



## Abstract

The aim of this guide is to give you as a KTH researcher more insight on how bibliometric measures are increasingly being used to assess your research and to present some methods to make your research publications more visible and influential. The ultimate goal is to increase the impact of KTH research publications to gain best possible results in bibliometric studies and international university rankings.

A summary of the tips and considerations mentioned in the guide:

**Check the outreach of your publishing channel.** The channels with the most prominent outreach and impact on bibliometric studies are international journals covered by the indexing service Thomson Reuters Web of Science.

**Check the impact of your journal.** If you are publishing in a journal, the Thomson Reuters Journal Impact Factor gives an indication of the average number of citations to articles in the journal.

**Publish in English.** If you primarily publish your findings in Swedish journals or as reports, consider re-publishing your results in an international peer-reviewed journal for increased visibility and impact.

**Plan your research and publishing for cooperation.** Co-authored publications have been shown to get more citations, thus usually ranking higher in bibliometric evaluations.

**Use a unique and consistent author name.** Try to use an author name that is as consistent and unique as possible or register a unique author ID with the database vendors.

**Write your organisational affiliation in a way that is easy to identify by an international audience.** The proper way to affiliate KTH is by starting the address with the KTH formal name "KTH Royal Institute of Technology", followed by the name of the school, department, research centre or group.

**Register your publication in the KTH publication database DiVA.** Publication records from DiVA are used to calculate publishing indicators, both for the yearly KTH school performance indicators and for the KTH yearly allocation of funding to schools. Registration in DiVA is especially important for publications not covered by the Web of Science or Scopus databases, such as monographs, reports and conference proceedings papers.

**Publish your article Open Access if possible.** Studies show that articles published for free access on the Internet gain more downloads and more citations. If your article is published in a traditional toll-based journal, you should try to do parallel publishing in the KTH publication database DiVA.

**Contact the Department of Publication Infrastructure at the ECE School for support and more information.** The ECE School will give you advice in matters regarding publication outreach and impact, DiVA registration, Open Access and bibliometrics.

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## 1 Background – why a publication management guide?

During recent years scientific publications have gained in importance, not primarily as the traditional vehicle for the dissemination of new scientific findings, but as a foundation for assessing the production and impact of organisations, research groups and individual researchers.

This means that publications are starting to play a new important role in the scientific community and that researchers should be aware of how publication and citation counts are being used to assess their research and the outreach, impact and reputation of their mother organisation. University rankings, for instance, often have some input parameters based on the publishing of the ranked institution.

This guide is not about scientific *writing* as such; it focuses on what happens to your publication *after* the publishing has taken place and things you should take into account while planning the publishing of your article.

The aim of this guide is thus to give you as a KTH researcher more insight on how bibliometrics is used to assess your research and to present some methods to make your research publications more visible and influential. The goal of the guide is to increase the impact of KTH research publications to gain best possible results in bibliometric studies and international university rankings.

## 1.1 The KTH policy for scientific publishing

In spring 2011 KTH adopted a policy for scientific publishing with the aim to make KTH's scientific publishing more visible for the international scientific community and the general public<sup>4</sup>. The policy encourages KTH researchers to publish in international high-impact journals. It also urges KTH researchers to make their articles freely available by publishing in Open Access journals or do parallel publishing of the articles. KTH researchers are also encouraged to write more popular science to increase KTH visibility and impact on society.

The policy also mandates bibliographic records for all publications produced by employees at the KTH to be registered in the KTH publication database DiVA. The schools are responsible for the registration of their publication records in the DiVA system. Support will be given by the staff at the Department of Publication Infrastructure (PI) at the School of Education and Communication in Engineering Science (ECE)<sup>5</sup>.

## 1.2 Content and quality is still King

Before going on with the publishing recommendations, a short disclaimer; even if metrics and statistical aspects of the publications are gaining importance for assessment and funding, it is still the quality of the research behind the publications and the dissemination of research findings to peers and general public that has to be the primary goal for your publishing.

But, on the other hand, there is no contradiction between doing high quality research and establishing a good communication with your fellow peers, and to consider some means for making the research results more visible and influential, utilising some of the considerations pointed out in this guide.

## 2 Outreach and visibility

The key to research impact, both for you and for KTH, is to make high-quality research and to reach the right audience with your research findings. Choosing the right channel – journal or publisher – for your publication can leverage its impact. The visibility and outreach can also be improved by publishing your findings as Open Access, free for all to download and read.

### 2.1 Channel and impact

Besides the primary goal of making your research accessible for your audience, your choice of distribution channel will affect how influential your publication will be in bibliometric studies of your and your organisation's research. Publishing in an international peer-reviewed journal with high impact, covered by the large indexing services will almost always render higher scores in bibliometric studies than publishing in another channel.

#### 2.1.1 The Thomson Reuters indexing service Web of Science

The channels with the most prominent outreach and impact on bibliometric studies are international journals covered by the indexing service Thomson Reuters Web of Science (WoS). Thomson Reuters indexes about 11 500 journal titles and adds around 1.6 million publication records to their database each year.

The Thomson Reuters' indices are usually the main data source for bibliometric studies and therefore it is of vital importance to publish in a journal that is covered by them. If you have a

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<sup>4</sup> Rector's decision: UF-0243 2011. (Date: 2011-04-23)

<sup>5</sup> E-mail: pi-support@lib.kth.se. Web: [http://www.lib.kth.se/main/eng/pi\\_support.asp](http://www.lib.kth.se/main/eng/pi_support.asp)

choice when deciding which journal to publish in, make a check with Thomson Reuters Master Journal List<sup>6</sup> to see if you can find an appropriate journal that is indexed.

### 2.1.2 The Thomson Reuters Journal Impact Factor (JIF)

If you are publishing in a journal, the Thomson Journal Impact Factor (JIF) will give you an indication of the average number of citations to articles in the journal. The Impact Factor for a journal is calculated by dividing the number of citations to a journal by the number of articles published in it<sup>7</sup>. The Impact Factor can be seen as a crude measure of how widely spread and how influential a journal is, and is therefore an indication of how much your article may be read and cited.

Journal Impact Factors should not be compared between research fields, due to the differences in publication and citation rates between fields. But within a field, the JIF can give you an indication of the most influential journals.

The Journal Impact Factor can be found in the Thomson Reuters system Journal Citation Reports<sup>8</sup>.

