much as expected given its overall output and the size of the field (SI 30.39). Istanbul Technical University is also highly specialised, ranking second at 5.09, and the NTUA is third (4.73). WUR and the Technical University of Catalonia score high (among the top five) for all scientific impact indicators. ARC and the share of highly cited publications could only be computed for 18 universities. Among them, WUR, Aristotle University of Thessaloniki and the Technical University of Catalonia form the top three according to the relative citation rate (ARCs of 2.29, 1.95 and 1.84, respectively). WUR (33.3%) and Aristotle University of Thessaloniki (28.4%) also have the highest shares of highly cited papers. They are followed by ETH Zurich (24.4%). According to ARIF, the University of Porto, the Katholieke Universiteit Leuven and WUR published on average in higher impact journals (1.48, 1.33, and 1.30, respectively). Eighty-five of the selected 303 ERA universities have at least 30 publications in Security. When the analysis is extended to these 303 universities, the University of Stavanger remains the leading institution with respect to specialisation (30.39) and is followed by

Given the size of the field of Security, only a handful of universities have a sizeable output in this area. Among them, the University of Stavanger stands out as highly specialised, with an SI score of 30.39, much higher than any other university. However, it has a low scientific impact overall based on received citations and its ARIF is just slightly above the world level. Aristotle University of Thessaloniki, ETH Zurich and NTUA also perform well in this area. Finally, WUR has a particularly high impact in Security but its output is low.

the Technical University of Crete (8.67). As no other university has valid scores for ARC and the percentage of highly cited publications, the ranking within the top 25 is still valid in this extended selection, with the exception of DTU, which comes in 11th position. Based on ARIF, five universities perform better than the University of Porto: Ataturk University and the University of Seville are first with 1.57, closely followed by Paul Sabatier University (1.56), Dokuz Eylul University (1.55) and New University of Lisbon (1.55). Finally, the ranking of institutions by proportion of scientific output within the top 10% most-cited publications is almost identical to the one presented for the top 25 universities, the only exception being the addition of DTU in ninth place.

4 COMPARATIVE ANALYSIS OF ERA AND NON-ERA UNIVERSITIES

This section compares the scientific performance of the 50 most actively publishing ERA universities to that of the 50 most active non-ERA universities using bibliometric indicators. Data for ERA universities are presented in Table XLIII, while those for leading non-ERA universities follow in Table XLIV. Note that the values shown in the tables for the world encompass all publications in the database and not just those produced by universities.

4.1 COUNTRY REPRESENTATION AMONG THE 50 MOST-PUBLISHING UNIVERSITIES (2007–2011) AT ERA AND NON-ERA LEVEL

At the international level (non-ERA universities), the US is the clear leader with more than half (27; 54%) of all universities presented among the top 50. China ranks second, with seven universities in this ranking, followed by Canada and Japan in third place, with four universities each. Australia is represented by three universities; the remaining three places are occupied by universities from Singapore (two), the Republic of Korea (two) and Brazil (one). As shown in Section 3, the concentration of leading universities in specific countries is not as pronounced in the ERA; in fact, the most active universities are distributed among 14 countries. There is nevertheless one country—the UK—that stands out, with about 30% (14) of leading ERA universities. The Netherlands ranks second with seven, followed by France in third place with six, and Italy in fourth place. Germany, Sweden and Spain are tied for fifth, as they are each represented by three universities among the 50 most actively publishing. If a single ranking of the top 50 universities in the world is produced (i.e., ERA and non-ERA pooled) 42 are from non-ERA countries or, conversely, only eight ERA universities make the list of the 50 most active universities. Of these eight, five are located in the UK and one each in France, Belgium and Denmark.

4.2 SCIENTIFIC OUTPUT OF THE 50 MOST-PUBLISHING UNIVERSITIES (2007–2011) AT ERA AND NON-ERA LEVEL

Harvard University is the largest non-ERA university based on the number of papers published during the 2007 to 2011 period (more than 91,600 FULL; close to 48,000 FRAC). At great distance, the University of Toronto ranks second with about 53,000 publications (FULL; 31,400 FRAC) and the University of Tokyo is the third most active non-ERA university (about 49,900 FULL; 26,400 FRAC). It is interesting to note that both Harvard and the University of Toronto have some of the largest involvement from affiliated hospitals among leading non-ERA universities, pointing to a focus on health-related research; for instance, 62% (first place) and 48% (third place) of their respective production involved at least one author from their affiliated hospitals. This is not the case for the University of Tokyo, for which affiliated hospitals contributed to only 1% of its output. At the ERA level, British universities occupy the top four positions, UCL being the most active one. With close to 39,000 publications (FULL; 20,000 FRAC) it would be positioned 12th in the non-ERA ranking, just above the University of Washington. In the ranking of most actively publishing universities within the ERA, UCL is ahead of Imperial College London and the University of Cambridge, both with 36,200 papers (FULL; 18,800 and 19,700 FRAC, respectively) in second and third place. The University of Oxford is not far behind, in fourth place,

with almost 36,200 papers (18,700 FRAC). Oxford is followed by the first non-UK institution, Pierre and Marie Curie University with about 33,400 publications (FULL; 15,000 FRAC), in fifth place.

Overall, contributions from affiliated hospitals are larger among leading universities within than outside the ERA. The average contribution rate from university hospitals among the 50 most actively publishing ERA universities (26%) is in fact twice as high as that of the 50 most actively publishing non-ERA universities (13%). As mentioned earlier, Harvard University has the highest proportion of publications associated with affiliated hospitals within the non-ERA selection (62%); the University of Toronto is second with 48%, followed by Duke University (42%) and Columbia University (41%). At the ERA level, Erasmus University Rotterdam ranks first for this indicator with 79% of its publications coming from its affiliated hospitals; Paris Descartes University (58%) and Radboud University Nijmegen (54%) follow.

4.3 Scientific Impact of the 50 Most-Publishing Universities (2007–2011) at ERA and Non-ERA Level

At the international level, US universities dominate the non-ERA ranking according to ARC, occupying the first 20 positions. MIT ranks first with a score of 2.45, and Harvard University and Stanford University (both 2.21) follow. With McMaster University in second place (1.84), the first non-US institution is from Canada. At the ERA level, the UK again dominates, with eight universities among the top 20 in terms of ARC. The Netherlands also has a strong presence in this regard, being represented by six universities. The University of Oxford ranks first with a score of 1.94, which would place the university in a tie for 12th place in a world ranking of the 100 most actively publishing universities. ETH Zurich (1.93) and Imperial College London (1.86) follow not far behind. Among the 50 most actively publishing ERA universities, 98% (49 universities) score above the world level with respect to ARC. This is the case for only 86% (43 universities) of non-ERA universities. In fact, there is less variation among the scores of ERA universities than among non-ERA universities (standard deviations of 0.19 and 0.42, respectively). However, the median ARC is higher for non-ERA universities (1.75; 1.59 for ERA universities). Furthermore, it should be noted that six of the seven non-ERA universities with ARC scores at or below the world level are Chinese institutions.

At the non-ERA level, the US is once again the frontrunner according to ARIF, occupying the top 21 positions. Harvard University achieves the highest score at 1.70, slightly ahead of MIT (1.66) and Stanford University (1.58). At the non-ERA level, the UK has 10 universities among the top 20 ERA universities in terms of ARIF. However, non-ERA universities have the lead, as the University of Oxford (1.50) only ranks 14th among the 100 institutions presented in Table XLIII and Table XLIV, tied with two other institutions. The University of Cambridge (1.48), ETH Zurich (1.47), the University of Bristol (1.47) and Imperial College London (1.46) follow closely behind. Although there is slightly less variation in the ARIF scores of ERA universities than among non-ERA ones, it should be pointed out that the ARIF of universities is generally comparable between the two groups, with the median score being slightly higher for non-ERA universities.

Regarding highly cited publications, MIT ranks first among the leading non-ERA universities, with 27.2% of its papers among the top 10% most-cited publications. It is followed by Harvard

University (25.4%), the University of California at San Francisco (24.6%), Stanford University (24.1%) and the University of California at Berkeley (24%). The US again dominates this list, taking up the top 24 positions, the first non-US university being the University of British Columbia in 25th place (18.6%). Only seven universities score lower than the world average, with five of these located in China, one in the Republic of Korea and one in Brazil. At the ERA level, ETH Zurich achieves the highest score with 22%, which would be enough for 14th place among all top-publishing universities worldwide. The University of Oxford ranks second (21.7%) and Imperial College London follows very close behind (21.0%). Only one ERA university scores below the world level. As mentioned for ARC and ARIF, the variation observed between the scores of ERA universities is slightly lower than the variation observed in the case of non-ERA universities, but the median of non-ERA universities is slightly higher (18.44% vs. 17.01%).

4.4 PERFORMANCE OF ERA AND NON-ERA UNIVERSITIES IN BRIEF

Overall, leading non-ERA universities appear to have an edge over leading ERA universities, having larger outputs and more scientific impact according to average citations (ARC), the impact factor of the journals in which they publish (ARIF) and the proportion of their publications among highly cited publications. Affiliated hospitals generally contribute a greater fraction of the output of ERA universities than they contribute to non-ERA universities. Another difference between ERA and non-ERA universities relates to the importance of existing gaps in the performance of organisations within each of these groups. For instance, existing differences in the performances of non-ERA universities are slightly more pronounced than among ERA universities; in other words, there seems to be slightly less inequality in the performance of ERA universities than non-ERA ones.

US universities clearly dominate both the non-ERA and world rankings with the best performing institutions, including Harvard University, MIT, Stanford University and many more that would be worth mentioning. While British universities have a strong presence—the University of Oxford, the University of Cambridge, Imperial College London and UCL being among the leaders—other countries appear among the top-performing universities within the ERA, including Switzerland (ETH Zurich) and the Netherlands (Erasmus University Rotterdam).

