35. Football lessons for universities or how to go beyond ranking

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INTRODUCTION

This chapter shows how universities can design and implement a proactive, critical approach to rankings. It starts with a short comparison between football league tables and university rankings, which serves to illustrate the deep-rooted methodological problems of the latter. This demonstrates why universities should never use aggregate rankings beyond communication purposes (and ideally not even for this purpose).

To overcome these shortcomings, the chapter first gives examples of how careful interpretation of individual indicators can, however, provide unexpected strategic insights. It underlines the importance of selecting these indicators and never taking ranking agencies' descriptions for granted. Next, it provides a few case studies of how institutions can go beyond rankings and build their own tools by combining indicators extracted from rankings with ad hoc indicators in order to better understand their potential, help define strategy and track their progress.

FOOTBALL LESSONS

At the time of writing in June 2020, most European football leagues have just restarted their seasons after the COVID-19 induced interruption. However, in France, the decision was made to finalise the league after 28 matches. Much controversy ensued with a number of clubs speaking out and planning possible legal action, including Lyon who will miss out on the Champions league and claim that had the ten remaining matches been played, the final league table might have been different. Interestingly, scientific evidence provides strong support to their argument.

Ranking specialists in sports sciences have shown that 'expected goals', calculated using a wide range of parameters, seem to be a better predictor of future results than 'goals actually scored' (Brechot and Flepp, 2020). Translating expected goals into expected final points would result in Lyon finishing 3rd in the French league, rather than 7th,[1] which would qualify them for the Champions League.

In football, 'expected goals scored' is a family of aggregate indicators that take into account a wide range of parameters. Both researchers and specialised agencies have proposed different ways of calculating them and they are the focus of an extensive scientific literature and much controversy.[2] In comparative terms, their closest parallel in the world of higher education and research is the family of 'citation' indicators.

'Expected goals scored' is just one of a wide range of indicators used to measure performance, alongside 'number of passes', 'financial income' or 'average age of the team'. Companies specialised in sports indicators such as Statsperform[3] produce and use these indicators in order to help football clubs and football players improve their performance, and sport commentators provide insight to the public.

The difference between football and higher education and research is that no one in the football industry would ever produce a football ranking which claims to reasonably represent the performance of football teams by aggregating the following indicators: reputational survey amongst football players (40 per cent), reputational survey amongst team owners (10 per cent), average age of team (20 per cent), goals scored (20 per cent), percentage of international players (10 per cent).

Of course, the comparison might seem slightly unfair. Universities do not have a single mission (win matches), nor do they have an agreed indicator that evaluates performance according to this mission (goals scored versus goals received),[4] which is why university rankings rely on proxies equivalent to football's 'expected goals'. Furthermore, each university has a different number of players and pitches of widely varying dimensions and characteristics, meaning that proxies themselves need to be correlated to a vast range of dimensions (size, finance, regulations, and so on). Finally, and most importantly of all, the very mission of each university is different and the rules that they follow are different, meaning that 'expected goals' are only one of an almost infinite number of proxies that can be used to compare universities, each of which may or may not make sense.

At the end of the day, these facts actually could be used to argue that our imaginary football ranking is probably more robust than comparable university rankings: aggregating indicators that measure different missions in order to compare different institutions makes no sense. Adding indicators that measure the same mission in different ways (for example, measuring research performance by adding and weighing publication output, citations per staff and research contracts) weakens the robustness of the result. And even if rankings agencies were to restrict their rankings to a couple of hundred institutions with the same mission,[5] these rankings would still be as random as the imaginary football ranking we proposed above.

INTERPRETING RANKINGS

University rankings become interesting when you start interpreting the individual indicators independently from the ranking itself. Each indicator hides a wealth of stories, which are often only indirectly related to the name of the indicator itself but provide important insights to the institutions concerned. The following section provides a few examples of stories that can be told; there are countless more.[6]

How the Same Score Can Tell Different Stories

Bonn University and Zhejiang University are both ranked 70th according to the Academic Ranking of World Universities (ARWU) 2019 ranking, with a total score of 29 (Table 35.1). Yet these two scores tell radically different stories.