## 2.2 Publication type

The type of publication you choose for disseminating your findings is also of great importance for how the research will be assessed in bibliometric studies. Journal articles will almost always give better scores in bibliometric studies than other types of publications such as conference proceedings, monographs and reports, due to the better coverage of journal articles in the bibliometric data sources.

### 2.2.1 Original peer-reviewed research articles and reviews

As mentioned above, Thomson Reuters primarily indexes about 11 500 international journals. The reason for focusing on journals is that the journals are the most influential channels in the most fields, but also because journal materials tend to be easier to index than other material due to stable re-occurring titles and regular publishing patterns.

When doing bibliometric studies and counting citations, there is a significant difference between the average number of citations to a regular original article and a review article. Reviews get on average 2.5 times the number of citations to an original article. This is of course due to the review being easier to digest and covering a broader view of the research field. Another finding regarding citation counts is that articles that deal with methodology tend to gather many citations, since everyone that utilises the method afterwards will have to refer to the article where it was first presented. So writing reviews and methodology articles could both be considered as justified methods to boost citation counts for your research.

### 2.2.2 Conference proceedings

In the databases and indices used for bibliometric studies the publication types "Article" and "Conference Proceedings" are being used and counted in quite different ways. Original research articles published in regular international journals are usually captured and indexed by the databases WoS and Elsevier Scopus. Conference publications, on the other hand, are a bit more problematic to gather and therefore conference proceedings are not covered by the databases to the same extent as regular articles.

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<sup>6</sup> Thomson Reuters Master Journal List can be found at <http://science.thomsonreuters.com/mjl/>

<sup>7</sup> In practice, the JIF is not a clean quota, since some articles are considered "non-citable" and are removed from the denominator.

<sup>8</sup> Journal Citation Reports web address is <http://admin-apps.webofknowledge.com/JCR/JCR>

If you do research in an area where conference proceedings are the primary vehicle for dissemination information, consider "repackaging" and republishing your material as an article, preferably in a journal indexed by WoS. An article in a prestigious journal with a high impact factor will also usually make a better impression in the publication list in your CV.

### 2.2.3 Monographs, antologies and reports

In many research fields monographs and reports are the primary sources for spreading research findings. When doing bibliometric studies based on the commercial data sources from Thomson Reuters and Elsevier these types of documents will not be counted, since they are not included in the indexes from these vendors.

Bibliometric studies can be extended to include monographs and reports by using local data, such as the KTH publication database DiVA, but currently there are no methods to count citations to publications that are not covered by the commercial data suppliers<sup>9</sup>.

If you are doing research in a field where monographs and reports are of vital importance, the same advice as for conference proceedings apply; try to repackaging and republish your findings as an article in a well-renowned journal covered by the WoS.

## 2.3 Language

Journals with articles written in English is the core of the WoS, which means that articles in English will always be more influential in bibliometric studies. WoS covers some journals in Swedish and other non-English languages but citation counts are usually low on articles in these journals, since the audience for these articles usually is smaller than for an English article.

If you primarily write in Swedish for a Swedish audience, the same repackaging and republishing recommendations as for conference proceedings and monographs apply. Consider if your findings can be targeted at an international audience and republished as an article in an international journal.

## 2.4 Cooperation

Cooperation in research is important in many aspects, one of them being the aspect of the "marketing" contact area for the resulting publications. If more researchers are involved in the research and the publication process, the article will be exposed to a broader audience. Studies have shown that there is a correlation between the number of authors and the number of citations to an article, even if so called self-citations<sup>10</sup> are excluded (Aksnes, 2006).

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<sup>9</sup> Google Scholar supplies citation counts for other publication types than journal articles, but there is no method to gather these citation counts for batch computations.

<sup>10</sup> Self-citation is when a researcher refers to her/his own previous publications in the reference list of an article.

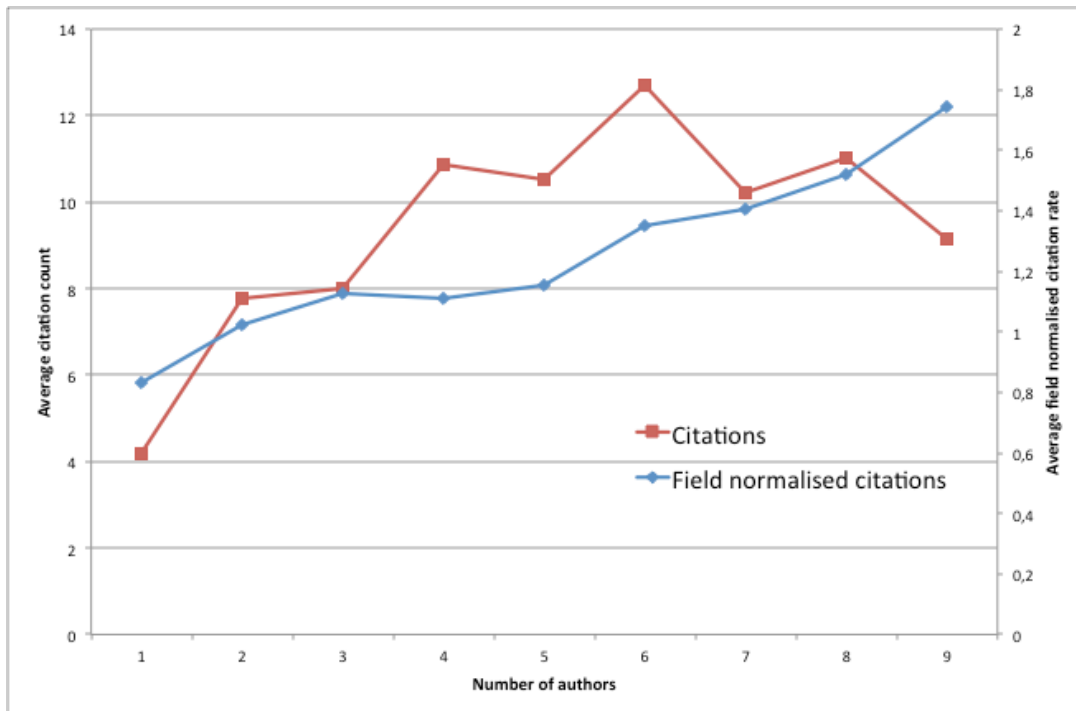


Figure 1. The correlation between the number of authors, the average number of citations and the average field normalised citation rate for KTH publications. Actual citations are measured in Web of Science July 2011 on KTH publications from the year 2005. Field normalised citations are calculated on KTH publications from 2005-2009 in the Karolinska Institutet bibliometric system<sup>11</sup>. (Both measures are done with open citation window and self-citations included. See 3.2.5 for an explanation of field normalised citations.)