Table XLIII Scientific performance as measured in Scopus for the 50 most actively publishing ERA universities (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	ARC	ARIF	Top 10 (%)
World		**9,091,464**	**9,091,464**	**n.c.**	1.00	1.00	10.0
Univ of London, Univ Coll London	GB	38,979	20,053	21	1.70	1.43	16.7
Univ of London, Imperial Coll London	GB	36,244	18,767	31	1.86	1.46	17.3
University of Cambridge	GB	36,240	19,688	14	1.85	1.48	18.1
University of Oxford	GB	36,159	18,654	16	1.94	1.50	18.7
Pierre and Marie Curie University	FR	33,360	15,044	32	1.47	1.28	11.6
University of Manchester	GB	28,612	16,110	15	1.59	1.33	12.7
Katholieke Universiteit Leuven	BE	27,337	14,974	16	1.70	1.32	15.7
University of Copenhagen	DK	27,054	14,486	43	1.76	1.32	15.4
Ludwig Maximilian University of Munich	DE	24,253	12,624	23	1.68	1.25	14.4
ETHZ-Swiss Federal Inst of Tech Zurich	CH	24,005	13,008	0	1.93	1.47	20.1
Utrecht University	NL	24,000	12,374	40	1.74	1.42	16.7
Univ of London, King's Coll London	GB	22,925	12,330	36	1.67	1.35	14.6
UNIROMA1 - Sapienza University of Rome	IT	22,886	11,683	9	1.30	1.20	9.1
Ghent University	BE	22,125	13,105	13	1.60	1.30	15.0
Technical University Munich	DE	21,928	12,060	17	1.50	1.23	13.4
University of Barcelona	ES	21,899	10,871	35	1.53	1.21	10.8
University of Edinburgh	GB	21,760	11,547	15	1.69	1.42	15.6
UvA - University of Amsterdam	NL	21,665	10,803	46	1.80	1.42	17.0
Heidelberg University	DE	21,308	10,762	29	1.55	1.26	12.8
Karolinska Institute	SE	20,963	10,170	32	1.63	1.35	13.2
Autonomous University of Barcelona	ES	20,594	10,535	37	1.42	1.23	10.2
Tel Aviv University	IL	20,511	12,363	31	1.32	1.29	10.7
University of Zurich	CH	20,137	10,362	36	1.73	1.36	16.3
University of Paris XI	FR	20,015	8,593	17	1.58	1.32	12.8
Paris Diderot University	FR	19,843	8,957	47	1.57	1.25	10.2
University of Helsinki	FI	19,766	9,686	22	1.64	1.36	13.4
Lund University	SE	19,644	10,451	26	1.62	1.33	13.2
Alma Mater Studiorum Univ of Bologna	IT	19,410	10,738	11	1.43	1.21	11.7
University of Oslo	NO	18,280	9,681	35	1.49	1.26	12.1
UNIPD - University of Padua	IT	18,245	9,459	3	1.51	1.28	12.6
UNIMI - University of Milan	IT	17,936	8,649	10	1.32	1.23	10.2
Charles University in Prague	CZ	17,865	10,059	29	0.98	0.88	4.7
University of Nottingham	GB	17,669	10,526	18	1.48	1.32	14.7
University of Aarhus	DK	17,593	9,402	30	1.65	1.32	14.9
University of Birmingham	GB	17,207	9,639	17	1.54	1.33	13.1
University of Southampton	GB	17,114	9,686	12	1.58	1.35	14.4
University of Groningen	NL	17,069	9,148	44	1.65	1.42	15.7
Uppsala University	SE	16,974	8,443	14	1.58	1.33	13.2
University of Sheffield	GB	16,945	9,935	13	1.54	1.33	14.6
Erasmus University Rotterdam	NL	16,936	8,814	79	1.83	1.43	17.1
University of Leeds	GB	16,907	9,691	19	1.47	1.31	12.4
Leiden University	NL	16,868	8,403	51	1.77	1.40	15.7
Paris Descartes University	FR	16,775	7,501	58	1.46	1.17	8.7
TUDelft - Delft University of Technology	NL	16,755	10,151	0	1.29	1.21	12.7
Complutense University of Madrid	ES	16,743	9,394	21	1.18	1.08	8.7
Claude Bernard University Lyon 1	FR	16,711	7,628	33	1.38	1.21	11.0
University of Glasgow	GB	16,711	8,831	23	1.64	1.39	13.2
University of Bristol	GB	16,593	8,859	6	1.77	1.47	16.9
Aix-Marseille Université	FR	16,588	8,356	25	1.32	1.19	9.9
Radboud University Nijmegen	NL	16,445	8,363	54	1.75	1.41	14.3

Note: The ARC and % in top 10% most-cited publications are computed for 2007 to 2008 publications only due to incomplete citation windows for more recent publications. A university's performance in comparison to the world level for ARC, ARIF and percentage of top 10% most-cited publications is indicated by a colour-coded icon: green (above), yellow (similar to) and red (below the world average).

Source: Computed by Science-Metrix using Scopus

Table XLIV Scientific performance as measured in Scopus for the 50 most actively publishing non-ERA universities (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	ARC	ARIF	Top 10 (%)
World		**9,091,464**	**9,091,464**	**n.c.**	1.00	1.00	10.0
Harvard University	US	91,656	48,063	57	2.21	1.70	23.5
University of Toronto	CA	53,028	31,440	38	1.74	1.41	15.7
University of Tokyo	JP	49,867	26,406	1	1.23	1.20	11.1
University of Michigan	US	44,910	25,955	10	1.87	1.50	18.5
Tsinghua University	CN	44,546	31,700	1	0.95	0.91	8.8
University of São Paulo / USP - Universidade de S	BR	44,332	26,504	6	0.90	0.89	6.2
Zhejiang University	CN	42,691	31,043	6	0.94	0.93	8.3
Stanford University	US	41,271	22,691	8	2.21	1.58	21.9
Johns Hopkins University	US	40,824	21,164	14	1.94	1.53	18.2
University of California, Los Angeles	US	40,448	21,691	6	2.00	1.50	19.5
Shanghai Jiao Tong University	CN	39,467	28,440	20	0.86	0.87	7.3
University of Washington	US	38,942	20,146	5	1.98	1.52	20.1
Columbia University	US	36,378	18,981	38	2.00	1.55	18.1
Cornell University	US	36,353	19,478	21	1.83	1.45	16.4
University of Pennsylvania	US	35,480	19,979	22	1.96	1.56	18.9
Kyoto University	JP	34,108	19,469	2	1.22	1.17	11.3
Harbin Institute of Technology	CN	33,557	26,072	0	0.78	0.76	6.5
MIT - Massachusetts Institute of Technology	US	33,368	17,597	0	2.45	1.66	24.5
Peking University	CN	33,133	21,091	17	1.11	1.06	9.9
Seoul National University	KR	32,700	19,629	11	1.18	1.23	10.6
University of British Columbia	CA	32,650	18,650	13	1.73	1.39	15.8
University of California, Berkeley	US	32,552	16,887	0	2.10	1.55	21.5
University of California, San Diego	US	32,447	16,828	5	1.95	1.54	20.0
University of Wisconsin-Madison	US	31,388	17,979	4	1.75	1.43	17.8
Penn State - Pennsylvania State University	US	31,301	18,485	6	1.65	1.31	15.1
University of Florida	US	30,555	17,692	2	1.52	1.33	14.1
University of Pittsburgh	US	29,759	16,508	21	1.80	1.44	16.8
Osaka University	JP	29,705	16,942	0	1.11	1.12	9.2
University of Melbourne	AU	29,259	15,689	22	1.68	1.38	15.0
University of Sydney	AU	29,041	16,174	20	1.48	1.29	12.7
National University of Singapore (NUS)	SG	28,880	17,378	5	1.57	1.41	17.2
Ohio State University	US	28,816	16,587	10	1.66	1.39	14.9
Tohoku University	JP	28,571	16,373	1	1.18	1.13	9.8
National Taiwan University	CN	28,341	16,988	15	1.30	1.30	12.1
Duke University	US	28,306	15,019	41	1.99	1.57	19.4
HUST - Huazhong University of Science and Technolog		28,244	20,828	14	0.59	0.75	4.8
University of California, Davis	US	28,111	15,249	5	1.75	1.45	15.8
University of Minnesota-Twin Cities	US	27,945	15,551	1	1.83	1.47	17.0
University of Illinois at Urbana-Champaign	US	27,834	17,144	0	1.75	1.44	16.9
Yale University	US	27,067	14,317	2	1.90	1.58	19.6
McGill University	CA	26,643	14,731	25	1.62	1.41	14.3
Northwestern University	US	25,658	14,103	8	1.97	1.57	20.0
University of California, San Francisco	US	25,560	12,635	1	2.03	1.66	20.9
University of Alberta	CA	23,876	14,099	4	1.52	1.33	13.2
University of North Carolina at Chapel Hill	US	23,718	12,552	6	1.88	1.52	18.2
University of Queensland	AU	23,619	12,991	7	1.55	1.33	14.8
University of Science and Technology (UST)	KR	23,592	12,693	0	1.00	1.10	8.3
University of Texas at Austin	US	23,288	14,071	0	1.76	1.39	17.1
Nanyang Technological University (NTU)	SG	22,841	14,759	0	1.49	1.44	15.4
University of Southern California	US	22,730	12,693	12	1.77	1.43	17.0

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

5 CONCLUSION

The present report provides a bibliometric assessment of the scientific performance of ERA universities based on their collaboration patterns and production profiles from 2007 to 2011. The analysis is carried out for each of the 22 main fields of research and each of the 17 thematic priorities funded under the Seventh Framework Programme for Research and Technological Development (FP7). The analysis first presents the performance of universities in the sciences in general (i.e., all fields combined) and in FP7 thematic priorities grouped, then at the level of individual areas. Key findings are presented for each section, beginning with the overall performance at the world and ERA levels (i.e., all countries combined, not just universities) and progressing to the performance of individual universities. The report focuses on those organisations that have published the greatest number of publications among the 303 selected universities in each area. Where applicable, the analysis is extended to institutions outside the top 25, whose production profiles presented some remarkable aspects for one or more of the presented indicators. Finally, a comparative analysis of the performance of the most actively publishing ERA and non-ERA universities in the sciences in general (all fields combined) is presented.

Universities' Collaboration Patterns within the ERA

The collaboration network of the 303 ERA universities in the sciences in general (i.e., all fields combined) is mostly structured according to the geographic location of universities; indeed, universities tend to cluster with organisations from the same country. This does not come as a surprise, as the physical and/or societal proximity of institutions tends to favour partnerships, resulting in some degree of isolation by distance. This is not to say that there is no integration of countries within the ERA, but simply that the strength of inter-institutional collaboration is usually greater within than between countries. For instance, a previous study that was conducted as part of the same suite of reports as the current document revealed that the integration of the collaboration network of ERA countries has increased in 2008–2011 compared to 2004–2007 in the sciences in general (i.e., overall in Scopus), as well as in the FP7 thematic priorities (i.e., grouped).[12]

The most important communities (i.e., sub-networks or clusters) in the network are formed by universities located in the UK, followed by Germany, France, Italy, the Netherlands, Sweden and Spain. These results corroborate the finding made in a previous study performed at the level of countries that the most central countries in the scientific collaboration network of the ERA are, in descending order, Germany, the UK, France, Italy, Spain and the Netherlands.[13] The slight

[12] Campbell, D., Roberge, G., Haustein, S., and Archambault, É. (2011). *Analysis and Regular Update of Bibliometric Indicators: Intra-European Cooperation Compared to International Collaboration of the ERA Countries (Analytical Report 2.3.6).* Report prepared by Science-Metrix for the European Commission Directorate-General for Research, 166 pages.

[13] Delivered output at this time: Campbell, D., Lefebvre, C., Picard-Aitken, M., Côté, G., Ventimiglia, A., Roberge, G., and Archambault, É. (2013). *Analysis and Regular Update of Bibliometric Indicators: Country and Regional Scientific Production Profiles (Analytical Report 2.3.1).* Report prepared by Science-Metrix for the European Commission Directorate-General for Research, 192 pages.

differences between this report and the preceding study in the rankings of countries can be attributed to their different timeframes (2007–2010 for universities vs. 2007–2009 for countries), as well as to the fact that the current study considers only the fraction of a country's publications that is attributable to its most actively publishing universities.

Most of the central players within the ERA network are also leading universities in terms of publication activity, and most of these are located in the UK. They include University College London (UCL), Cambridge, Imperial College London, Oxford, the University of Manchester and Pierre and Marie Curie University. Four smaller institutions that are less central to the network structure considering their absolute numbers of co-publications, but that stand out in terms of the diversity of their partners, include the University of Helsinki, Lund University, the University of Oslo and Charles University Prague. In terms of the impact of their research output measured by the impact factors of the journals in which they publish, the Weizmann Institute of Science in Israel and the University of Nova Gorica in Slovenia stand out especially. They are followed by Oxford and Cambridge.