Rank	Institution	Score in Academic Ranking of World Universities (ARWU) 2019						
		Alumni winning Nobel Prizes and Fields Medals	Staff winning Nobel Prizes and Fields Medals	Highly Cited Researchers	Papers in Nature & Science	Number of Publications	Per Capita Performance	Total
70	University of Bonn	23.8	35.3	23.2	17	39.4	30.3	29.0
70	Zhejiang University	0	0	32	18.6	80.2	22.4	29.0

Table 35.1 University of Bonn and Zhejiang University according to the different indicators of the ARWU 2019 ranking

In the case of the University of Bonn, the result is largely due to the Nobel Prizes won by former alumni and awarded to staff, the most recent of which was awarded in 1994. The University of Bonn is in the top 100 thanks to past performance, not current potential.

Zhejiang University, on the contrary, has no Nobel Prizes and manages to be in the top 100 thanks exclusively to its current volume of publications. However, it performs less well in terms of excellence of research as measured, for example, by the proportion between total number of articles and articles in *Nature* and *Science*.

The fact that both universities should be ranked in the same position says little about them as institutions, whereas the lessons that can be gleaned from their ranking on individual indicators are truly insightful. These, however, require careful interpretation as the next couple of examples show.

How 'Citations' and 'Research' Diverge

In 2015, the former Paris 7 – Paris Diderot University was ranked 180th in the world by the *Times Higher Education* (*THE*) World University Rankings, but this overall rank hid a great disparity between indicators. Paris Diderot was 37th in the world on the criteria for citations, but 338th for research, and 326th for teaching. Figure 35.1 shows the position of Paris 7 compared to other French institutions across the five publicly available indicators.

The lack of correlation between Paris 7 – Paris Diderot University's score in citations and research on the one hand, and the close correlation between the scores in research and teaching on the other, is surprising. However, what is even more surprising is that this is true of the scores of most other universities, as the graphs in Figure 35.2 show.

These graphs can be interpreted in two ways:

- either (a) the quality of a university's research is closely correlated to the quality of its teaching and (b) the impact of research as measured by citations has nothing to do with the quality of research;[7]
- or the indicators used by *THE* World University Rankings do not measure either quality of research or quality of teaching but are proxies for a completely different parameter.

To test these two interpretations, we compared the scores of UK universities according to the teaching criteria of *THE* World University Rankings with the results of the National Student Survey data (Figure 35.3).

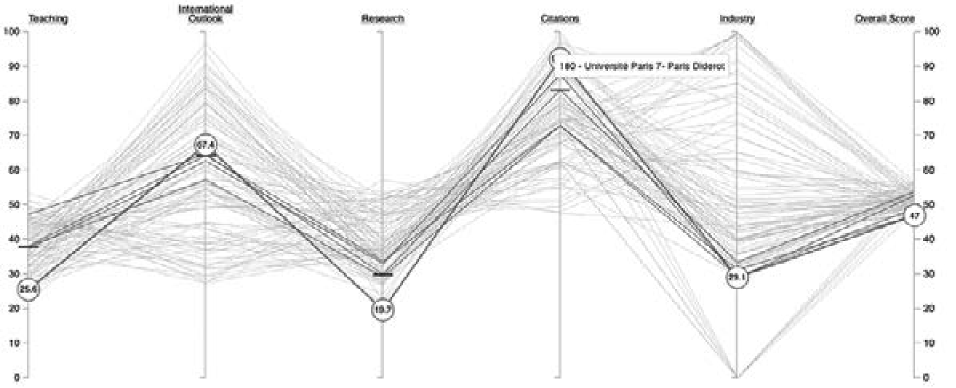
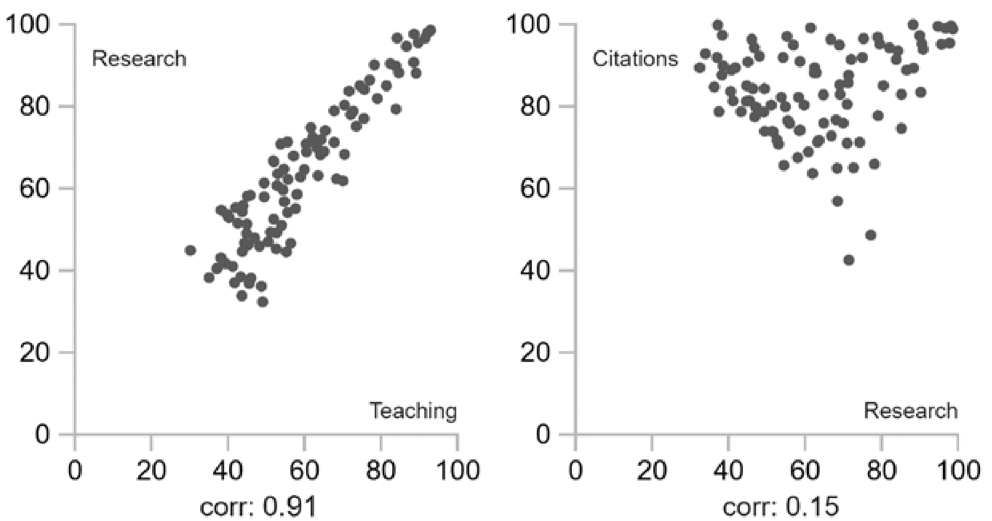


