

SciVisions Methodology (2016)

Data

To rank the universities, journals' papers published in the world's most prestigious journals during 2012-2015 including the Q1 journals according to the Journal Citation Reports (JCR) and US Patent (USPTO) information during 2006-2015 were used. The Q1 journals receive about 60% of the world's citations and involve about 3000 journals. The journals' citations were extracted from Google Scholar; however, only those citations made from JCR journals to the Q1 journals were calculated. The affiliations were extracted from the journals web sites, while spelling variances for each university were determined.

Criteria and indicators

Scientific impact Indicators

a) World reputation

1. **Scientific reputation:** The scientific reputation shows the extent in which the research publications of the university are internationally used. To measure the degree of internationality of the universities, a reference profile including the number citations made by countries to the world's publications in different fields was created. For example, according to this profile, we know that country X made N percent of the world's citations in Y subject field. More international universities receive citations from each country in each field according to the share of citations of that country in that field. For example, university A receive 80% of their citations from USA and 20% from Belarus and university B receive 80% of their citations from Belarus and 20% of them from USA. The university A is more international than the university B because of this fact that USA made much more citations than Belarus. The degree of internationality of a university is measured using Euclidean distance as a relative measure. The Euclidean distance formula were calculated as it is used in the following paper: Zitt, M., & Bassecouard, E. (1999). Internationalization of communication a view on the evolution of scientific journals. *Scientometrics*, 46(3), 669-685.

b) Productivity

1. **Scientific productivity:** Total number of the university's citable documents including article, review, proceedings paper.

c) Impact

1. **Research performance:** The total number of normalized citations received by the university.
2. **Research performance (Average):** The number of normalized citations received per the university's papers.
3. **Top 10% highly-cited papers:** Top 10% publications are top 10% of highly-cited papers determined after normalizing the number of received citations. This indicator

counts the proportion of top 10% highly-cited papers as the fraction of the university's papers.

- 4. Top 11-20% highly-cited papers:** This group of papers involve top 11-20% highly-cited papers determined after the number of received citations were normalized.
- 5. High-impact researchers:** To count the number of high-impact, international, funded and industrial researchers, first of all, the author names on the journals' papers were disambiguated, where the precision is 98% and recall is 93%. Next, the papers' citations were normalized based on the field and publication year. Finally, the total number of normalized citations for each researcher were counted during 2006-2015 and top 2% of researchers were chosen as high-impact researchers with respect to their number of received citations.

High-impact researchers

d) Collaboration

- 1. International collaboration:** The number of international co-authored papers of the university.
- 2. The size of inter-organizational teams:** The number of inter-organizational co-authored papers of the university.
- 3. The scientific impact of teams:** The average number of normalized received citations for inter-organizational co-authored papers of the university.
- 4. International researchers:** The number of international co-authored papers for each researcher were counted. Next, the researchers were sorted according to the number of papers written jointly by at least one author from another country. Finally, top 2% of researchers with the most number international collaboration were chosen.

Technological impact Indicators

a) Technological impact

- 1. Science-technology linkage:** The number patents' citations to the university's papers according to the USPTO.
- 2. University-industry collaboration:** The number of university's papers jointly written with at least one researcher from one industry.
- 3. Industrial impact:** The number of citations made by industries papers to the university's papers. The number of citations was normalized based on the paper's field and publication year.
- 4. Funded researchers:** The number funded research based on the funding information on the papers was counted for each researcher. Next, the researchers were sorted

according to the number of funded research. Finally, top 2% of researchers with the most number funded research were chosen. The funding information extracted from journals' web sites, where they are openly accessible.

- 5. Industrial researchers:** The papers written by collaboration of at least one researcher from a university and at least one researcher from an industry were determined. Next, the researchers were sorted based on the number of collaborated papers with industries. Finally, top 2% of researchers with the most number of the collaborated papers were determined.

b) Technological reputation

- 1. Technological reputation:** This indicator measures the extent in which the innovational and industrial papers of a university are internationally used. Innovational papers are those papers cited by patents and industrial papers refers to those research publications cited by industries published papers. A reference profile was defined that include the number of countries' citations made to the journals' papers in different fields, which consist of patents' citations and industrial papers' citations to the journals' papers. According to this profile, for example we know that country X made N percent of the world's citations in Y subject field. The degree of internationality of a university is measured using Euclidean distance as a relative measure. The Euclidean distance formula were calculated as it is used in the following paper: Zitt, M., & Bassecoulard, E. (1999). Internationalization of communication a view on the evolution of scientific journals. *Scientometrics*, 46(3), 669-685.

Learning environment Indicatorss

a) Learning impact

- 1. Researchers employed by high-impact universities:** The number of researchers affiliated to the university and have been moved to one of the top 100 high-impact universities.
- 2. Researchers employed by industries:** The number of researchers affiliated to the university and have been moved to an industry.

Counting Methods

Fractional counting: In the fractional counting method the score of a university is calculated based on the number of that university's researchers on the publication. For example, if a paper was affiliated to 1 researcher from X's institution and 3 researchers from Y's institution then the score of X's institution is $1/4$ or 0.25 and the score of Y's institution is $3/4$ or 0.75.

Full counting: In the full counting method the score of a university is calculated irrespective to the number of that university's researchers on the publication. For example, if a paper was written by 1 researcher from X's institution and 3 researchers from Y's institution then the score of X's institution is 1 and the score of Y's institution is the same as the Y's.

The weight of indicators

Criteria	Indicator	Weight	Counting method
Scientific impact	Scientific reputation	2%	Full
	Scientific productivity	8%	Fractional
	Research performance	16%	Fractional
	Research performance (Average)	6%	Fractional
	Top 10% highly-cited papers	5%	Fractional
	Top 11-20% highly-cited papers	2%	Fractional
	High-impact researchers	2.5%	Full
	International researchers	2.5%	Full
	International collaboration	2%	Fractional
	The size of inter-organizational teams	2%	Fractional
	The scientific impact of teams	2%	Fractional
Technological impact	Science-technology linkage	10%	Fractional
	University-industry collaboration	5%	Fractional
	Industrial impact	5%	Fractional
	Funded researchers	3.5%	Full
	Industrial researchers	3.5%	Full
	Technological reputation	3%	Full
Learning environment	Researchers employed by high-impact universities	10%	Full
	Researchers employed by industries	10%	Full