The 25 ERA universities that published the most in the sciences in general (i.e., all fields combined) from 2007 to 2011 generally published between 64% to 84% of their peer-reviewed papers through inter-institutional co-authorship, while the remaining 16% to 36% of the publications were published without any external partners. Inter-institutional collaboration is particularly important for the University of Paris XI, Pierre and Marie Curie University, the Karolinska Institute, Paris Diderot University and Utrecht University. The ranking based on collaboration with other academic and/or research-performing organisations (RPOs) is almost the same, except that Paris Diderot University and the Karolinska Institute switch places and Heidelberg University takes Utrecht's place. Collaboration with the private sector is very low in several universities, the highest collaboration rates being observed for technical universities, namely Technical University Munich and ETH Zurich (10% and 9%, respectively). Outside of the 25 most actively publishing institutions, the universities that stand out with respect to collaboration rates with the private sector (i.e., rates above 15%) include Chalmers University of Technology, Tampere University of Technology, Graz University of Technology and the Johannes Kepler University of Linz.

Scientific Production Profiles

ERA countries produced approximately one-third of the world scientific production in the sciences in general (i.e., the peer-reviewed scientific literature indexed in Scopus between 2007 and 2011), the most actively publishing country being the UK. The UK is represented by seven among the 25 most active universities, followed by Germany and France with three institutions each. UK institutions also lead the field of most actively publishing universities. UCL occupies first place and is followed by Imperial College London, Cambridge and Oxford. Four institutions stand out for their strong performances in terms of scientific impact, as they are always among the top five according to the three citation-based impact measures: the University of Nova Gorica, the University of Oxford, École polytechnique fédérale de Lausanne (EPFL) and ETH Zurich.

Performance of ERA Universities by Main Fields

The scientific production of the ERA as a whole (including, but not limited to, universities) generally accounts for one-third of the world production between 2007 and 2011, with some variation among the 22 main research fields. The ERA's share is particularly high in the domain of the Arts & Humanities, in which its contribution to the world output is more than 40% in the fields of Philosophy & Theology and in the Visual & Performing Arts, while more than half of the worldwide output in Historical Studies is conducted by ERA institutions. The lowest shares are observed in the domain of Applied Sciences (i.e., in the fields of Enabling & Strategic Technologies and Engineering) and in General Science & Technology journals, with the ERA contributing to roughly one-quarter of the world production in these areas.

Universities located in the UK are well represented among the 10 most actively publishing universities within the 303 selected. The UK is represented by the largest number of universities among all of the 22 research fields except for Agriculture, Fisheries & Forestry, Chemistry and Mathematics & Statistics, two of which belong to the domain of Natural Sciences. Italy is strongly represented in the Applied Sciences fields, having the second highest number of universities among the top 25 in Built Environment & Design, Enabling & Strategic Technologies, Engineering and ICT, while the Netherlands follows the UK in the two Economics & Social Science fields, three out of four fields in Health Sciences and two out of four Arts & Humanities fields. Germany and France are represented by the largest number of universities in Chemistry and Spain and France in Mathematics and Statistics. The field of Agriculture, Fisheries & Forestry is very heterogeneous in terms of nationalities with three universities from Denmark and two each from Austria, Belgium, Germany and Italy. Except for Chemistry, France and Germany are important in Biomedical Research, Physics & Astronomy and General Science & Technolog. France is also strongly represented in Earth & Environmental Sciences, while German universities are also important publishing entities in the field of Enabling & Strategic Technologies in the domain of Applied Sciences.

When all bibliometric indicators (i.e., number of publications, SI, ARC, ARIF and % of papers in the top 10% most-cited publications) are combined in a single analysis, three British universities repeatedly appear among the top three, namely the University of Oxford, the University of Cambridge and UCL. Oxford shows one of the strongest overall performances in Economics & Social Science (Economics & Business and Social Sciences), in the Arts & Humanities (Philosophy & Theology and Historical Studies) and in the fields of Biomedical Research and General Science & Technology. UCL is strong in Health Sciences, scoring highest in Clinical Medicine and in Psychology & Cognitive Sciences, and is also among the top three according to overall scientific performance in Historical Studies and General Science & Technology. Cambridge, among the top three in five research fields, reflects a mixed profile as it shows one of the highest overall performances in each domain except for Economics & Social Science: i.e., Applied Sciences (Enabling & Strategic Technologies), Arts & Humanities (Historical Studies), Health Sciences (Biomedical Research), Natural Sciences (Physics & Astronomy) and General Science & Technology. While British universities dominate the Arts & Humanities, Economics & Social Science, Health Sciences and General Science & Technology, French—particularly Parisian—universities perform best in the Natural Sciences. The Applied Sciences are led by Dutch and Scandinavian Universities. The Karolinska Institute is particularly strong in Health Sciences,

where it is among the top three in the fields of Biomedical Research, Clinical Medicine and Public Health & Health Services. TU Delft, DTU, EPFL and the Technical University of Catalonia are each among the top three in two research fields in the Applied Sciences. Overall, WUR, the University of Warwick, Erasmus University Rotterdam, ETH Zurich and Pierre and Marie Curie University are also worth mentioning, as they are among the top three in more than one of the 22 main research fields.

Universities that performed well with respect to many indicators in a given area are presented below in each of the main research fields. Please note that the area in which a university performs well often matches its specialisation pattern. Also, it should be noted that the lists provided below can be restrictive, in the sense that other universities might have very similar performances to those presented here. The reader is referred to the core sections of this report for more detailed information on leading universities by field.

Applied Sciences

- **Agriculture, Fisheries & Forestry:** WUR – Wageningen University and Research Centre, the Swedish University of Agriculture Sciences and Mendel University Brno
- **Built Environment & Design:** TU Delft, Technical University of Denmark (DTU) and Istanbul Technical University
- **Enabling & Strategic Technologies:** Technical University of Denmark (DTU), École polytechnique fédérale de Lausanne (EPFL) and the University of Cambridge
- **Engineering:** TU Delft, Technical University of Catalonia and Polytechnic University of Turin
- **Information & Communication Technologies (ICT):** École polytechnique fédérale de Lausanne (EPFL), Technical University of Catalonia and Aalto University

Arts & Humanities

- **Communication & Textual Studies:** University of Amsterdam (UvA), Ghent University and University of Warwick**Historical Studies:** University of Cambridge, University of Oxford and University College London (UCL)
- **Philosophy & Theology:** University of Oxford, Bar-Ilan University and University of Leeds
- **Visual & Performing Arts:** *due to too few publications, indicators could not be computed*

Economic & Social Sciences

- **Economic & Business:** Copenhagen Business School, Erasmus University Rotterdam, University of Oxford
- **Social Sciences:** University of Oxford, University of Warwick and University of Manchester

Health Sciences

- **Biomedical Research:** University of Oxford, University College London (UCL), University of Cambridge, the Karolinska Institute and the University of Copenhagen
- **Clinical Research:** University College London (UCL), Charité and the Karolinska Institute
- **Psychology & Cognitive Sciences:** University College London (UCL), VU–Amsterdam University and King's College London
- **Public Health & Health Services:** The Karolinska Institute, Maastricht University and Erasmus University Rotterdam

Natural Sciences

- **Biology:** WUR–Wageningen University and Research Centre, Swedish University of Agricultural Science and University of Copenhagen

- **Chemistry:** University of Strasbourg, ETH Zurich and University of Bordeaux 1
- **Earth & Environmental Sciences:** ETH Zurich, Stockholm University and Pierre and Marie Curie University
- **Mathematics & Statistics:** Pierre and Marie Curie University, Paris Diderot University and University of Granada
- **Physics & Astronomy:** Paris Institute of Technology, University of Paris XI and University of Cambridge

General Fields

- **General Arts, Humanities & Social Sciences:** *due to too few publications, indicators could not be computed*
- **General Science & Technology:** University of Oxford, University of Cambridge and University College London (UCL)

Performance of ERA Universities by FP7 Priority

The scientific production of the ERA as a whole (including, but not limited to, universities) in the FP7 priorities generally accounts for one-third of the world production between 2007 and 2011. The ERA's share of world publications is particularly high in the Humanities (46%). The lowest shares are observed in Materials (excluding Nanotechnologies), Other Transport Technologies, Energy and New Production Technologies, with the ERA producing approximately one fifth of the world output in these areas.

On the institutional level, results overall are comparable to those based on the 22 main research fields, with slight differences in some of the thematic priorities. The UK is represented by the highest number of universities among the top 25 in all thematic priorities except Food, Agriculture and Fisheries and New Production Technologies. While the former is led by Denmark, but is generally quite heterogeneous (compared to Agriculture, Fisheries & Forestry of the 22 fields described above), Italy plays a vital role in New Production Technologies. The UK particularly dominates the thematic priorities of Socio-Economic Sciences and Humanities, where about half of the 25 most active universities are British. In Aeronautics, Space and Environment (including Climate Change & Earth Sciences), universities from the UK make up more than one-third. Italy is represented by at least three universities in eight areas (i.e., ICT, New Production Technologies, Construction and Construction Technologies, Energy, Aeronautics, Space, Other Transport Technologies and Security), Germany in five (Health, Biotechnology, Nanosciences and Nanotechnologies, Materials and Automobiles) and the Netherlands (i.e., Health, Environment, Socio-Economic Sciences, and Humanities) and France (Health, Nanosciences and Nanotechnologies, Materials and Environment) in four priority areas. Although the UK dominates in terms of number of universities among the 25 most active in 15 of the 17 thematic priorities, there are no British universities among the top three in terms of overall performance based on all indicators in nine priorities. The overall performance reflects all bibliometric indicators (i.e., number of publications, SI, ARC, ARIF and % of papers in the top 10% most-cited publications) in a single analysis. On the other hand, the Humanities are led by British universities only, namely Oxford, Cambridge and UCL. TU Delft performs best in most thematic priorities, as it is among the top three in terms of overall performance in five areas (i.e., New Production Technologies, Construction and Construction Technologies, Aeronautics, Space and Other Transport

Technologies). DTU, the University of Oxford, University College London and WUR are each among the top three in three thematic priorities.

The top three universities that perform best for all examined bibliometric indicators overall in each FP7 thematic priority are:

- **Health:** University College London (UCL), the Karolinska Institute and Charité
- **Food, Agriculture & Fisheries:** WUR–Wageningen University and Research Centre, the Swedish University of Agriculture Sciences and Mendel University Brno
- **Biotechnology:** WUR–Wageningen University and Research Centre, Technical University of Denmark (DTU) and BOKU–Univ. of Natural Resources and Applied Life Sciences
- **Information & Communication Technologies (ICT):** École polytechnique fédérale de Lausanne (EPFL), Technical University of Catalonia and the Vienna University of Technology
- **Nanosciences & Nanotechnologies:** École polytechnique fédérale de Lausanne (EPFL), University of Cambridge and University of Freiburg
- **Materials:** Istanbul Technical University, University of Aveiro and RWTH Aachen University
- **New Production Technologies**: Polytechnic University of Milan, TU Delft and Technical University of Catalonia
- **Construction & Construction Technologies:** TU Delft, Technical University of Denmark (DTU) and Istanbul Technical University
- **Energy:** Technical University of Denmark (DTU), Chalmers University of Technology and NTUA–National Technical University of Athens
- **Environment (with Climate Change):** ETH Zurich, WUR–Wageningen University and Research Centre and the Swedish University of Agricultural Sciences
- **Aeronautics & Space:** TU Delft, the Technion Israel Institute of Technology and University of Southampton
- **Automobiles:** University of Southampton and Aalborg University *(due to too few publications, indicators could not be computed for other universities)*
- **Other Transport Technologies:** Vilnius Gediminas Technical University, Kaunas University of Technology and TU Delft
- **Socio-Economic Sciences:** University of Warwick, University of Oxford and UvA– University of Amsterdam
- **Humanities:** University of Oxford, University of Cambridge and University College London (UCL)
- **Security:** The University of Stavanger, Aristotle University of Thessaloniki and ETH Zurich

Again, it should be noted that the lists provided above are sometimes restrictive, in the sense that other universities might have very similar performances to those presented here. The reader is referred to the core sections of this report for more detailed information on leading universities by area.