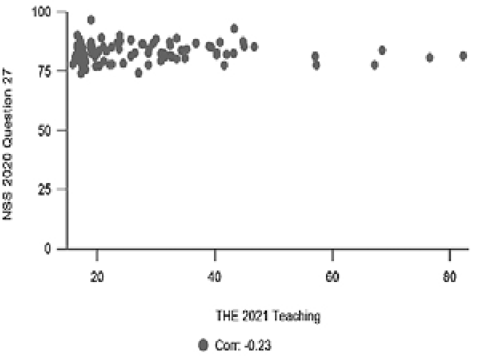
Figure 35.1 *Scores of French institutions for each indicator of 2015 THE World University Rankings*



Note: Both research and teaching are themselves aggregate indicators, however *THE* does not provide the scores for the individual indicators.

Figure 35.2 *Correlations between the categories of research and, respectively, teaching and citations according to THE World University Rankings for the world's top 100 universities in 2015*

Whereas the correlation between the scores in teaching and research of the 98 UK universities ranked by *Times Higher Education* in 2020 is almost absolute (with a correlation of 0.99, where no correlation is 0 and perfect correlation is 1); the correlation between the score of the 98 universities on the Teaching criteria of *Times Higher Education* and their score in the National Student Survey is actually slightly negative (-0.23).[8]



Note: Both research and teaching are themselves aggregate indicators, however *THE* does not provide the scores for the individual indicators.

Figure 35.3 Correlations between the score of UK universities according to the 2020 National Student Survey (question 27) and according to the THE World University Rankings indicator for 'Teaching'

This clearly shows that the reputational surveys of *THE* do not measure the quality of teaching or research, but a different parameter than is most likely linked to 'institutional prestige'. 'Institutional prestige' seems to be weakly correlated with both research impact and teaching impact, and strongly linked to name recognition.[9]

In this light the interpretation of the ranking of Paris 7 – Paris Diderot University in 2015 is simple: it was producing high-impact research as measured by the citations indicator used by *THE* but suffered from a lack of name recognition, presumably linked to the idiosyncrasies of the French system of higher education and research, and a weak brand (the 7th university in Paris, named in honour of a French philosopher).[10]

Following a merger with Paris 5 – Paris Descartes University in 2019, the university is now called the University of Paris, which should ensure a rapid increase in reputation once the institution is correctly identified in reputational surveys.[11] This is positive for the University of Paris but does not change the deeper methodological issue derived from the way in which rankings aggregate unrelated indicators such as citations and name-recognition.

Indeed, to return to our football comparison, aggregating an indicator similar to 'goals scored' with one which would be closer to 'presence in social media' is unlikely to produce a meaningful ranking.

Being the Best for Citations

Citations are often assumed to be an objective measure of research impact of a university, and the position of Paris 7 – Paris Diderot University according to *THE* citations indicator was rightly a motive of pride within the university; however, the value of this indicator is itself questionable.

There are a myriad ways to measure citations and a vast literature that analyses the pros and cons of each approach. However, one might think that if the publications of a given university truly have a greater impact than those of another university, different ways of measuring citations (normalised citation impact, percentage in the top 10 per cent of most cited, citations per faculty, highly cited researchers, and so on) should all result in a fairly similar rank of given institutions. As Table 35.2 shows, this is not the case.

