The University of Stockholm Trio

How would they perform together in international rankings?

(Gabor Schubert, Analyst, Stockholm University Library, 2017-11-16)

Tim Ekberg's 2011 report[1] describes in detail which collaborations already exist between the *University of Stockholm Trio* (Stockholm University (**SU**), Karolinska Institute (**KI**), and Royal Institute of Technology (**KTH**)) and which opportunities exist to increase the collaborations. The report indicated that the question of a theoretical ranking of the Trio has emerged earlier: "*Overall, the three universities in Stockholm would probably be located around position 25 on the Shanghai ranking.*" That estimate was made six years ago. In this report, I have made a new estimate, based on the recent Shanghai ranking, to the fact that it is possible for an alliance between the three universities in Stockholm (the Trio) to be among the top 10 universities in the world. I have also investigated how other rankings calculate their scores, to see if it is possible to estimate the Trio's position on those rankings.

It is important to note that international university rankings do not report the raw data behind their ranking lists, so it is not possible to make exact calculations.

QS (Quacquarelli Symonds) and THE (Times Higher Education) rankings

The QS and THE rankings have similar calculation methods. They mainly use 3 types of indicators:
- The reputation of higher education institutions by means of surveys. The respondents' rank the universities in various respects (research, education, etc.). These survey-based indicators have a 33% weight in the THE ranking and a 50% weight in the QS ranking.
- Scientific success based on publications and citations from publication databases. Both QS and THE use the Scopus database, owned by the publisher Elsevier.
- Various statistical indicators collected from higher education institutions, such as income, number of students, number of teachers, and combinations of these.

The ranking institutions calculate scores based on those indicators after normalization and other statistical treatments. QS uses 6 indicators, THE uses 13 indicators (which are aggregated into 5 main indicators). These normalized values ("scores" or "points") are listed on their webpages; 6 indicators for QS and the 5 aggregated indicators for THE. The normalization and aggregation mean that it is not possible to mathematically add the individual institutions' "points" together and from that obtain an estimate of the joint results of the Trio.

In addition, indicators based on questionnaires cannot be added together at all, even if you have access to the raw data: opinions on institutions are not additive. Probably the Trio would get high rankings in questionnaires, but it is impossible to predict it from the individual results of the Trio.

The abovementioned facts entail that it is not possible to estimate the ranking position of a theo-retical institution on the QS or THE ranking.

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[1] Tim Ekberg: SU + KI + KTH = ? En studie om förutsättningar för ett mer systematiserat samarbete mellan universiteten i Stockholm (2011), in Swedish.
Available at https://karebremer.files.wordpress.com/2013/01/su_ki_kth_rapport.pdf

ARWU (the Shanghai ranking)

The Shanghai ranking uses 6 indicators and, according to the description on their website[2], sub-scores are reported with only smaller statistical adjustments according to the following method: the world's best HEI according to an indicator receives 100 points and all others receive fewer points in correlation to their respective results. This allows for making a kind of approximate combination of the sub-points of individual institutions.

Table 1 shows the scores for the world's number one HEI (Harvard University) together with SU, KI, and KTH individually and a total estimate of the Trio (SU + KI + KTH).

Table 1. Sub-scores for some HEI's on the Shanghai ranking (2017)

HEI	Total score	Sub-scores					
		Alumni[I]	Award[II]	HiCi[III]	N&S[IV]	PUB[V]	PCP[VI]
Sub-score weight		*10%*	*20%*	*20%*	*20%*	*20%*	*10%*
Harvard University	**100**	100	100	100	100	100	79.5
Karolinska Institute	**33.3**	25.4	26.3	24.4	23.7	53.3	45.8
Stockholm University	**28.2**	23.8	27.1	21.8	21.2	41.8	28.2
KTH	**16.4**	0	14.7	0	11.5	40	27.8
The Trio (SU + KI + KTH)	**58.6**	**49.2**	**68.1**	**46.2**	**45.1**	**80**	**33.9**

[I] Alumni: Number of prize winners (Nobel prizes + Fields medals) who have studied at the HEI
[II] Award: Number of prize winners (Nobel prizes + Fields medals) employed at the HEI when they received the prize
[III] HiCi: Number of highly cited researchers from the HEI according to Clarivate Analytics "Highly Cited Researchers"[3]
[IV] N&S: Number of publications in the journals Nature and Science in the last 5 years.
[V] PUB: Number of publications in the Web of Science database in recent years
[VI] PCP (Per Capita Academic Performance): Weighted scores for the first 5 indicators divided by the number of employees