Comparative Analysis of ERA and Non-ERA Universities

All together, the 50 most actively publishing non-ERA universities publish more and have a slightly higher scientific impact than the 50 most actively publishing ERA universities. American universities clearly dominate among non-ERA universities, with more than half of the 50 most actively publishing non-ERA universities being from the US. Within the ERA, British universities dominate, but to a lesser extent; they are followed closely by a number of universities in the Netherlands and other countries.

Among the differences found between ERA and non-ERA universities, the higher percentage of publications of ERA universities that are authored with affiliated hospitals is notable; the average proportion for ERA universities is twice that observed in non-ERA countries (26% vs. 13%). Another difference between ERA and non-ERA universities relates to the importance of existing

gaps in the performance of organisations within each of these groups, especially in terms of scientific impact. Existing differences in the performance of non-ERA universities are slightly more pronounced than among ERA universities; in other words, there seems to be less inequality in the performance of ERA universities than non-ERA ones. For instance, the variation in the impact scores of the most actively publishing ERA universities is less pronounced than for leading non-ERA universities, with most scores being higher than the world level. Conversely, several non-ERA universities score below the world level in scientific impact, and there is more variation in the impact scores. This is mostly due to the fact that among the most actively publishing non-ERA universities are American (generally high-impact) and Chinese (generally low-impact) universities, both at extremes of the distribution of impact scores. The median impact scores of the three citation-based indicators (ARC, ARIF and highly cited papers) are, however, still slightly higher for non-ERA than ERA universities.

6 METHODS

The bibliometric indicators in this report were produced using the Scopus database (Elsevier). Science-Metrix hosts an in-house version of Scopus in the form of an SQL-relational database and is licensed to use this database to produce bibliometric data and reports. Science-Metrix has carefully conditioned the database for the purpose of producing large-scale comparative bibliometric analyses.

Science-Metrix has also built a journal-based, mutually-exclusive classification scheme (i.e., taxonomy) to delineate the main fields and subfields of science.[14] Moreover, subfields (and, when necessary, journals) were matched to 17 FP7 thematic priorities. Documentation outlining the procedures used to develop the taxonomy and for matching have been provided to and approved by the DG Research.

6.1 BIBLIOMETRIC INDICATORS

In producing bibliometric data, only documents published in refereed scientific journals are retained, as these documents have been reviewed by peers prior to being accepted for publication. The peer-review process ensures that the research is of good quality and constitutes an original contribution to scientific knowledge. In the context of bibliometrics, these documents are collectively referred to as publications.

Bibliometric indicators were calculated using either full counting (i.e., each paper was counted once for each entity listed in the address field) or fractional counting (i.e., each author/entity is attributed a fraction of the paper, so that the total across entities adds up to the total number of papers). Fractioning of publications was also done across FP7 thematic priorities in cases where more than one area was matched to the same scientific subfield, so that the total across thematic areas adds up to the total number of papers. The following indicators were produced:

- ***Number of publications:*** Number of peer-reviewed scientific publications written by authors located in a given geographical or organisational entity (e.g., the world, a country, a NUTS2 region, a university, an RPO or a company). Both full and fractional counting are used.
- ***Contribution by university hospitals:*** The percentage of a university's publications that were authored by at least one researcher located at at least one of the given university's affiliated hospitals. They include publications authored exclusively by researchers at the affiliated hospitals without external partners (i.e., no partners directly at the university), as well as publications co-authored by researchers at the affiliated hospitals and directly at the university. Both full and fractional counting is used. In this report, the numbers based on fractional counting are shown.

[14] Science-Metrix' ontology of science and its journal classification are freely available at: http://www.science-metrix.com/.

Archambault É., Caruso J., and Beauchesne O. (2011). Towards a Multilingual, Comprehensive and Open Scientific Journal Ontology, in Noyons, B., Ngulube, P. and Leta, *J. Proceedings of the 13th International Conference of the International Society for Scientometrics and Informetrics (ISSI)*, Durban, South Africa, pp 66-77.

- ***Number of co-publications:*** A co-publication is defined as a publication that was co-authored by different authors. At the university level, six categories were computed: 1) number of exclusively intra-university publications (one or more authors in the considered university); 2) number of unclassified co-publications; (at least two authors but the information available in the author addresses does not allow for a determination of their location); 3) number of co-publications with at least one external partner; 4) number of co-publications with at least one external partner abroad (i.e., in a foreign country); 5) number of co-publications with at least one external partner in the academic and/or RPO sector; and 6) number of co-publications with at least one external partner in the private sector.
- ***Specialisation Index (SI):*** The SI is an indicator of research intensity in a given entity (e.g., a country, a NUTS2 region, or an institution) for a given research area (e.g., a field or FP7 thematic priority), relative to the intensity in a reference entity (e.g., the world, or the entire output as measured by the database) for the same research area. In other words, when a country is specialised in a field (e.g. Chemistry), it places more emphasis on that field at the expense of other research areas. Specialisation is therefore said to be a zero-sum game: the more one specialises somewhere, the less one does elsewhere. The SI is formulated as follows:

$$SI = \frac{(X_S/X_T)}{(N_S/N_T)}$$

Where:

X_S = Papers (fractional count) from entity X in a given research area (e.g., papers in biology by University College London in Biology);

X_T = Papers (fractional count) from entity X in a reference set of papers (e.g., total papers by University College London);

N_S = Papers (fractional count) from reference entity N in a given research area (e.g., world papers in Biology);

N_T = Papers (fractional count) from reference entity N in a reference set of papers (e.g., total world papers).

An index value above 1 means that a given entity is specialised relative to the reference entity, whereas an index value below 1 means the reverse.

- ***Average of Relative Citations (ARC):*** The ARC is an indicator of the scientific impact of papers produced by a given entity (e.g., the world, a country, a NUTS2 region, an institution) relative to the world average (i.e., the expected number of citations). Because it is based on the citations received by the actual publications of an entity, it is said to be a *direct* measure of scientific impact. The number of citations received by each publication is counted for the year in which it was published and for the three subsequent years. For papers published in 2000, for example, citations received in 2000, 2001, 2002 and 2003 are counted.

  To account for different citation patterns across fields and subfields of science (e.g., there are more citations in Biomedical Research than in Mathematics), each publication's citation count is divided by the average citation count of all publications of the corresponding document type (i.e., a review would be compared to other reviews, whereas an article would be compared to other articles) that were published the same year in the same subfield to obtain a Relative Citation count (RC). The ARC of a given entity is the average of the RCs of the papers belonging to it. An ARC value above 1 means that a given entity is cited more frequently than the world average, while a value below 1 means the reverse. The ARC is computed for the

2000–2008 period only since publications in 2009, 2010 and 2011 have incomplete citation windows.

- ***Average of Relative Impact Factors (ARIF):*** The ARIF is a measure of the scientific impact of papers produced by a given entity (e.g., the world, a country, a NUTS2 region, an institution) based on the impact factors of the journals in which they were published. As such, the ARIF is an *indirect* impact metric reflecting the scientific "quality" measured by the average citation rate of the publication venue instead of the actual publications.

  Thomson Reuters calculates an annual impact factor (IF) for each journal based on the number of citations it received in the previous two years relative to the number of papers it published in the previous two years. Thus, each journal's IF will vary from year to year. The IF of a journal in 2007 is equal to the number of citations to articles published in 2006 (8) and 2005 (15) divided by the number of articles published in 2006 (15) and 2005 (23) (i.e., IF = numerator [23] / denominator [38] = 0.605). However, as pointed out by Archambault (2009), this indicator carries the weight of history and of many choices that were made a long time ago, when their effect had not yet been studied thoroughly[15]. For example, Moed and colleagues have described the effect of the observed asymmetry between the numerator and denominator of the Thomson Reuters' IF[16]:

  > ISI classifies documents into types. In calculating the nominator of the IF, ISI counts citations to all types of documents, while as citable documents in the denominator ISI includes as a standard only normal articles, notes and reviews. However, editorials, letters and several other types are cited rather frequently in a number of journals. When they are cited, these types do contribute to the citation counts in the IF's numerator, but are not included in the denominator. In a sense, the citations to these documents are 'for free'.

  In this study, Science-Metrix therefore computes and uses a symmetric IF based on the document types that are used throughout this entire project for producing bibliometric data.

  The IF of publications is calculated by ascribing to them the IF of the journal in which they are published for the year in which they are published. Subsequently, to account for different citation patterns across fields and subfields of science (e.g., there are more citations in Biomedical Research than Mathematics), each paper's IF is divided by the average IF of all papers of the corresponding document type (i.e., a review would be compared to other reviews, whereas an article would be compared to other articles) that were published the same year in the same subfield to obtain a Relative Impact Factor (RIF). The ARIF of a given entity is the average of its RIFs (i.e., if an institution has 20 papers, the ARIF is the average of 20 RIFs: one per paper). When the ARIF is above 1, it means that the entity scores better than the world average; when it is below 1, it means that on average, the entity publishes in journals that are not cited as often as the world level.

- ***Highly cited publications:*** The number of publications by an entity (e.g., the world, a country, a NUTS2 region, an institution) in the 10% most-cited publications in the database is

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15 Archambault É. and Larivière V. 2009. History of the journal impact factor: contingencies and consequences. *Scientometrics*. 79(3).

16 Moed, H.F., Van Leeuwen, T.H.N., Reedijk, J. (1999). Towards appropriate indicators of journal impact. *Scientometrics*, 46: 575-589.

determined using the relative citation (RC) scores of publications computed using a three-year citation window. (See above description of the ARC for the computation of RC scores.) Because some publications are tied based on their RC scores, including all publications in the database that have an RC score equal to or greater than the 10% threshold, this often leads to the inclusion of slightly more than 10% of the database. To ensure that the proportion of publications in the 10% most-cited publications in the database is exactly equal to 10% of the database, publications tied at the threshold RC score are each given a fraction of the number of remaining places within the top 10%. For example, if a database contains 100 publications (i.e., the top 10% should contain 10 publications) and the 9th, 10th, 11th and 12th publications all have the same RC score, they are each given a quarter of the remaining two places in the top 10% (0.5 publications of the top 10% each). An institution whose publications rank second and ninth would therefore have 1.5 publications in the top 10% using whole counting (at the level of addresses). Both full and fractional counting of publications based on author addresses were used in providing data to the Commission. (Here there can be fractions of fractions if, for example, the publication in ninth place in the top 10% has been co-authored.) However, in this report, only the top 10% based on full counting is presented. This indicator is computed for the 2000–2008 period only since publications in 2009, 2010 and 2011 have incomplete citation windows.