Figure 1 shows that the average number of citations to publications involving two researchers (7.8) is almost twice as much as the citation rate for single-author publications (4.2). The field normalised citation rate, adjusted for differences between research fields, also shows an increase in average citation rate (+20%) when going from one author to two.

A disclaimer may be in place here; not all cooperation is beneficial per se. As seen from the graphs above, the correlation between the number of authors and the citations start to decrease above six authors. If fractional counting<sup>12</sup> is used when counting publications and citations the correlation between the number of authors and indicator values will decrease. Also, bringing in other researchers just to enhance the exposure of the finished publication may not be justified during the phases of actual research and writing.

## 2.5 Affiliation

The selection of data material used in bibliometric studies that utilise the commercial data sources is usually based on text string searches. There are no unique identifiers for organisations or researchers in the systems. This means that if you want a publication to be credited to KTH, you need to write your organisational affiliation in a way that is easy to understand by an international audience and can be matched using computer-based methods.

Database vendors and other organisations collecting information about scientific publications usually expect author affiliations to be written according to the following pattern:

<sup>11</sup> Certain data included herein are derived from the Web of Science ® prepared by THOMSON REUTERS ®, Inc. (Thomson®), Philadelphia, Pennsylvania, USA: © Copyright THOMSON REUTERS ® 2010. All rights reserved.

<sup>12</sup> In fractional counting publication are split based on the number of authors or addresses, see 3.2.3 for an explanation.

Organisation, Faculty, Department, Unit, City, Country

If you choose to write your affiliation using a form that starts with the name of your research lab or a centre, it may happen that your main organisation won't be identified and attributed, since its name will be buried further down in the address and maybe not detected by the system doing the publication selection.

When writing the address, the KTH official name should be used:

KTH Royal Institute of Technology

According to the following formula:

KTH Royal Institute of Technology, School of XX, Department YY, Unit ZZ, Stockholm, Sweden

If you work in a large collaborating team (as CERN/LHC), please make sure that the main author of the publication at least gets information about the proper name of KTH and the country information to put in the address list:

KTH Royal Institute of Technology, Stockholm, Sweden

If you do your research as a part of a research centre, such as AlbaNova, Nordita or Science for Life Laboratory, it is of importance that you use the proper KTH name as a prominent part of the address if you are affiliated with the KTH:

KTH Royal Institute of Technology, Centre for XX, Department YY, Unit ZZ, Stockholm, Sweden

To the complications with research centre names can be added a number of variants where the acronym KTH has been "built into" the school or centre name or abbreviation as; ICT KTH, KTH Syd, KTH Technol & Hlth, KTH Voice Res Ctr, and so forth. Even though the acronym KTH is unique<sup>13</sup> and well known in Sweden, it is probably not known to a foreign organisation undertaking a bibliometric study.

Using an organisation name that not begins with *KTH Royal Institute of Technology* may result in the publication not being attributed to KTH in bibliometric studies and in international ranking lists. For instance, highly cited KTH publications were left out from the 2010 Jiao Tong Academic Ranking of World Universities (ARWU), since these publications were affiliated with the organisation "KTH" in Web of Science and the ARWU evaluators were looking for publications from the "Royal Institute of Technology".

## 2.6 Author names

A common problem when doing analyses of publications is the lack of unique author identifiers in the bibliometric indices. The names of the authors to the publications are being entered into the database indices in the way they appear in the journal, which often is just a family name followed by an initial. If you have a common name like John Smith or Anders Andersson, your name ends up like Smith, J and Andersson, A in the indices and there might be a lot of other researchers sharing these names. So the importance of having a unique and consistent author name should not be underestimated.

If you have a common name that you know you might share with other researchers, especially if they are within the same organisation and field, consider to create a unique author "artist name" by adding an initial from for instance your middle name, for instance Andersson, A would become Andersson, A J. If you decide to make up a name like this, try to make the decision as early as possible in your research career and be sure to be consistent about its

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<sup>13</sup> KTH shares acronym with the Kenneth Taylor Hall at McMaster University in Canada: *McMaster Univ, Dept Econ, KTH 426, Hamilton, ON L8S 4M4, Canada*



usage, otherwise you might end up having your publication records split up over several "authors" with slightly different names. This is a fairly common problem, especially for researchers with double family names, which might end up with or without a hyphen between the family names or one of the family names interpreted as a given name. For instance, Jessica Wide Cederkvist might end up as author Wide Cederkvist, J; Wide-Cederkvist, J; or even Cederkvist, J W.

There are several initiatives trying to solve the problem with the lacking identifier for authors, both among the commercial vendors of databases and vendor-independent "global" solutions. Thomson Reuters have their own initiative ResearcherID.com<sup>14</sup>, where researchers can register and do housekeeping of their publication records in the WoS database. This is recommendable to do, especially if you know that your publication records in Web of Science are going to be used for an assessment of your research.

Elsevier Scopus also have their own service for author identification, named SciVerse Author Identifier<sup>15</sup> and Google Scholar is also building a Google Scholar Citations service<sup>16</sup> with the same purpose. There is also a fourth vendor-neutral initiative that is aimed at a global unique author identifier named ORCID: Open Researcher & Contributor ID<sup>17</sup>, but this initiative is still at a planning stage and has not yet delivered any working results.

If you change your family name during your research career it is especially important to make use of the vendors' system for author name unification to keep your publication records together, since there is yet no automatic methods other than a unique identifier (such as Thomson's Researcher ID) to detect that two different family names may belong to the same researcher.

## 2.7 Open Access

The world of scientific publishing is right now going through a transition where the old reader-pays model is replaced with a new producer-pays model. This means that more and more journals begin to cover the costs for the publishing with a fee from the publishing researcher or her/his organisation or funding agency, or being a part of a publishing-funding learned organisation.