I made the estimate using the following calculation method:
For the indicators *Alumni*, *Award,* and *HiCi*, which are calculated for individual higher education institutions and use absolute values, I added the sub-scores of the Trio's individual higher education institutions.
For the indicator *Number of publications in Nature and Science (N&S)*, I added the scores, but I have used a weight of 0.9 to reflect co-publications between SU, KI, and KTH researchers. This weight is an estimate from Web of Science.
For the *Total number of publications (PUB)* indicator, I compared the number of publications in Web of Science in 2016 for SU + KI + KTH (8,189) with the ranking's number one, Harvard University (10,262). The score was then calculated as the ratio of 8,189 to 10,262: (8,189/10,262) · 100 ≈ 80.
The indicator *Per Capita Academic Performance (PCP)* is a relative indicator that is size independent. It is not additive, so you cannot add up the points. Here I estimated the sub-scores as the average of the results for SU, KI, and KTH.

The total score is calculated using the Shanghai ranking weights. When weighing together the published sub-scores in the Shanghai ranking, due to the ranking's own statistical adjustments, you

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[2] "*For each indicator, the highest scoring institution is assigned a score of 100, and other institutions are calculated as a percentage of the top score. The distribution of data for each indicator is examined for any significant distorting effect; standard statistical techniques are used to adjust the indicator if necessary.*" http://www.shanghairanking.com/ARWU-Methodology-2017.html
[3] http://hcr.stateofinnovation.com/

obtain a score which is around 2% less than the published score on the website, so I adjusted the final score to obtain a score comparable with the other higher education institutions in the ranking. According to this estimate, the Trio (SU + KI + KTH) would occupy 9th place in the world on the Shanghai ranking. The top ten scores of this study are shown in Table 2.

Table 2. Positions on the Shanghai ranking (2017) for some selected academic institutions

Position	HEI	Score
1	Harvard University	100.0
2	Stanford University	76.5
3	University of Cambridge	71.0
4	Massachusetts Institute of Technology (MIT)	70.4
5	University of California, Berkeley	69.1
6	Princeton University	61.2
7	University of Oxford	60.1
8	Columbia University	58.8
9	**University of Stockholm Trio (SU+KI+KTH)**	**58.6**
10	California Institute of Technology	57.3

CWTS (the Leiden ranking)

The Leiden ranking is actually not a ranking. It is rather a database created by the CWTS research group at Leiden University in Belgium and contains various types of advanced publication statistics based on data from the Web of Science database. CWTS publishes some of its data, but not the underlying raw data. In the published data one can find both fractional and non-fractional numbers for the higher education institutions, where fractional means indicators weighed by the proportion of authors from a particular institution. For example, SU has 8,161 non-fractional publications in the period 2011-2014, but only 3,420 full equivalent publications in the same period, taking into account the proportion of authors affiliated to SU.

Certain types of fractional indicators can easily be calculated from published data or from other indicators. With regard to fractional absolute indicators (e.g. number of publications, number of citations, number of highly cited articles), the overall result will always be higher than the results of the individual institutions. On the other hand, relative indicators (e.g. number of citations/number of publications, the proportion of highly cited publications) are most often ranked between the institutions' individual results. I show some rankings based on selected absolute indicators in Table 3 for the Trio (SU + KI + KTH) calculated from aggregated fractional data in the period 2011-2014.

Table 3. Selected absolute indicators and positions in the world for the Trio (SU + KI + KTH)

Indicator	Position on the CWTS world ranking
Number of publications	7
Number of citations	19
Number of field normalized citations	16
Number of publications that are among the world's 1% most quoted in their field	26
Number of publications that are among the world's 10% most quoted in their field	21

Summary

It is not possible to know exactly how the Trio (SU, KI, and KTH) would be ranked on international university rankings. Most rankings use indicators that are not additive, thus it is not even theoretically possible to estimate positions on these. The only major university ranking using more or less additive indicators is the Shanghai ranking. The University of Stockholm Trio is estimated to be ranked 9th in the world on that list. Estimated research indicators from the Leiden ranking indicate that the Trio would be among the world's 20 largest research universities.

Translated from Swedish original using Google Translate. "SU+KI+KTH-alliance" replaced by "University of Stockholm Trio".