6.2 Graphical Representation of Data

Science-Metrix uses several types of graphical representations to facilitate the visualisation and interpretation of bibliometric data, including dashboards and networks.

6.2.1 Dashboards

Dashboard tables are used to present several indicators side-by-side, often in the form of microcharts (i.e., small graphics inserted in the table). Dashboard tables allow for rapid comparison between entities and/or the easy interpretation of trends over time.

Note for this report's dashboards: The number of publications is presented based on both full (FULL) and fractional (FRAC) counting. The contribution of affiliated hospitals (%) and the SI are based on fractional counting of publications. The ARC, ARIF and the percentage of papers in the 10% most-cited publications are based on whole counting of publications and/or citations. Citations were counted from the year of publication to year + 3 in computing the ARC. Thus, the ARC and the percentage of publications in the top 10% most-cited publications covers the years 2007 and 2008 only, since publications in 2009, 2010 and 2011 have incomplete citation windows.

The SI, ARC and ARIF are accompanied by icons indicating whether the entity performs above (green arrow), near (yellow horizontal line) or below (red arrow) the world level. The same icon set is used for the percentage of publications in the top 10% most-cited publications. In this case, a green arrow indicates that an entity has a greater proportion of its publications among highly cited publications than expected (more than 10%), a yellow horizontal line indicates that it has a proportion of highly cited publications similar to that expected (i.e., about 10%) and a red arrow indicates that it has a smaller proportion of highly cited publications than expected (less than 10%).

6.2.2 Collaboration Networks

Collaboration networks are used to help illustrate the scientific collaboration between entities (e.g., countries or NUTS2 regions). Based on a matrix (either a symmetric or asymmetric matrix in full or sparse format) cross-linking the number of co-publications by the relevant entities, the software program GEPHI was used to produce a visual representation of the strength of the relationships between the selected 303 universities. More specifically, the OpenOrd layout algorithm was used to establish the relative locations of the entities in the graphical representation. Statistics (e.g., degree of nodes, weighted degree of nodes, PageRank of nodes and weighted PageRank of nodes) describing the importance of institutions in the network were also computed (see Section 2 for a definition of these indicators). The advantage of the collaboration network is that it allows for rapid visualisation of major "hubs" in the network (i.e., entities for which the centrality is highest). It also allows for the rapid visualisation of ties between universities.

In the network, each university is represented by a node in the network and identified using a label that includes its country code. (The legend for universities is available in the Appendix.) Of the 303 selected universities, only those with at least 30 papers for which a relative impact factor could be calculated are presented in the network. The size of nodes is proportional to the number of publications (based on fractional counting) or the ARIF of universities depending on the figure. The width of links is proportional to the number of co-publications between any pair of universities. Only links representing at least 300 co-publications are shown. Finally, nodes are coloured according to their country of affiliation.

6.3 Standardisation of Author Addresses from Universities and RPOs

Measuring the scientific production of research institutions requires the standardisation of author addresses, which indicate the affiliation of authors with the research institutions at which the scientific effort was performed. Every scientific paper can therefore be attributed to one or more institutions, depending on how many addresses are listed for the paper. The standardisation of the author addresses consists of assigning all variants of a research organisation's address under a single, unique name. Fundamentally simple, this process is complicated by the fact that every country has its own way of recording addresses, as well as the fact that organisations may have multiple addresses. These procedures are even more complex when, as in the case of this project, research organisations need to be categorised as either universities, research-performing organisations (RPOs) or profitable organisations (firms).

Various approaches were used to produce the lists of leading research organisations in the European Research Area (ERA). The selection of appropriate approaches depended primarily on where the organisations in question are conducting research (i.e., restricted to a country or across multiple countries). This Section presents the method used by Science-Metrix for the standardisation of the universities' and Level 1 and 2 RPOs' addresses, as well as that used for the Level 3 RPOs. Note that definitions for these three levels of RPOs are also presented.

The standardisation of the author addresses of universities and RPOs was performed by examining each country in the ERA individually. For each country, an Excel file was created that contained all of the author addresses listed in the Scopus database from 2007 onward for that

country, as well as the number of scientific papers associated with each address (i.e., the article corpus for that country). In this file, expert analysts searched for specific names, abbreviations and/or pieces of words (using filters and other Excel functions) used in the author addresses of leading research organisations and associated a harmonized organisation name with each author address.

Cleaning the preliminary lists of organisations moves from those that publish the most to those that publish the least. This is done until it becomes highly unlikely that an "un-cleaned" organisation would have more publications once cleaned than the organisation with the smallest production among those selected as the most actively publishing. Once a list of leading organisations has been identified and their addresses standardised, validation and quality control measures are used to verify the results of this process. Finally, when the addresses of leading universities and RPOs have been standardised, the unique and standardised organisation names are reincorporated into the database, where they can be used to produce robust bibliometric data and statistics at the institutional level.

6.3.1 Main Rules for the Standardisation of the Author Addresses

- For all research organisations found in the bibliometric database, small "subsidiary" institutions were included in the larger organisation (e.g., the parent organisation). For example, university-based institutions are included under the standardised name of the university; hospitals are included under the name of their associated trust, etc.
- Research institutions resulting from the collaboration of two leading research institutions are included under the name of each of these two leading institutions.
- Research institutions resulting from the collaboration of more than two leading research institutions are considered to be a consortium and are therefore standardised under a single RPO name (see note on hospitals, below).

6.3.2 Universities

As stated above, a university includes all institutions under its umbrella. These institutions are recognized by their web site (e.g., which contains the logo of the university) and/or by their Internet address, which is hosted by the university. All other not-for-profit organisations are considered to be RPOs.

Table presents the number of leading universities per country in the ERA in the list prepared by Science-Metrix; this list contains 303universities.

In certain countries, fewer universities (with more than 10 papers) existed than the number of universities requested by the European Commission. Also, more universities are included for Israel. Note that Science-Metrix standardised the addresses of several other universities to guarantee that the universities presented were indeed the leading institutions for each country.

Table XLV Number of leading universities, by country

Country Code	Country Name	#	Country Code	Country Name	#
DE	Germany	20	PT	Portugal	10
FR	France	20	RO	Romania	10
UK	United Kingdom	20	SE	Sweden	10
IT	Italy	20	TR	Turkey	10
AT	Austria	10	HR	Croatia	5
BE	Belgium	10	IL	Israel	5
BG	Bulgaria	10	LT	Lithuania	5
CH	Switzerland	10	LV	Latvia	5
CZ	Czech Republic	10	SK	Slovakia	5
DK	Denmark	10	SI	Slovenia	4
EL	Greece	10	EE	Estonia	3
ES	Spain	10	MK	Macedonia	3
FI	Finland	10	IS	Iceland	2
HU	Hungary	10	CY	Cyprus	2
IE	Ireland	10	LI	Liechtenstein	2
NL	Netherlands	10	LU	Luxembourg	1
NO	Norway	10	MT	Malta	1
PL	Poland	10			

6.3.3 RPOs

RPOs are defined as not-for-profit organisations performing research without direct association with universities. These are separated into three groups on the basis of their size, their multidisciplinarity and the geographic areas in which the research is conducted. The list provided by Science-Metrix presents the 150 leading RPOs in Europe. These RPOs are categorised based on three levels, which are described below, along with examples.

6.3.4 Level 1 RPOs

Level 1 RPOs are multidisciplinary in scope and often comprise several small-to-medium research institutions and centres across the country. Typically, each country in the ERA has one or two such research organisations, though some have none. Following the rules set out in Section 6.3.1, all institutions funded by one of these institutions are included under the main RPO name. Table XLVI presents examples of some Level 1 RPOs.

Table XLVI Examples of Level 1 RPOs

#	Organisation Name	Country
1	Austrian Academy of Sciences	Austria
2	Academy of Sciences of the Czech Republic	Czech Republic
3	Bulgarian Academy of Sciences	Bulgaria
4	CNR–Consiglio Nazionale delle Ricerche	Italy
5	CNRS–Centre national de la recherche scientifique	France
6	CSIC–Consejo Superior de Investigaciones Científicas	Spain
7	Hungarian Academy of Sciences	Hungary
8	INSERM–Institut national de la santé et de la recherche médicale	France
9	NCSR–National Centre for Scientific Research Demokritos	Greece
10	Max-Planck-Gesellschaft	Germany
11	NOW–Dutch National Science Foundation	Netherlands
12	Polish Academy of Sciences	Poland
13	Romanian Academy	Romania

14	Slovak Academy of Sciences	Slovakia

6.3.5 Level 2 RPOs

Level 2 RPOs perform research in a specific scientific domain. Smaller than the Level 1 RPOs, they may also have small centres and/or institutions across the country, which are included under the name of the principal organisation. Hospitals and affiliated centres without affiliations with universities are found in this category. The individual institutes of Level 1 RPOs are generally not considered in Level 2 (i.e., Level 2 RPOs usually cover "independent" institutes not grouped in umbrella organisations). In some cases, Level 2 RPOs might belong to larger Level 1 RPOs when the structure of the Level 1 RPO is complex (e.g., Institut Cochin, which is a partnership between CNSR, INSERM and Université Paris Descartes). Table XLVII presents examples of research-performing organisations that fall under this category.

Table XLVII Examples of Level 2 RPOs

#	Organisation Name	Country
1	Assistance publique–Hôpitaux de Paris (AP-HP)	France
2	Cancer Research UK	United Kingdom
3	Norwegian Institute of Public Health	Norway
4	CIEMAT–Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas	Spain
5	Robert Koch Institute	Mostly in Germany

A note on hospitals

Hospitals are organised differently in different countries. Some countries in the ERA, such as Austria, consider their major hospitals to be medical universities. Based on the rules set out in Section 6.3.1, these are then considered to be universities. Several other countries, such as the UK and France, group their hospitals within trusts. All hospitals associated with a specific trust are therefore included under the trust's name.

Moreover, several cases arose for which author addresses corresponded to hospitals affiliated with universities. In these cases:

- Scientific publications with the addresses of hospitals affiliated with only one or two universities were given a name that identified both organisations (i.e., the university and the hospital), but these hospitals were ultimately considered to be university-based institutions and not included in the list of RPOs. An exception to this rule occurred when the hospital was part of a trust for which not all hospitals are affiliated with a university. In these cases, the publications of those hospitals that are affiliated with a university within a trust were also counted in the output of the university. As such, some publications were double-counted between universities and RPOs.
- Hospitals collaborating with more than two universities were considered to be RPOs.

The ease of finding affiliation information differs greatly between countries. The affiliation of some hospitals is clearly mentioned on the first page of the hospital's website, but many others never refer to the university affiliation of their academic and research programmes. Hospitals' and universities' web sites were scanned to find and/or confirm such affiliations. When no evidence of a university affiliation was found, or when it was affiliated with more than two universities, the hospital was considered a Level 2 RPO.

6.3.6 Level 3 RPOs

Level 3 RPOs conduct research internationally or across the ERA. To allow for comparison with other research organisations in the ERA, only the author addresses located within the ERA for these international research organisations were included.