When the cost of publishing is moved from the reader to the producer, articles can be published on the Internet free for all to read without any barriers as subscriptions or tolls and that is why this new publishing model has been named *Open Access*. Another way to make the content of the publications freely available to the public is to do *parallel publishing* of articles that have been published in a subscription-based journal. The publishers usually gives authors the right to publish the reviewed last manuscript before publication in an institutional repository, sometimes after an *embargo period* of six to 36 months after publication. This is called *post-print* parallel publishing.

The conditions for parallel publishing and the length of the embargo periods for various publishers can be checked at the online service SHERPA/RoMEO<sup>18</sup>. The conditions presently seems to be in a constant flux, so it is safest to do a final check at the website of the publisher or the contract you signed before publishing.

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<sup>14</sup> <http://www.researcherid.com/>

<sup>15</sup> <http://www.info.sciverse.com/scopus/scopus-in-detail/tools/authoridentifier>

<sup>16</sup> <http://scholar.google.com/intl/en/scholar/citations.html>

<sup>17</sup> <http://www.orcid.org/>

<sup>18</sup> <http://www.sherpa.ac.uk/romeo/>

### 2.7.1 Why publish Open Access?

There are a number of reasons why you should try to get your publications freely available on the Internet:

- Studies show that articles published for free access on the Internet gain more citations (Eysenbach G, 2006)
- Your publication will be more visible in the international search engines and may be read by a broader audience
- You have to publish your findings as Open Access if you have funding from a body that mandates it, such as the Swedish Research Council or Riksbankens Jubileumsfond
- The KTH policy for scientific publishing urges KTH researchers to publish their results in Open Access journals or in the DiVA repository

### 2.7.2 Open Access mandated by the Swedish Research Council and Riksbankens Jubileumsfond

As from 2010, the research funding agencies Swedish Research Council (Vetenskapsrådet, VR) and Riksbankens Jubileumsfond (RJ) are mandating open access publishing for all peer-reviewed articles and conference proceedings produced as a result of funding fully or in part from financing from the agencies. The mandates stipulate the articles either to be published in an *open access journal* or by *parallel publishing* where a copy of the article is placed in an institutional repository, which in our case is DiVA.

Some criticism regarding the mandates for Open Access publishing from the VR and RJ has been raised by researchers, claiming that they have to publish in less-renowned Open Access (OA) journals rather than in the well-known traditional journals with high impact factors. But the mandates do not limit the researchers to publishing in OA journals. There is always the possibility to do parallel publishing of the manuscript or pay a fee to make an article freely available, even in the toll-based journals. VR and RJ project grants are nowadays designed to cover the extra costs for OA publishing.

## 2.8 Searchability and preservation

If you want to reach out with your research results, it is of vital importance that your publications are preserved and searchable in the global search engines on the Internet. This is where the KTH publication database DiVA is playing an important role.

### 2.8.1 DiVA – the KTH publication database

The DiVA (Digitala vetenskapliga arkivet) publication database stores information about publications produced by KTH researchers, teachers and students. The DiVA system is also KTH's institutional repository, where copies of the publications may be stored in full text. The DiVA system is run by Uppsala University on behalf of a consortium of 28 higher education institutions in Sweden<sup>19</sup>.

Publication records from DiVA are used at KTH to calculate publishing indicators, both for the yearly KTH school performance indicators and for KTH yearly allocation of funding. Registration in DiVA is especially important for publications not covered by the Web of Science, as monographs, reports and conference proceedings papers.

The DiVA system is also used for the following purposes:

- to generate publication lists on web pages for schools, departments and individual researchers
- to generate publication lists for CV's and project applications

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<sup>19</sup> <http://www.diva-portal.org/smash/aboutdiva.jsf>

- to visualise and market research results from KTH
- to get a comprehensive picture of the KTH publishing
- as a source for bibliometric analyses of KTH research areas and groups
- to deliver KTH publication records to search engines as Google and Google Scholar
- to deliver KTH publication records to SwePub – the Swedish national publication database

Every week the staff at the Department for Publication Infrastructure (PI) at the ECE School searches the Web of Science (WoS) for new KTH publications and upload these publication records into DiVA. Since WoS only contains publication records for peer-reviewed journal articles and some conference proceedings, publications of other types as popular science, monographs and reports have to be registered into DiVA manually by the KTH researchers themselves<sup>20</sup>. Since journal titles and conference proceedings are not fully covered by the WoS, they also have to be checked for completeness and added manually if they are missing from the weekly upload to DiVA.

Publications that KTH researchers have published without giving KTH as affiliation also have to be registered manually in DiVA, if they are to be included in research assessments based on the production of individual researchers (such as the KTH RAE 2008 and RAE 2012).

More information on how to register your publications in DiVA is supplied by the DiVA support at the PI Department at the ECE School<sup>21</sup>, e-mail: pi-support@lib.kth.se.

### 2.8.2 SwePub – the Swedish scientific publication database

When you register your publication in the KTH DiVA system, the publication record will automatically be transferred to the SwePub system run by the Swedish National Library. If you do parallel publishing and register a PDF with the full text it will also be transferred to the SwePub system.

The publication record will be stored together with records from other Swedish universities and be searchable and analysed for national statistics on Swedish scientific publishing. If the PDF is published it will be archived by the National Library at a persistent web address. The SwePub system also delivers data to Google Scholar, which will make your publication even more visible internationally.

## 3 Publications as measures of production and impact

As mentioned in the beginning, publication measures are increasingly being used as tools in the race for funding in a world of tightening competition for shares of constrained budgets. This means for you as a researcher that you have to keep a good record of your publishing and see to that all your publications are being visible and attributed to you in the various assessments based on publications.

### 3.1 Publication lists for web pages of individuals and research groups

The most important tool for exhibiting your scholarly impact as an individual researcher is of course the publication list that is a part of your *curriculum vitae* (CV). Many researchers keep

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<sup>20</sup> Rector's decision: UF-0243 2011:

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| Rektor beslutar vidare att det åligger varje forskare vid KTH att säkerställa att publikationer som denne skrivit i egenskap av KTH-anställd finns registrerade i DiVA, samt att organisatorisk tillhörighet är korrekt angiven. Skolchef, eller person utsedd av |
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<sup>21</sup> [http://www.lib.kth.se/main/helpdesk\\_publicering.asp](http://www.lib.kth.se/main/helpdesk_publicering.asp)

their list as word-processing documents, in local EndNote databases or on static or dynamic CV web pages.