Ranking	**ARWU**	**THE**	**QS**	**CWTS**	**CWTS**	**NTU**	**NTU**	**USNWR**
Indicator[14]	**HiCi**	**Citations**	**Cit/Faculty**	**PP Top10%**	**PP Top 1%**	**11 year cit.**	**Ave. Cit.**	**NCI**
Amsterdam	7th	4th	1st	3rd	8th	2nd	6th	2nd
TU Delft	9th	10th	3rd	8th	1st	10th	12th	9th
TU Eindhoven	10th	12th	2nd	10th	5th	11th	10th	10th
Erasmus Rotterdam	1st	1st	11th	4th	7th	4th	1st	1st
Groningen	8th	3rd	12th	9th	7th	5th	8th	6th
Leiden	5th	8th	9th	6th	10th	5th	2nd	8th
Radboud Nijmegen	6th	7th	4th	7th	3rd	6th	3rd	4th
Utrecht	3rd	5th	7th	2nd	4th	1st	5th	7th
VU Amsterdam	2nd	6th	13th	5th	9th	3rd	4th	5th
Wageningen	4th	2nd	8th	1st	2nd	8th	7th	3rd

Table 35.2 Universities from the Netherlands ranked in 2020 according to citation indicators used by different rankings (all universities appearing at least once in the Dutch top three included)

Of course, it would be possible to discuss at length the robustness of each indicator (see, e.g., Roars, 2020). However the differences of ranking of universities according to CWTS Leiden's PP Top 1 per cent and PP Top 10 per cent, which are calculated using the same robust methodology, shows that interpreting even a single indicator is far harder than it might appear at first glance.

Rankings and Missions

One of the universities in Table 35.2 which sees the greatest swing in position, depending on the indicator for citations used, is Delft University of Technology (henceforth TU Delft).
TU Delft is one of the world's leading universities of technology and as such is well ranked in many international rankings. Comparing its global rankings with those of other universities in the Netherlands tells an elegant story of how the choice of indicators and their weight reflect the value that rankings unavoidably confer on missions (Table 35.3).

For TU Delft the relatively weak performance in ARWU is simple to explain when looking at individual indicators (Table 35.2).

TU Delft scores zero in the 'awards' indicator, whereas the four universities in the Netherlands that are ranked in the world's top 100 are also the only universities which have employed researchers who were awarded a Nobel Prize. Delft's score of 11.2 on 'alumni' is

	ARWU (2020)		THE (2020)		QS (2020)		Reuters (2020)	
	Global	National	Global	National	Global	National	European	National
Amsterdam	101-150th	6th	62th	2nd	61th	2nd	58th	7th
TU Delft	151-200th	8-9th	67th	3-4th	57th	1st	16th	2nd
TU Eindhoven	301-400th	11th	186th	11th	120th	4th	29th	4th
Erasmus - Rotterdam	68th	3rd	69th	5th	197th	8-9th	36th	5th
Groningen	65th	2nd	73th	6th	128th	6-7th	54th	6th
Leiden	82th	4th	67th	3-4th	128th	6-7th	14th	1st
Maastricht	201-250th	10th	127th	8th	234th	11th	89th	9th
Radboud - Nijmegen	101-150th	6th	128th	9th	214th	10th	Ø	Ø
Twente	401-500th	12th	201-250th	12-13th	197th	8-9th	88th	8th
Utrecht	49th	1st	75th	7th	121th	5th	25th	3rd
VU Amsterdam	101-150th	6th	138th	10th	236th	12th	Ø	Ø
Wageningen	151-200th	8-9th	59th	1st	115th	3rd	Ø	Ø

Table 35.3 Universities from the Netherlands ranked according to ARWU, QS, THE and Reuters (the list includes all top 500 Netherland universities according to ARWU)