The method used to identify and standardise Level 3 RPOs is also slightly different from the method used for universities and Level 1 and 2 RPOs. Organisations identified as Level 3 RPOs during the standardisation of the addresses for Level 1 and 2 RPOs were placed in a separate list, and a preliminary exploration of the database was performed to identify the most common ways in which the addresses for these RPOs were written. The same exploration was performed for each of their affiliated centres and institutions. An Excel file was then created for each Level 3 RPO and affiliated centres and institutions (unlike the method used for universities and Level 1 and 2 RPOs, when the files for standardisation were created for each country). Using these files, the organisation's names were standardised based on author addresses using the same method described for the universities and other types of RPOs. Table XLVIII provides the list of Level 3 RPOs for which author addresses were standardised under a single name. Note that not all of these organisations are presented in the list of the 150 leading RPOs.

Table XLVIII Examples of Level 3 RPOs

#	Organisation Name
1	CERN–European Organisation for Nuclear Research
3	EMBL–The European Molecular Biology Laboratory
4	ENO–European Northern Observatory
5	ESA–European Space Agency
6	ESO–European Southern Observatory
7	ESRF–European Synchrotron Radiation Facility
8	EURANDOM
9	IAEA–International Atomic Energy Agency
10	IIASA–International institute for Applied systems Analysis
11	ILL–Institut Laue-Langevin
12	JRC–Joint Research Centre
13	UNESCO
14	WHO–World Health Organization

6.4 Methods for Matching Scientific Subfields to FP7 Thematic Priorities

The classification scheme developed by Science-Metrix to classify the scientific papers indexed in Scopus resulted in a three-level taxonomy of scientific journals. The first level contains six broad scientific domains (i.e., Natural Sciences, Health Sciences, Applied Sciences, Arts, Humanities & Social Sciences and a general category). The second level contains 22 scientific fields, and the third level contains 176 scientific subfields.

The goal of this exercise is to determine the best possible aggregation scheme of S&T fields and subfields in order to match the FP7 thematic priorities. In the context of this project, the FP7 thematic priorities are defined as follows:

1. Health

2a. Food, Agriculture and Fisheries
2b. Biotechnology
3. Information & Communication Technologies
4a. Nanosciences & Nanotechnologies
4b. Materials (excluding Nanotechnologies)
4c. New Production Technologies
4d. Construction & Construction Technologies
5. Energy
6. Environment (including Climate Change)
7a. Aeronautics
7b. Automobiles
7c. Other Transport Technologies
8a. Socio-Economic Sciences
8b. Humanities
9. Space
10. Security

The Commission anticipated that the matching would result from a direct association between research fields and thematic priorities. However, the classification at the level of the 22 does not offer enough granularity, and thus a match based solely on fields would be imperfect. When the match at the field level did not yield meaningful results, subfields were used instead.

The match has been prepared by using expert judgment supported by relevant statistics. The first step was to delineate the breadth of each thematic priority by reading the Work Programmes[17] for all themes. The documents were also used to extract keywords relevant to each thematic priority. These keywords were then used to perform keywords-in-title, in-abstract and in-author keywords searches in Scopus to retrieve scientific publications of relevance to each thematic priority. By measuring the Specialisation Index (SI) of the resulting datasets by field and subfield of science, it was possible to identify the fields and subfields that were the most relevant to each thematic priority.

In this case, the SI is an indicator of the concentration of a dataset in a given field (or subfield), relative to the concentration in a reference dataset (i.e., the entire output as measured by the database) for the same field (or subfield). In other words, when a dataset is specialised in a field, it is more concentrated in that field at the expense of other research areas. The SI is formulated as follows:

$$SI = \frac{(X_S/X_T)}{(N_S/N_T)}$$

Where:

X_S = Publications from dataset X in a given research area (e.g., papers associated with ICT in Biology);

X_T = Publications from entity X in a reference set of papers (e.g., total papers associated with ICT);

17 http://cordis.europa.eu/fp7/find-doc_en.html

N_S = Publications from reference dataset N in a given research area (e.g., Scopus papers in Biology);

N_T = Publications from reference dataset N in a reference set of papers (e.g., total papers in Scopus).

An index value above 1 means that a given dataset is specialised relative to the reference dataset, whereas an index value below 1 means the reverse.

The matching was very straightforward—only a few cases were less univocal. Table 25 presents the resulting matching scheme between FP7 thematic priorities and the S&T classification of Scopus scientific papers.

Table XLIX The matching scheme between FP7 priorities and the S&T classification

FP7 Thematic Priorities	SM_Field	SM_SubField
1. Health	Biomedical Research	All subfields
	Clinical Medicine	All subfields
	Psychology & Cognitive Sciences	All subfields
	Public Health & Health Services	All subfields
	Engineering	Biomedical Engineering
2a. Food, Agriculture and Fisheries	Agriculture, Fisheries & Forestry	All subfields
2b. Biotechnology	Enabling & Strategic Technologies	Biotechnology
	Enabling & Strategic Technologies	Bioinformatics
3. Information and Communication Technologies	Information & Communication Technologies	All subfields
4a.Nanosciences and Nanotechnologies	Enabling & Strategic Technologies	Nanoscience & Nanotechnology
4b. Materials (exluding nanotechnologies)	Enabling & Strategic Technologies	Materials
	Chemistry	Polymers
4c. New Production Technologies	Engineering	Industrial Engineering & Automation
	Engineering	Operations Research
4d. Construction and Construction Technologies	Built Environment & Design	All subfields
5. Energy	Enabling & Strategic Technologies	Energy
6. Environment (including Climate Change)	Earth & Environmental Sciences	All subfields
	Engineering	Environmental Engineering
	Biology	Ecology
7a. Aeronautics	Engineering	Aerospace & Aeronautics
7b. Automobiles	Engineering	Automobile Design & Engineering
7c. Other Transport Technologies	Economics & Business	Logistics & Transportation
	Engineering	Mechanical Engineering & Transports
	Engineering	Civil Engineering
8a. Socio-Economic Sciences	Communication & Textual Studies	Communication & Media Studies
	Economics & Business	All subfields except Logistics & Transportation
	Social Sciences	All subfields
8b. Humanities;	Historical Studies	All subfields
	Communication & Textual Studies	Languages & Linguistics
	Communication & Textual Studies	Literary Studies
	Philosophy & Theology	All subfields
	Visual & Performing Arts	All subfields
9. Space	Engineering	Aerospace & Aeronautics
10. Security.	Enabling & Strategic Technologies	Strategic, Defence & Security Studies

Note: For a complete list of journals by field and subfield in Science-Metrix's ontology of science, visit: http://www.science-metrix.com/SM_Ontology_102.xls.
Source: Science-Metrix

The resulting scheme matches one or more S&T field(s) and/or subfield(s) to each thematic priority. All themes have been matched to at least one relevant field/subfield. No S&T field or

subfield has been matched with more than one theme, with the exception of Aerospace & Aeronautics, which has been matched to both Space and Aeronautics. It is impossible to split Aerospace & Aeronautics into two subfields, even using a match that would be based on journals, because many journals present research on both aerospace science and aeronautics (e.g. *Aircraft Engineering and Aerospace Technology*, *Transactions of the Japan Society for Aeronautical and Space Sciences* and *The Canadian Aeronautics and Space Journal*). However, it should be noted that this subfield includes substantially more articles on space science than on aeronautics.

It should be noted that this solution contains missing links between thematic priorities and scientific papers which are not classified under the suggested matching S&T field/subfield (false negatives) and spurious links between thematic priorities and scientific papers which are classified under the suggested match but are not relevant to the theme. Nevertheless, extensive testing suggests this matching scheme is highly effective for linking the FP7 priorities with scientific output (through bibliometric data).

6.5 Limitations of Bibliometrics in the Social Sciences and Humanities

Several limitations should be noted in the context of the social sciences and humanities (SSH). First, compared to the Natural Sciences and Engineering (NSE) and the Health Sciences (HS), the SSH produce a greater proportion of scientific publications that are not journal articles—especially books. This phenomenon is even more pronounced in the Humanities, such that research in these areas would best be examined using instruments that, compared to traditional bibliometrics, also consider publications in—or as—books. When counting publications using citation databases (e.g., Scopus), as in this study, a greater portion of the scientific output is omitted in the SSH compared to the NSE and HS. Indeed, journals of local interest, books and various publications that are generally referred to as "grey literature" (such as in-house research reports), as well as most conference and symposium proceedings, are not indexed in these databases. *As a result, the size of the scientific output of an entity in the SSH should not be compared to the size of its production in other areas.*

Another aspect requiring consideration when performing bibliometric analyses of the SSH is the more local orientation of SSH research. Whereas the research questions identified in the NSE tend to be universal, SSH research subjects are often more local in orientation/focus and, as a result, the target readership is more often limited to a country or region. Consequently, SSH scholars publish somewhat more frequently in a language other than in English—and in journals with a national rather than international distribution—than do NSE researchers. Because the major citation databases (e.g., WoS, Scopus) that are suitable for performing analysis of scientific impact are somewhat biased in favour of scientific literature authored in English, the uninformed or careless use of bibliometrics to benchmark SSH research can lead to erroneous conclusions.

The application of traditional bibliometrics to the SSH is problematic in the context of lateral comparisons (e.g., Poland versus Spain) when the groups being compared differ in their mother tongue and/or geographical location. Thus, the lateral comparisons performed in the SSH should be interpreted cautiously. The authors refer readers to the following publication for a thorough and comprehensive discussion of the limitations of bibliometrics in the context of the SSH:

- Archambault, É. and Larivière V. (2010). The limits of bibliometrics for the analysis of the social sciences and humanities literature. In *World Social Science Report: Knowledge Divides*, Chapter 7. Competing in the knowledge society (7.2 Assessment and evaluation of research), Co-publication commissioned by UNESCO from the International Social Science Council (ISSC), ISBN: 978-92-3-104131-0, pp. 251-254.
- Archambault, É., Vignola-Gagné, É., Côté, G., Larivière, V., and Gingras, Y. (2006). Benchmarking scientific output in the social sciences and humanities: The limits of existing databases. *Scientometrics*, 68(3): 329-342.