With the introduction of the KTH publication database DiVA a new possibility to keep and display your publication record has been introduced. The DiVA system has functions to extract a department or a researcher's publication records for display on a web page by creating a linked feed<sup>22</sup>. The result from the feed link is delivered as HTML code may be embedded into a web page and is dynamically updated as you enter your publication records into the DiVA system.

## 3.2 Bibliometrics

"Bibliometrics is the application of statistical methods to publications and is commonly used to assess scientific research through quantitative studies on research publications, primarily articles in peer-reviewed journals." (Karolinska Institutet, 2011)

The reason for bibliometrics gaining in popularity and importance is the urge for some kind of measurability in research assessment and funding allocation. Review by peers is the gold standard in research assessment, but has the drawbacks that it usually not presents hard numbers and also may suffer from personal bias in judgements.

Publications and citations are some of the few aspects of basic research that can be measured and presented as hard numbers, and this is probably why bibliometrics has become so popular to use in research assessments and in funding allocation schemes.

On the other hand, you should rarely use bibliometric numbers by themselves. If interpreted without caution they might be misleading. There are a number of reasons why good research may end up with low bibliometric indicator values. If the research is in a start-up phase, if the research field is very narrow, or the researchers publish in forms and channels not covered by the bibliometric sources the bibliometric indicators can end up with low numbers, even if the research is of excellent quality.

The best usage of bibliometrics is to supplement peer judgement and supply extra statistical information to the experts that preferably know the organisation and the research field that is assessed. If the bibliometric numbers support the expert opinions, the experts can feel a bit more assured in their judgement. If the numbers contradict their opinions, they may be a signal for consideration and rethinking, or at least to try to explain the discrepancy between peer review and bibliometrics.

### 3.2.1 Databases for bibliometrics

There are a few data sources that capture enough publication data to be used as viable sources for a bibliometric study. The most important sources for bibliometric data are:

- Thomson Reuters Science Citation Index – approximately the same content as the Thomson Reuters Web of Science
- Elsevier Scopus
- Google Scholar
- The organisation's own database – in our case the KTH publication database DiVA

To the list above may also be added a number of specialised databases within certain research fields such as PubMed, ArXiv, SPIRS, Chemical Abstracts etc. but these sources are seldom used for organisation-wide bibliometric analyses.

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<sup>22</sup> <http://kth.diva-portal.org/smash/builder.jsf?type=createLink>

The most basic forms of bibliometrics, as counting publications and citations, can be done in the online versions of the commercial databases Web of Science, Scopus and Google Scholar. The DiVA system can only be used for publication counting, since there is no citation matching and counting in the system.

When it comes to more advanced bibliometrics, doing comparisons of citation counts to world-wide averages, the online services won't do the job. To be able to do that you have to licence the data for the whole publication indices and build your own analysing system, usually covering about 20-30 million publication records. This is a procedure that involves large costs, both in licenses from the commercial vendors and in costs for personnel building and maintaining the database system. In Sweden only two such systems have been built so far, one at the Swedish Research Council and one at the Karolinska Institutet.

### 3.2.2 Capturing publication data

When you are about to decide which publications to include in a bibliometric analysis of an organisation, you need some sort of identifier that links publications to the organisation. The KTH publication database DiVA has the advantage of internal ID's for KTH organisational units and KTH staff ID's for researchers, so publication records may be selected on the basis of those ID's. On the other hand, DiVA does not have any citation counts, so if you want to do citation-based bibliometrics, you need to get data from one of the commercial vendors.

In the commercial databases there are no unique identifiers for organisations and researchers, so the selection of publication records has to be based on text string matching of author and organisation names. This less desirable method of record selection is the reason for the importance of keeping author and organisation names unique and consistent. In the Thomson Reuter database the search key

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AD=(KTH OR roy* inst* tech* OR alfven OR kung* tek* hog* OR kgl tek* hog* OR roy* tech* univ*) AND AD=(Sweden)
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has to be used to capture the KTH publications, and even when using this elaborate search key, you can't be completely sure that all KTH records are retrieved<sup>23</sup>. Trying to locate publication records for a KTH School, department or research group using this text-based method is impossible, due to the large variation in naming of the organisational units.

### 3.2.3 Counting fractions of publications

When doing bibliometric studies on co-authored publications, publication and citation counts are often shared between the contributing parties. This is called fractionalisation and can be based on author names or addresses. The easiest and most common method when doing analyses of organisations is to do an address-based fractionalisation and this is what the Swedish Research Council does when it analyses the output of Swedish research.

The address fractionalisation means that if KTH researchers have one of four affiliation addresses in a publication, KTH will get attributed one fourth of the publication, regardless of the number of researchers that are affiliated with each of the addresses and regardless of which amount of work each researcher has put into the publication. The share of addresses is also often used as a weight when doing calculation of citation averages, so that publications where KTH addresses have a larger share will weigh heavier in the average calculation. The Swedish Research Council uses this average weighting method.

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<sup>23</sup> For instance, AlbaNova and Nordita addresses are not covered by this search key, due to both KTH and Stockholm University sharing this address.

The methodology opposite to fractionalisation is called *full* or *whole counting*, where each contributing organisation or researcher gets full credit for the publication and all its citations. This method can on one hand be considered to be more "fair" to the researchers and the organisations, but has the disadvantage of the sum of the parts being larger than the whole. For instance, when doing full counting the sum of publications from Swedish organisations will be larger than the Swedish publication production.

#### 3.2.4 Research fields and subject classification

In the commercial databases Thomson Reuters Science Citation Index and Elsevier Scopus the publications are classified into research subject fields. Thomson Reuters uses 250 field categories to classify each journal issue in 1-6 fields, and the classification of the publications is inherited from the classification of the journal issue they were published in.

When doing more advanced bibliometrics the classification of the journal issues are used to divide the publications into different research fields and compare the assessed publications only to publications within the same research field, due to differences in publication and citations frequencies between the fields.

#### 3.2.5 Citations

Citation-based bibliometric indicators are based on the assumption that a reference (an outbound citation) from a scientific work to a previously published work represents an indication of scientific impact of the cited publication and that the number of (inbound) citations to a publication can act as a proxy to assess the impact of the scientific work of the author or the group that has produced the cited publication.