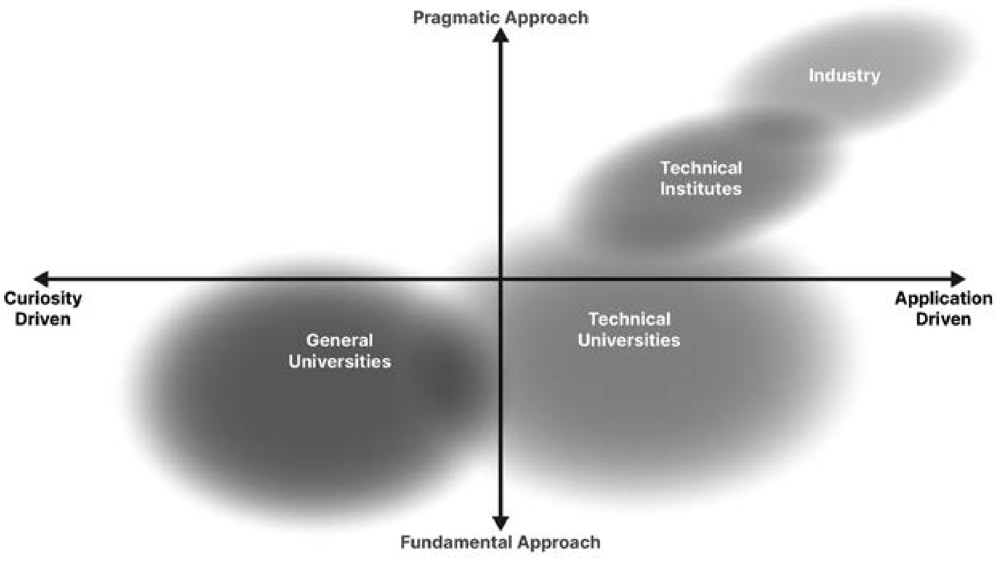
Institution	Rank	Alumni	Award	HiCi	N&S	PUB	PCP	Score
Utrecht	49	22.4	19.7	36.7	25.6	52.6	29.2	32.8
Groningen	65	13.7	25.2	24.3	18	54.3	32.6	29.6
Erasmus - Rotterdam	68	0	14.7	41.5	14.1	51.7	41.2	29.1
Leiden	82	15.9	9.3	28.4	20.9	53.5	31.4	27.8
TU Delft	151	11.2	0	18	20.7	44.9	25.9	Ø

Table 35.4 Table representing the scores of the four top 100 universities in the Netherlands and Delft UT for each indicator of ARWU's 2020 ranking

thanks to Simon van der Meer who studied engineering at Delft University and spent his career designing instruments at the European Organization for Nuclear Research (CERN).[12] Finally, only four highly cited researchers with a primary affiliation at TU Delft are currently listed by Clarivate, in part because the majority of the 21 categories that Clarivate uses to categorise highly cited researchers are fields in which Delft does not have specialists.[13] These results are to be expected, because Delft UT is not focused primarily on curiosity-driven research.

Surprisingly, the ranking of universities from the Netherlands in Quacquarelli Symonds (QS) is almost a mirror of that in ARWU. Whereas, in the Netherlands, TU Delft was 8–9th according to ARWU it is 1st according to QS, Wageningen is 3rd (8–9th in ARWU), and TU Eindhoven 4th (11th in ARWU). At the global level, universities with a strong engineering component perform similarly well in QS: MIT is 1st, CalTech 4th, ETH Zurich 6th and Imperial 8th; in France, Paris Sciences et Lettres[14] is 1st, École Polytechnique 2nd, and CentraleSupélec 4th.

It is difficult to know why the universities of technology are so much better ranked by QS than by other rankings (QS, like *THE*, is not reproducible), but the databases that QS uses to measure reputation seem to be skewed.[15] More surprisingly, QS's citation indicator, which measures citations per faculty normalised per field, clearly favours universities of technology: globally four of the five universities with a perfect score for citations are universities of technology,[16] whereas in the Netherlands, TU Eindhoven is 2nd and TU Delft is 3rd (see Figure 35.4).



Source: Reproduced from Roadmap TU Delft 2020 (TU Delft, 2013).

Figure 35.4 Illustration of the positioning of TU Delft

TU Delft has a particularly well-designed web page where it highlights its results in international rankings and its approach to using these in order to benchmark itself.[17] But the best way of understanding its perspective is by reading its successive strategic plans. In the 2015–20 plan, it thus published an adaptation of Pasteur's Quadrant where it positioned itself as a 'technical university' by opposition with both 'general universities' and 'technical institutes'.