APPENDIX — UNIVERSITY LEGEND

Table L Legend of the collaboration networks for the selected ERA universities (2007–2011)

Label	Country	University
AT-1	Austria	BOKU-University of Natural Resources and Applied Life Sciences / Universität für Bodenkultur Wien
AT-2	Austria	Graz University of Technology / Technische Universität Graz (TU Graz)
AT-3	Austria	Innsbruck Medical University / Medizinische Universität Innsbruck
AT-4	Austria	Johannes Kepler University of Linz / Johannes Kepler Universität Linz
AT-5	Austria	Medical University of Graz / Medizinische Universität Graz
AT-6	Austria	Medical University of Vienna / Medizinische Universität Wien
AT-7	Austria	University of Graz / Karl-Franzens Universität Graz
AT-8	Austria	University of Innsbruck / Leopold-Franzens Universität Innsbruck
AT-9	Austria	University of Vienna / Universität Wien
AT-10	Austria	Vienna University of Technology / Technische Universität Wien (TU Wien)
BE-1	Belgium	Ghent University / Universiteit Gent
BE-2	Belgium	Hasselt University / Universiteit Hasselt
BE-3	Belgium	Katholieke Universiteit Leuven
BE-4	Belgium	Université catholique de Louvain
BE-5	Belgium	Université Libre de Bruxelles
BE-6	Belgium	University of Antwerp / Universiteit Antwerpen
BE-7	Belgium	University of Liège / Université de Liège
BE-8	Belgium	University of Mons / Université de Mons
BE-9	Belgium	University of Namur / FUNDP - Facultés universitaires Notre Dame de la Paix à Namur
BE-10	Belgium	Vrije Universiteit Brussel
BG-1	Bulgaria	Medical University of Plovdiv
BG-2	Bulgaria	Medical University of Varna
BG-3	Bulgaria	Plovdiv University
BG-4	Bulgaria	Sofia Medical University
BG-5	Bulgaria	Sofia University
BG-6	Bulgaria	Technical University of Sofia
BG-7	Bulgaria	Trakia University

BG-8	Bulgaria	University of Chemical Technologies and Metallurgy - Sofia
BG-9	Bulgaria	University of Food Technologies - Plovdiv
BG-10	Bulgaria	University of Ruse
CH-1	Switzerland	École polytechnique fédérale de Lausanne
CH-2	Switzerland	Swiss Federal Institute of Technology Zurich / ETHZ - Eidgenössische Technische Hochschule Zürich
CH-3	Switzerland	University of Basel / Universität Basel
CH-4	Switzerland	University of Bern / Universität Bern
CH-5	Switzerland	University of Fribourg / Université de Fribourg
CH-6	Switzerland	University of Geneva / Université de Genève
CH-7	Switzerland	University of Lausanne / Université de Lausanne
CH-8	Switzerland	University of Lugano / Università della Svizzera italiana
CH-9	Switzerland	University of Neuchâtel / Université de Neuchâtel
CH-10	Switzerland	University of Zurich / Universität Zurich
CY-1	Cyprus	Cyprus University of Technology
CY-2	Cyprus	University of Cyprus
CZ-1	Czech Republic	Brno University of Technology / Vysoké ucení technické v Brne
CZ-2	Czech Republic	Charles University in Prague / Univerzita Karlova v Praze
CZ-3	Czech Republic	Czech Technical University in Prague / Ceské vysoké ucení technické v Praze
CZ-4	Czech Republic	Institute of Chemical Technology Prague / Vysoká škola chemicko-technologická
CZ-5	Czech Republic	Masaryk University / Masarykova Univerzita
CZ-6	Czech Republic	Mendel University Brno / Mendelova Univerzita v Brne
CZ-7	Czech Republic	Palacký University of Olomouc / Univerzita Palackého v Olomouci
CZ-8	Czech Republic	Technical University of Ostrava / Technická univerzita Ostrava
CZ-9	Czech Republic	University of South Bohemia
CZ-10	Czech Republic	University of West Bohemia / Západoceská Univerzita v Plzni
DE-1	Germany	Charité - Universitätsmedizin Berlin
DE-2	Germany	Dresden University of Technology / TU Dresden - Technische Universität Dresden
DE-3	Germany	Friedrich Schiller University of Jena / Friedrich-Schiller-Universität Jena
DE-4	Germany	Goethe University Frankfurt / Johann Wolfgang Goethe Universität
DE-5	Germany	Heidelberg University / Universität Heidelberg
DE-6	Germany	Johannes Gutenberg University of Mainz / Johannes Gutenberg Universität

DE-7	Germany	Ludwig Maximilian University of Munich / Ludwig-Maximilians-Universität München
DE-8	Germany	Ruhr University Bochum / Ruhr-Universität Bochum
DE-9	Germany	RWTH Aachen University / RWTH - Rheinisch-Westfälische Technische Hochschule Aachen
DE-10	Germany	Technical University Munich / Technischen Universität München
DE-11	Germany	University Duisburg-Essen / Universität Duisburg-Essen
DE-12	Germany	University of Bonn / Universität Bonn
DE-13	Germany	University of Cologne / Universität zu Koln
DE-14	Germany	University of Erlangen-Nuremberg / Universität Erlangen-Nurnberg
DE-15	Germany	University of Freiburg / Albert-Ludwigs-Universität Freiburg
DE-16	Germany	University of Göttingen / Universität Göttingen
DE-17	Germany	University of Hamburg / Universität Hamburg
DE-18	Germany	University of Münster / Westfälische Wilhelms-Universität Münster
DE-19	Germany	University of Tübingen / Universität Tubingen
DE-20	Germany	University of Würzburg / Universität Würzburg
DK-1	Denmark	Aalborg University / Aalborg Universitet
DK-2	Denmark	Copenhagen Business School (CBS)
DK-3	Denmark	IT University of Copenhagen / IT Universitetet i København
DK-4	Denmark	Roskilde University / Roskilde Universitet
DK-5	Denmark	Technical University of Denmark / DTU - Danmarks Tekniske Universitet
DK-6	Denmark	University of Aarhus / Aarhus Universitet
DK-7	Denmark	University of Copenhagen / Universitetet i København
DK-8	Denmark	University of Southern Denmark / Syddansk Universitet
EE-1	Estonia	Estonian University of Life Sciences / Eesti Maaülikool
EE-2	Estonia	Tallinn University of Technology / Tallinna Tehnikaülikool
EE-3	Estonia	University of Tartu / Tartu Ülikool
EL-1	Greece	Aristotle University of Thessaloniki
EL-2	Greece	Democritus University of Thrace
EL-3	Greece	NTUA - National Technical University of Athens
EL-4	Greece	Technical University of Crete
EL-5	Greece	University of Athens
EL-6	Greece	University of Crete
EL-7	Greece	University of Ioannina

EL-8	Greece	University of Patras
EL-9	Greece	University of the Aegean
EL-10	Greece	University of Thessaly
ES-1	Spain	Autonomous University of Barcelona / Universitat Autònoma de Barcelona
ES-2	Spain	Autonomous University of Madrid / Universidad Autónoma de Madrid
ES-3	Spain	Complutense University of Madrid / Universidad Complutense de Madrid
ES-4	Spain	Polytechnic University of Valencia / Universitat Politècnica de València
ES-5	Spain	Technical University of Catalonia / UPC - Universitat Politècnica de Catalunya
ES-6	Spain	University of Barcelona / Universitat de Barcelona
ES-7	Spain	University of Granada / Universidad de Granada
ES-8	Spain	University of Seville / Universidad de Sevilla
ES-9	Spain	University of Valencia / Universitat de València
ES-10	Spain	University of Zaragoza / Universidad de Zaragoza
FI-1	Finland	Aalto University / Aalto-yliopisto
FI-2	Finland	Abo Akademi University / Åbo Akademi
FI-3	Finland	Lappeenranta University of Technology / Lappeenrannan teknillinen yliopisto
FI-4	Finland	Tampere University of Technology / Tampereen Teknillinen yliopisto
FI-5	Finland	University of Eastern Finland / Itä-Suomen yliopisto
FI-6	Finland	University of Helsinki / Helsingin yliopisto
FI-7	Finland	University of Jyväskylä / Jyväskylän yliopisto
FI-8	Finland	University Of Oulu / Oulun yliopisto
FI-9	Finland	University of Tampere / Tampereen yliopisto
FI-10	Finland	University of Turku / Turun yliopisto
FR-1	France	Aix-Marseille University / Aix-Marseille Université
FR-2	France	Claude Bernard University Lyon 1 / Université Claude Bernard Lyon 1
FR-3	France	Joseph Fourier University / Université Joseph Fourier
FR-4	France	Lille 2 University of Health and Law / Université de Lille 2
FR-5	France	Montpellier 2 University / Université Montpellier II
FR-6	France	Paris 12 Val de Marne University / Université Paris 12 Val de Marne
FR-7	France	Paris Descartes University / Université Paris Descartes - Paris 5
FR-8	France	Paris Diderot University / Université Paris Diderot - Paris 7

FR-9	France	Paris Institute of Technology / École Polytechnique - ParisTech
FR-10	France	Paul Sabatier University / Université Paul Sabatier
FR-11	France	Pierre and Marie Curie University / Université Pierre et Marie Curie - Paris 6
FR-12	France	Université Bordeaux 1 Sciences Technologies / Université Bordeaux 1
FR-13	France	University of Burgundy / Université de Bourgogne
FR-14	France	University of Montpellier / Université Montpellier 1
FR-15	France	University of Nantes / Université de Nantes
FR-16	France	University of Nice Sophia Antipolis / Université de Nice Sophia Antipolis
FR-17	France	University of Paris XI / Université Paris-Sud - Paris 11
FR-18	France	University of Rennes 1 / Université de Rennes 1
FR-19	France	University of Strasbourg / Université de Strasbourg
FR-20	France	Victor Segalen University / Université Victor Segalen Bordeaux 2
HR-1	Croatia	J.J. Strossmayera University of Osijek / Sveučilište J.J. Strossmayera
HR-2	Croatia	University of Dubrovnik / Sveučilište u Dubrovniku
HR-3	Croatia	University of Rijeka / Sveučilište u Rijeci
HR-4	Croatia	University of Split / Sveučilište u Splitu
HR-5	Croatia	University of Zagreb / Sveučilište u Zagrebu
HU-1	Hungary	BME - Budapest University of Technology and Economics / Budapesti Muszaki és Gazdaságtudományi Egyetem
HU-2	Hungary	Cornivus University of Budapest / Budapesti Corvinus Egyetem
HU-3	Hungary	Eötvös Loránd University / Eötvös Loránd Tudományegyetem
HU-4	Hungary	Semmelweis University / Semmelweis Tudományegyetem
HU-5	Hungary	Szent István University / Szent István Egyetem
HU-6	Hungary	University of Debrecen / Debreceni Egyetem
HU-7	Hungary	University of Miskolc / Miskolci Egyetem
HU-8	Hungary	University of Pecs / Pécsi Tudományegyetem
HU-9	Hungary	University of Szeged /Szegedi Tudományegyetem
HU-10	Hungary	University of Veszprém (2006) - University of Pannonia / Pannon Egyetem
IE-1	Ireland	Dublin City University
IE-2	Ireland	Dublin Institute for Advanced Studies
IE-3	Ireland	Dublin Institute of Technology
IE-4	Ireland	National University of Ireland, Galway

IE-5	Ireland	National University of Ireland, Maynooth
IE-6	Ireland	Royal College of Surgeons in Ireland
IE-7	Ireland	Trinity College Dublin
IE-8	Ireland	University College Cork
IE-9	Ireland	University College Dublin
IE-10	Ireland	University of Limerick
IL-1	Israel	Bar-Ilan University / Universitat Bar-Ilan
IL-2	Israel	Ben-Gurion University of the Negev / Universitat Ben Gurion Banegev
IL-3	Israel	Hebrew University of Jerusalem / al-Gami'ah al-'Ibriyyah fil-Quds
IL-4	Israel	Technion Israel Institute of Technology
IL-5	Israel	Tel Aviv University / Universitat Tel Aviv
IL-6	Israel	Weizmann Institute of Science / Machon Weizmann LeMada
IS-1	Iceland	Reykjavik University / Háskólinn í Reykjavík
IS-2	Iceland	University of Iceland / Háskóli Íslands
IT-1	Italy	Polytechnic University of Milan / Politecnico di Milano
IT-2	Italy	Polytechnic University of Turin / Politecnico di Torino
IT-3	Italy	Sacro Cuore Catholic University of Milan / Università Cattolica del Sacro Cuore
IT-4	Italy	UNIBA - University of Bari / Università degli Studi di Bari
IT-5	Italy	UNIBO - Alma Mater Studiorum University of Bologna / Alma Mater Studiorum Università di Bologna
IT-6	Italy	UNICT - University of Catania / Università degli Studi di Catania
IT-7	Italy	UNIFI - University of Florence / Università degli Studi di Firenze
IT-8	Italy	UNIGE - University of Genoa / Università degli Studi di Genova
IT-9	Italy	UNIMI - University of Milan / Università degli Studi di Milano
IT-10	Italy	UNIMIB - University of Milan Bicocca / Università degli Studi di Milano-Bicocca
IT-11	Italy	UNINA - University of Naples Federico II / Università degli Studi di Napoli Federico II
IT-12	Italy	UNIPA - Università degli Studi di Palermo / University of Palermo
IT-13	Italy	UNIPD - University of Padua / Università degli Studi di Padova
IT-14	Italy	UNIPG - University of Perugia / Università degli Studi di Perugia
IT-15	Italy	UNIPI - University of Pisa / Università di Pisa
IT-16	Italy	UNIPV - University of Pavia / Università degli Studi di Pavia
IT-17	Italy	UNIROMA1 - Sapienza University of Rome / Sapienza - Università di Roma