This assumption does not always hold true at the micro level. There may be negative citations, claiming the cited author to be wrong or that the results are disputable and there are also a number of other reasons to cite a publication that can be considered less valid in relation to the assumption stated above.

On the other hand, we also know that if we use bibliometrical methods on a large number of publications, like a thousand or more, we usually find a good correlation between citation-based indicators and a peer review of the work of the studied group (Moed 2005), which means that the major part of the citations are to be considered as valid in relation to the bibliometric impact assumption. Thus we can conclude that there is a good reason to believe that high scores in citation-based bibliometric indicators are to be seen as a sign of high-impact research when working at the macro level.

Different research fields have different publication and citation cultures. In some fields as for instance mathematics, the publication frequency is low and reference lists are short. In other fields as for instance biotechnology publication frequency is high and reference lists are long. This means that the citation density in the field of biotechnology will be much higher than the citation density in mathematics and that raw citation counts to publications from the two fields should not be compared without any precautions. See figure 2 for a picture of the differences in average citation rates between research fields.

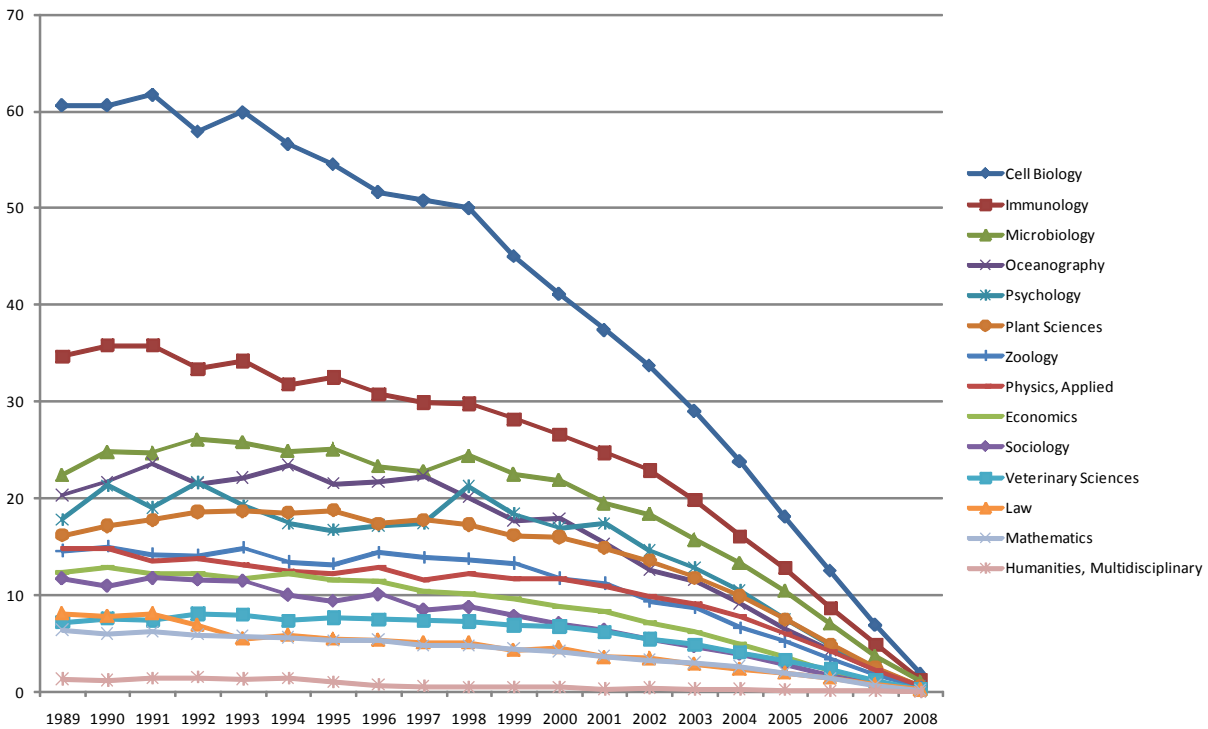


Figure 2. Average citation rate for publications in a number research fields. Measurement in the Swedish Research Council's bibliometric system 2009, open citation window, self-citations included.

The state-of-the-art bibliometric method to handle differences in citation frequencies between research field is the *field normalised citation rate* ( $c_f$ ), introduced by the bibliometric centre CWTS at the Leiden University in the middle of the 90's and refined and documented by the Swedish Research Council and Karolinska Institutet in the 00's (Kronman, et.al. 2010, Rehn et.al. 2008).

When calculating the field normalised citation rate, citation counts for publications are compared with the world average citation rate for publications of the same *type* and the same *publication year* and within the same *research field*. Using the normalisation procedure, the world average within each combination of field, year and publication type will per definition be 1, and a field normalised citation rate value above 1 will indicate that a publication has been cited more than the average in the field. The KTH usually has a  $c_f$  of 1.2 when assessed as a whole, with the individual schools  $c_f$  values ranging from 0.76 to 1.37.

When your publications are measured using the field normalised citation rate it is thus the journal in which you publish that decides which field your publication will be compared to. If you publish in a journal classified in a low-cited field as mathematics or humanities the citations your publication receives will end up having more weight in the field normalised citation rate indicator.

There are examples of researchers who are active in areas that link together computer programming and arts and publish in journals classified in the arts field. The result of having articles about programming classified in the arts field will often be high field normalised citation indicators due to the relatively high citation rates among computer scientist compared to the low citation rates in the humanities.

### 3.3 Research evaluations

Research evaluations seem to be a prevailing trend among the Swedish universities after the turn of the millennium. Every larger Swedish university seems to do one evaluation every third or fourth year, and usually bibliometrics play an important part of these assessments.

### 3.3.1 The KTH Research Assessment Exercise (RAE)

KTH did a research assessment exercise in 2008, the KTH RAE 2008<sup>24</sup>. In the RAE 2008 it was decided that the bibliometric analysis should be of a prospective researcher-based type, which means that the production of the researchers in each Unit of Assessment was counted regardless of if it was produced at the KTH or not. This was done to measure the present and the possible future "brain power" of the group. The bibliometric analysis in RAE 2008 was therefore based on records that could be located by searching publications based on author names in the Web of Science.