This graph in Figure 35.4 beautifully illustrates the position of its Nobel Prize alumni, Simon van der Meer, whose autobiography states that he studied 'Technical Physics' and adds:

> The physics taught in this newly created subsection of an old and established engineering school, although of excellent quality, was of necessity somewhat restricted and I have often felt regrets at not having had the intensive physics training that many of my colleagues enjoyed. Nevertheless, if I have at times been able to make original contributions in the accelerator field, I cannot help feeling that to a certain extent my slightly amateur approach in physics, combined with much practical experience, was an asset.[18]

In this light, the position of TU Delft in global university rankings is arguably irrelevant (beyond purely marketing purposes). However, its position on individual indicators in relation to universities which position themselves in the same quadrant as themselves can potentially provide insights on its performance. For example, amongst the three big rankings, *THE*'s 'industry income' should be particularly relevant, seeing the explicit aim of TU Delft is to position itself as application-driven rather than curiosity-driven (in 2020, TU Delft was in the top 25 worldwide with a score of 99.4 out of 100[19]), but as Delft itself states, many other indicators and rankings are interesting, such as Reuters' World's Most Innovative Universities where it was 60th in the world in 2019. This said, even when an indicator seems aligned with the mission of a university, the use of rankings is delicate.

Measuring Innovation

Reuters' World's Most Innovative Universities and Europe's Most Innovative Universities explicitly aim to measure a single mission: innovation. The first surprise is that Delft is 60th in the world and 16th in Europe, whereas Leiden is 71st in the world and 14th in Europe. Reuters explains that 'an institution's ranking relative to others may be different in the global and the regional rankings since the ranking is dependent on summarizing the ranks of ten indicators among others in the population, resulting in a composite score specifically geared to those in the comparison group'.[20] This is an elegant acknowledgement that the way the final score is reached depends largely on your baseline and is, in practice, very hard to interpret meaningfully.[21] Both Leiden[22] and Delft[23] can thus claim to be the most innovative university in the Netherlands according to the ranking agency: Reuters.

Even more interesting is comparing the raw data that Reuters provides, which shows that the top three fields in which the university patents are filed are, respectively, chemicals; semiconductor and electrical components; and energy and petroleum (TU Delft); and pharmaceuticals and biotech; agriculture, forestry and food; and medical devices and healthcare (Leiden). The only common field in which both universities have patents is chemicals; however, even within this field both universities patent in very different subfields of chemistry. All further methodological discussion of how to weigh the different indicators is moot, since patent practice (such as patent citation, impact or collaboration with industry) varies radically from one field to another, and comparing the global innovation potential of Delft and Leiden therefore makes little sense.

BEYOND RANKINGS (CASE STUDIES)

The previous examples illustrate how each ranking and each indicator should be interpreted, and how these interpretations can enable stories to emerge that are far more robust than the ranking itself. This is why, from an institutional perspective, it can be more helpful to proceed in reverse and create ad hoc indicators that help to gain a better perspective of the institution for strategic purposes. In this section, we give a few examples of how this can be done, using real case studies for which the institutions' names have been anonymised.

Understanding Why Researchers Act the Way They Do

Institution W is specialised in aeronautical and aerospace engineering and was not preoccupied by rankings until the main agencies started publishing rankings in this field. To its consternation, despite considering itself to be within the world's top 20 institutions, W was ranked by none.

Internally, the teams at W felt that the most relevant ranking was that produced by ShanghaiRanking Consultancy (Global Ranking of Academic Subjects) for aerospace engineering.[24] A reconstruction of how W would have been ranked had the top 200 institutions been taken into account, showed that W would have been 103rd in the world.[25] This relatively disappointing result was due to three main factors.

First, there was a major problem with institutional affiliations in both Web of Science and Scopus, with numerous mistaken affiliations at the level of the individual scholar, the research unit and the institution. These are linked to problems within the dataset and problems with the institutional affiliation indicated by researchers: in the case of W (a fairly small, specialised institution), researchers use 54 different affiliations.[26]

Second, the definition of institutional boundaries is often very complex[27] because no accepted rule is able to account for every specificity. The interaction between W and its ecosystem and the way in which boundaries between W and this ecosystem are taken into account is particularly complex, with two major issues having a massive impact:

- The position of W within a larger university system, in which much research in aeronautical engineering was taking place in units shared between various institutions.
- The role of national research organisations, one of which was employing researchers working within laboratories hosted by W and another which had major laboratories on the same campus as W but considered these laboratories as separate from W.

By simulating the ranking of a theoretical entity, which would have regrouped researchers from W and the other institutions sharing the same campus, it was possible to show that, taken as a whole, had the different institutions of higher education been considered as a single institution, this institution would have been ranked 36th in the world. Had the national research organisation's laboratories also been integrated, it would have been in the top ten worldwide (Table 35.5).