IT-18	Italy	UNIROMA2 - University of Rome Tor Vergata / Università degli Studi di Roma Tor Vergata
IT-19	Italy	UNISI - University of Siena / Università degli Studi di Siena
IT-20	Italy	UNITO - University of Turin / Università degli Studi di Torino
LI-1	Liechtenstein	Private University in the Principality of Liechtenstein - UFL
LI-2	Liechtenstein	University for Human Sciences
LI-3	Liechtenstein	University of Liechtenstein
LT-1	Lithuania	Kaunas University of Medicine / Kauno medicinos universiteto
LT-2	Lithuania	Kaunas University of Technology / Kauno technologijos universitetas
LT-3	Lithuania	Vilnius Gediminas Technical University / Vilniaus Gedimino technikos universitetas
LT-4	Lithuania	Vilnius University / Vilniaus Universitetas
LT-5	Lithuania	Vytautas Magnus University / Vytauto Didžiojo universitetas
LU-1	Luxembourg	University of Luxembourg
LV-1	Latvia	Daugavpils University / Daugavpils Universitate
LV-2	Latvia	Latvian University of Agriculture / Latvijas Lauksaimniecibas universitate
LV-3	Latvia	Riga Stradins University / Riga Stradina Universitates
LV-4	Latvia	Riga Technical University / Rigas Tehniska universitate
LV-5	Latvia	University of Latvia / Latvijas Universitate
MK-1	Macedonia	Macedonian Academy of Sciences and Arts
MK-2	Macedonia	South East European University
MK-3	Macedonia	Ss. Cyril and Methodius University of Skopje
MT-1	Malta	University of Malta / L-Università ta' Malta
NL-1	Netherlands	Erasmus University Rotterdam / Erasmus Universiteit Rotterdam
NL-2	Netherlands	Leiden University / Universiteit Leiden
NL-3	Netherlands	Maastricht University / Universiteit Maastricht
NL-4	Netherlands	Radboud University Nijmegen / Radboud Universiteit Nijmegen
NL-5	Netherlands	TU Delft - Delft University of Technology / Technische Universiteit Delft
NL-6	Netherlands	University of Groningen / Rijksuniversiteit Groningen
NL-7	Netherlands	Utrecht University / Universiteit Utrecht
NL-8	Netherlands	UvA - University of Amsterdam / Universiteit van Amsterdam
NL-9	Netherlands	VU - University Amsterdam / Vrije Universiteit Amsterdam
NL-10	Netherlands	WUR - Wageningen University and Research Centre / Wageningen Universiteit en Researchcentrum

NO-1	Norway	Norwegian School of Economics and Business Administration
NO-2	Norway	Norwegian School of Veterinary Science / Norges Veterinærhøgskole
NO-3	Norway	NTNU - Norwegian University of Science and Technology / Norges teknisk-naturvitenskapelige universitet
NO-4	Norway	Oslo and Akershus University College of Applied Sciences
NO-5	Norway	UMV - Norwegian University of Life Sciences / Universitetet for miljø- og biovitenskap
NO-6	Norway	University of Agder / Universitetet i Agder
NO-7	Norway	University of Bergen / Universitetet i Bergen
NO-8	Norway	University of Oslo / Universitetet i Oslo
NO-9	Norway	University of Stavanger / Universitetet i Stavanger
NO-10	Norway	University of Tromsø / Universitetet i Tromsø
PL-1	Poland	Adam Mickiewicz University / Uniwersytet im. Adama Mickiewicza
PL-2	Poland	AGH University of Science and Technology / Akademia Górniczo-Hutnicza
PL-3	Poland	Jagiellonian University / Uniwersytet Jagiellonski
PL-4	Poland	Medical University of Lodz / Uniwersytet Medyczny w Lodzi
PL-5	Poland	Nicolaus Copernicus University / Uniwersytet Mikolaja Kopernika
PL-6	Poland	Technical University of Lodz / Politechnika Lódzka
PL-7	Poland	University of Warsaw / Uniwersytet Warszawski
PL-8	Poland	University of Wroclaw / Uniwersytet Wroclawski
PL-9	Poland	Warsaw University of Technology / Politechnika Warszawska
PL-10	Poland	Wroclaw University of Technology / Politechnika Wroclawska
PT-1	Portugal	New University of Lisbon / Universidade Nova de Lisboa
PT-2	Portugal	Technical University of Lisbon / Universidade Técnica de Lisboa
PT-3	Portugal	University of Algarve / Universidade do Algarve
PT-4	Portugal	University of Aveiro / Universidade de Aveiro
PT-5	Portugal	University of Beira Interior/ Universidade da Beira Interior
PT-6	Portugal	University of Coimbra / Universidade de Coimbra
PT-7	Portugal	University of Lisbon / Universidade de Lisboa
PT-8	Portugal	University of Minho / Universidade do Minho
PT-9	Portugal	University of Porto / Universidade do Porto
PT-10	Portugal	University of Trás-os-Montes and Alto Douro / Universidade de Tras-os-Montes e Alto Douro

RO-1	Romania	Alexandru Ioan Cuza University / Universitatea Alexandru Ioan Cuza
RO-2	Romania	Babes-Bolyai University / Babes-Bolyai Tudományegyetem
RO-3	Romania	Bucharest Academy of Economic Studies / ASE - Academia de Studii Economice Bucuresti
RO-4	Romania	Gheorghe Asachi Technical University / Universitatea Tehnica Gheorghe Asachi
RO-5	Romania	Politehnica University of Bucharest / UPB - Universitatea Politehnica din Bucuresti
RO-6	Romania	Politehnica University of Timisoara / Universitatea Politehnica din Timisoara
RO-7	Romania	Technical University of Cluj-Napoca / Universitatea Tehnica din Cluj-Napoca
RO-8	Romania	Transilvania University of Braçov / Universitatea Transilvania din Brasov
RO-9	Romania	University of Bucharest / Universitatea din Bucureşti
RO-10	Romania	University of Craiova / Universitatea din Craiova
SE-1	Sweden	Chalmers University of Technology / Chalmers tekniska högskola
SE-2	Sweden	Karolinska Institute / Karolinska Institutet
SE-3	Sweden	Linköping University / Linköping universitet
SE-4	Sweden	Lund University / Lunds universitet
SE-5	Sweden	Royal Institute of Technology / KTH - Kungliga Tekniska högskolan
SE-6	Sweden	Stockholm University / Stockholms universitet
SE-7	Sweden	Swedish University of Agricultural Sciences / Sveriges Lantbruksuniversitet
SE-8	Sweden	Umeå University / Umeå universitet
SE-9	Sweden	University of Gothenburg / Göteborg University
SE-10	Sweden	Uppsala University / Uppsala universitet
SI-1	Slovenia	University of Ljubljana / Univerza v Ljubljani
SI-2	Slovenia	University of Maribor / Univerza v Mariboru
SI-3	Slovenia	University of Nova Gorica / Univerza v Novi Gorici
SI-4	Slovenia	University of Primorska / Univerza na Primorskem
SK-1	Slovakia	Comenius University / Univerzita Komenského v Bratislave
SK-2	Slovakia	Pavol Jozef Šafárik University / Univerzita Pavla Jozefa Šafárika v Košiciach
SK-3	Slovakia	Slovak University of Technology / Slovenská technická univerzita v Bratislave
SK-4	Slovakia	Technical University of Košice / Technická univerzita v Košiciach
SK-5	Slovakia	University of Žilina / Žilinská univerzita
TR-1	Turkey	Ankara University / Ankara Üniversitesi
TR-2	Turkey	Ataturk University / Atatürk Üniversitesi
TR-3	Turkey	Dokuz Eylul University / Dokuz Eylül Üniversitesi

TR-4	Turkey	Ege University / Ege Üniversitesi
TR-5	Turkey	Gazi University / Gazi Üniversitesi
TR-6	Turkey	Gulhane Military Medical Academy
TR-7	Turkey	Hacettepe University / Hacettepe Üniversitesi
TR-8	Turkey	Istanbul Technical University / Istanbul Teknik Üniversitesi
TR-9	Turkey	Istanbul University / Istanbul Üniversitesi
TR-10	Turkey	Middle East Technical University / Orta Dogu Teknik Üniversitesi
UK-1	United Kingdom	Cardiff University
UK-2	United Kingdom	Newcastle University (UK)
UK-3	United Kingdom	University of Birmingham
UK-4	United Kingdom	University of Bristol
UK-5	United Kingdom	University of Cambridge
UK-6	United Kingdom	University of Edinburgh
UK-7	United Kingdom	University of Glasgow
UK-8	United Kingdom	University of Leeds
UK-9	United Kingdom	University of Leicester
UK-10	United Kingdom	University of Liverpool
UK-11	United Kingdom	University of London, Imperial College London
UK-12	United Kingdom	University of London, King's College London
UK-13	United Kingdom	University of London, Queen Mary
UK-14	United Kingdom	University of London, University College London
UK-15	United Kingdom	University of Manchester
UK-16	United Kingdom	University of Nottingham
UK-17	United Kingdom	University of Oxford
UK-18	United Kingdom	University of Sheffield
UK-19	United Kingdom	University of Southampton
UK-20	United Kingdom	University of Warwick

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This report is part of a broader study aimed at characterising the scientific performance - including impact and collaboration patterns - of countries, regions, and research performers (such as universities, public research institutes, and companies) with an emphasis on the European Research Area (ERA). The analyses presented in the report rely on a series of indicators designed to take into account national and sector specificities. These indicators also allow for a comprehensive analysis of the evolution, interconnectivity, performance, and impact of national research and innovation systems in Europe. In measuring progress towards past and current objectives, this information aims to support the coherent development of research policies for the ERA.

The current report aims more specifically at assessing the scientific performance and collaboration profile of 300 ERA universities across 22 fields representing somewhat traditional scientific disciplines, as well as across 17 thematic priorities funded under the Seventh Framework Programme for Research and Technological Development (FP7). The universities were selected in order to provide information on those institutions within the ERA that publish the most, while ensuring a comprehensive coverage of all countries within the ERA. Consequently, a maximum of 20 universities were selected on the basis of their number of published papers from 2007 to 2011 in each country. Thus, the resulting selection is not equivalent to a list of the 300 most actively publishing universities throughout the ERA, irrespective of the countries in which they are located. ERA universities are also compared to the most actively publishing non-ERA universities.

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