For the upcoming KTH RAE 2012 the ECE School is planning to use the DiVA system as the basis for the selection of the publication records for the researchers. By using the DiVA system other publication types than peer-reviewed articles and conference proceedings can be included in the analysis, but the citation analysis will only be based on records found in WoS, as in the previous RAE 2008.

### 3.3.2 The yearly KTH School indicators

Every year a set of indicators are assembled for each of the KTH Schools, to be used in the dialogue between the rector and the school managements. Among the indicators, four are related to publications:

- The *number of peer-reviewed publications*, presented as a trend for the last three years
- The *number of citations* to peer-reviewed publications the last five years, presented as a trend for three-year groupings
- The *number of publications produced with international co-authoring*, presented as a trend for the last three years
- The *field normalised citation rate* to publications from the last five years, presented as a trend of averages for three-year groupings

The three indicators that count raw numbers of publications and citations will of course favour large schools that publish in fields with high publication frequencies and high citation density, which should be taken into consideration when comparing the numbers. The field normalised citation indicator, on the other hand, is completely size-independent, which gives small schools and schools that publish in low-cited fields equal opportunities to get good indicator values.

## 3.4 Funding based on publication measures

Bibliometrics is playing a role of increasing importance in performance-based funding all over the world. Among the Nordic countries Norway was first out with a model which allocates funding based on publication counts, Sweden was second with a citation-based model and now Denmark and Finland are introducing publication-based models of the same type as in Norway.

### 3.4.1 Swedish governmental funding

In 2008 the Swedish government introduced a model for performance-based funding to the Swedish universities<sup>25</sup>. Ten per cent of the direct funding from the government is allocated based on the parameters *project funding from external sources* and *publications and citations*, each indicator responsible for half of the performance-based funding.

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<sup>24</sup> <http://kth.se/rae/>

<sup>25</sup> Resurser för kvalitet. SOU 2007:81. <http://www.sweden.gov.se/sb/d/8439/a/91339>



The funding indicator for publications and citations is based on publication records from the WoS. It is calculated from the field normalised citation rate in combination with the number of publication records from each higher education institution in Sweden. The Swedish Research Council (Vetenskapsrådet, VR) does the calculations for the indicator each year.

In order for VR to calculate the indicator it needs to know which publications should be attributed to which Swedish university, and this is done on the basis of the author addresses in the publication records in the Thomson Reuters database. So if an article is not properly labelled with a computer-identifiable address to a Swedish university, the funding points for that publication and its citations may get lost for the university.

The system for performance-based funding is presently (2011) being investigated<sup>26</sup> and revised and a future funding model may include publication records from other sources than WoS. It may well be that self-reported records from the universities' repositories (such as the KTH DiVA) will be the basis for Swedish allocation of university funding in the future.

#### 3.4.2 KTH School funding

Two per cent of the yearly funding allocation within KTH is based on a citation indicator. The indicator used is the field normalised citation rate, which as mentioned above, is size-independent.

The records for the funding allocation indicator are primarily retrieved per school from the DiVA system and then run through the Karolinska Institutet bibliometric system for citation analysis. This means that only publication records present in *both* DiVA and the Web of Science will be the basis for the indicator.

### 3.5 University rankings

Since the turn of the millennium worldwide university rankings have become increasingly important and they are growing in number for each year. International students use the rankings when they choose among universities, universities use them to evaluate potential cooperation partners and they are used as a foundation for benchmarking and marketing. Politicians, decision makers and the industry also use the rankings to evaluate higher education institutions for policymaking and allocation of funding.

Assessment of university research output in the terms of publications often constitutes an important part of the indicator set used to calculate the rankings.

The three most prestigious international rankings are the Shanghai Jiao Tong "The Academic Ranking of World Universities" (ARWU), the Times Higher Education "The World University Rankings" (THE/WUR) and QS "World University Rankings".

The information below is fetched from the Chalmers' excellent webpages about university rankings (Chalmers' Library webpages, 2011) and slightly adapted for this guide.

#### 3.5.1 Shanghai Jiao Tong Academic Ranking of World Universities (ARWU)

The ARWU list is published yearly by the Institute of Higher Education at Shanghai Jiao Tong University. It was first produced in the year 2003 as part of a plan to create "world-class universities" in China. The methodology is relatively open, well documented and non-subjective. Universities are judged by unusual achievements, e.g. Nobel prizes and Fields Medal, over a very long time period. Large and old universities are favoured. Biomedical and physical sciences are given more weight than engineering, social sciences and humanities.

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<sup>26</sup> Utvärdering av forskningskvalitet som en grund för tilldelning av resurser till universitet och högskolor (U 2010:C). Delivering report in September 2011.

The ARWU list is fairly good at ranking the 50-100 most prestigious universities in the world. Outside this scope it is of limited value. This is acknowledged by the ARWU and therefore universities below rank 100 are grouped together in chunks of 50 and 100.

KTH is ranked in position 201-300 in the 2011 edition of ARWU. KTH indicator values rose from year 2010 to 2011, due to the ARWU staff spotting a highly cited researcher at KTH, which they had overlooked before, due to the researcher being affiliated with the organisation "KTH", rather than the "Royal Institute of Technology", which they were looking for. This once again stresses the importance of having proper affiliations in the publications.

### 3.5.2 Times Higher Education World University Rankings (THE/WUR)

During the years 2004-2009 Times Higher Education (THE) made their ranking list in cooperation with QS Quacquarelli Symonds Ltd. As from 2010, THE is using a new methodology and is producing the list in cooperation with Thomson Reuters. The QS list continued separately as QS World University Rankings.

The most important measures in the THE ranking are the citation measure and the international reputation surveys. Together they account for two thirds of the total score. It may be worth noting that the citation indicator weighting a third of the indicator is size-independent, which resulted in some peculiar effects in the 2010 ranking. This indicator will therefore be revised for the 2011 ranking.

### 3.5.3 QS World University Rankings

The QS list has been published in 2004-2009 by the journal Times Higher Education in cooperation with QS Quacquarelli Symonds Ltd. Starting with 2010, QS is solely responsible for the ranking. 50% of the score is based on surveys, the rest on quantitative data.

In addition to the main list, there are also a number of subject lists such as Natural Sciences, Engineering & Technology. These rankings are only based on the survey results.

### 3.5.4 Criticism of university rankings

There are a number of inherent shortcomings with university rankings:

- All aspects of a university's activities and duties – education, research and impact on society – are squeezed into *one single measure* (or some of them – as societal impact – are even neglected).
- Ranking is a way to make a champions' league and *magnify small differences* in the underlying indicator values.
- When the final composite score is calculated, ranking providers *assign weights to each indicator* in the overall score. This means that the ranking provider's subjective judgement determines which indicators are more important.

An example of the magnification effect that makes a single indicator have large effect on the resulting rank position is the indicator Highly Cited Researchers in the ARWU list. In the 2010 ARWU list for top 100 Universities in Engineering, Chalmers had a position, but KTH did not. When scrutinising the part indicator Highly Cited Researchers, Chalmers had four scientists on the list and gained 16.1 points, while KTH had none and thus gained zero points.

After investigating further, it was realised that KTH actually had a highly cited researcher in computer science, but he was affiliated with the organisation "KTH", which the ARWU evaluators had overlooked. This has now been corrected, and KTH is now in the top 100 list together with Chalmers.

### 3.5.5 Impact and importance of university rankings

Even though university rankings are crude and one-dimensional they represent an easy-to-digest form of information to the broad public and they are very influential. This is what the European University Association has to say about the rankings in a recent report: "Despite their many shortcomings, biases and flaws 'rankings enjoy a high level of acceptance among stakeholders and the wider public because of their simplicity and consumer-type information'. Thus, university rankings are not going to disappear; indeed, the number of rankings is expected to increase although they will become more specialised." (European University Association, 2011)

In order for KTH to continue to be highly ranked in the lists and to preserve its respected brand name it is of vital importance that all the quality research KTH scientists publishes is credited to KTH.

### 3.6 ISIHighlyCited.com

Thomson Reuters is running a service named ISIHighlyCited.com based on the citation data in their citation databases. The publications in the Thomson Reuters citation databases are divided into 21 subject categories, and within each category the 250 most cited authors are selected<sup>27</sup>. ISIHighlyCited.com is an important source for input to the Shanghai ARWU ranking list. 20% of the merit points in the ARWU are based on the organisations' number of researchers in ISIHighlyCited.com.

If you get selected to be a highly cited researcher Thomson Reuters will get in contact with you and give you a user account in ISIHighlyCited.com so you can add and adjust your personal details as full name and affiliation. If you as a KTH researcher get included in ISIHighlyCited.com it is a good idea to use this opportunity to update your affiliation to the KTH proper name "KTH Royal Institute of Technology".

## 4 The ECE School – your local support in publication matters

The newly formed 10th KTH School *ECE – School of Education and Communication in Engineering Science* – has as one of its core tasks to support KTH researchers and students in all matters regarding scientific publishing. As the KTH Library is a part of the ECE School, traditional information supply of electronic journals and databases is of course in place, but with the new *Department for Publication Infrastructure* the ECE School takes on the task of managing published information produced by researchers at the KTH.

The Department for Publication Infrastructure deals with the following publication-related issues:

- Management of KTH publications in the KTH publication database DiVA
- Open Access publishing
- Bibliometrics

Please contact the ECE school / KTH Library for support and more information regarding publishing issues and bibliometrics.

Web: [http://www.lib.kth.se/main/eng/pi\\_support.asp](http://www.lib.kth.se/main/eng/pi_support.asp)

E-mail: [pi-support@lib.kth.se](mailto:pi-support@lib.kth.se)

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<sup>27</sup> The process is described here: [http://hcr3.webofknowledge.com/isi\\_copy/howweidentify.htm](http://hcr3.webofknowledge.com/isi_copy/howweidentify.htm)

## 5 Appendices

### 5.1 Sources and references

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### 5.2 Useful tools and websites

| Tool/website                                      | Purpose/usage                                    | Address   |
|---|--|---|
| KTH publication database DiVA - search            | Searching and extracting KTH publication records | <a href="http://kth.diva-portal.org/">http://kth.diva-portal.org/</a>                                   |
| KTH publication database DiVA - manage            | Registration of publications (via KTH login)     | <a href="https://kth.diva-portal.org/dream/login.jsf">https://kth.diva-portal.org/dream/login.jsf</a>   |
| Thomson Reuters Web of Knowledge / Web of Science | Search publications and do bibliometrics         | <a href="http://webofknowledge.com/">http://webofknowledge.com/</a>                                     |
| Thomson Reuters Master Journal List               | Check if a journal is included in Web of Science | <a href="http://science.thomsonreuters.com/mjl/">http://science.thomsonreuters.com/mjl/</a>             |
| Thomson Reuters Journal Citation Reports          | Check Journal Impact Factors                     | <a href="http://admin-apps.webofknowledge.com/JCR/JCR">http://admin-apps.webofknowledge.com/JCR/JCR</a> |
| Directory of Open                                 | Check which Open                                 | <a href="http://www.doaj.org/">http://www.doaj.org/</a>   |

|  |   |   |
|--|---|---|
| Access Journals  | Access journals that are present in your research field                         |   |
| Sherpa/Romeo   | Check the conditions for parallel publishing for journals and publishers        | <a href="http://www.sherpa.ac.uk/romeo/">http://www.sherpa.ac.uk/romeo/</a>   |
| ResearcherID.com   | Register a researcher ID and a researcher profile to gather your publications   | <a href="http://www.researcherid.com/">http://www.researcherid.com/</a>   |
| SciVerse Author Identifier   | Author identifier for the Elsevier Scopus system                                | <a href="http://www.info.sciverse.com/scopus/scopus-in-detail/tools/authoridentifier">http://www.info.sciverse.com/scopus/scopus-in-detail/tools/authoridentifier</a> |
| ORCID: Open Researcher & Contributor ID                              | An upcoming a central registry of unique identifiers for individual researchers | <a href="http://www.orcid.org/">http://www.orcid.org/</a>   |
| Shanghai Jiao Tong University Academic Ranking of World Universities |   | <a href="http://www.shanghairanking.com/">http://www.shanghairanking.com/</a>   |
| Times Higher Education World University Rankings                     |   | <a href="http://www.timeshighereducation.co.uk/world-university-rankings/">http://www.timeshighereducation.co.uk/world-university-rankings/</a>                       |
| QS World University Rankings   |   | <a href="http://www.topuniversities.com/">http://www.topuniversities.com/</a>   |