Table 35.5 Reconstructed ranking of W's ecosystem in ShanghaiRanking's Global Ranking of Academic Subjects for aeronautical and aerospace engineering

	ShanghaiRanking's Global Ranking of Academic Subjects – Aerospace Engineering (simulation)
Institution W	103rd
Institution W + other institutions sharing the same campus	36th
Institution W + other institutions sharing the same campus + national research organisation	6th

Third, and maybe most interesting of all, was W's performance on the individual indicators of this ranking[28] and in particular on the indicator TOP (number of papers in top journals),[29] where W (and the ecosystem as a whole) performed proportionally less well, with a ratio between TOP and PUB (number of papers indexed in the field) of less than half that of an institution such as TU Delft.

During a seminar, the scientific community of W agreed that the journals selected by ARWU as TOP journals made sense and that it would make sense for the governance of W to encourage publication in these journals. However, they also underlined that, despite being employed by W and publishing exclusively in the field of aerospace and aeronautical engineering, many of them identified themselves primarily not as aerospace engineers but as (for example) physicists specialised in fluid dynamics. As a result, for reasons of self-perception, peer recognition and especially career path,[30] their primary goal was to publish in journals of fluid dynamics, even when they acknowledged that their articles would probably have had more impact and been more cited if they had been published in a journal of aviation science.

A discussion on why it was not ranked thus made it possible for W to initiate a much deeper discussion about the way research was being produced within the institution. One of the options currently being studied is to reinforce the institutional research strategy by encouraging a shift from classical disciplinary departments to interdisciplinary challenges in the field of aeronautical and aerospace engineering, and by aligning performance indicators, recruitments and promotions to these challenges.[31]

Imagining the World in My Image

In the case of X, a small institution specialising in air transport, the previous approach was not possible because no relevant ranking existed. The field is highly competitive and surprisingly diverse, with a wide variety of actors ranging from private pilot schools to governmental research centres, and from specialised universities (either focused on teaching such as Embry-Riddle, or more research-intensive such as Cranfield or Nanjing University of Aeronautics and Astronautics) to both comprehensive universities and universities of technology such as Beihang, Delft, Purdue and Waterloo.

X was not included in any international rankings and with under 100 publications per year, its presence is little more than testimonial in databases such as Scopus. Its fear was that it lacked the critical mass to be truly significant even in a very specialised subfield such as air transport, yet its aim was to be one of the world's leading institutions.

To understand its potential, subject rankings such as *THE*'s Mechanical and Aerospace Engineering, QS's Engineering Mechanical, Aeronautical & Manufacturing or ARWU's Aeronautical Engineering were of little use, because research in the field of air transport is drowned out by research in aeronautical engineering in the main bibliographic databases, whereas reputational enquiries favour large, well-known institutions. This made it difficult for X to compare itself with others or to evaluate the pertinence of the strategy that it was implementing.

The only way to approach such a question was to identify the scientific production that X considered relevant and to measure its position within this production. One way of doing this was to model the world in X's image by extracting all articles that used semantically similar keywords to those used by its researchers and were published in Scopus indexed journals in which its researchers published. The results are given in Table 35.6.

Table 35.6 *Number of publications indexed by Scopus with semantically similar keywords to those used by researchers from institution X, published in the same subset of journals*

	Affiliation	Records
1	Beihang University	557
2	Deutsches Zentrum für Luft- Und Raumfahrt	374
3	NASA Ames Research Center	298
4	Chinese Academy of Sciences	284
5	Northwestern Polytechnical University	266
6	Nanjing University of Aeronautics and Astronautics	264
7	Ministry of Education China	244
8	NASA Langley Research Center	238
9	Delft University of Technology	230
10	Georgia Institute of Technology	213
11	CNRS Centre National de la Recherche Scientifique	196
12	University of Colorado at Boulder	191
13	Tsinghua University	188
14	Institution X	172
15	National Oceanic and Atmospheric Administration	169
16	National University of Defense Technology	166
17	Cranfield University	160
18	Massachusetts Institute of Technology	149
19	Jet Propulsion Laboratory, California Institute of Technology	136
20	Wright-Patterson AFB	135

These results confirmed that X was indeed one of the key research actors in its field, with a total research production similar to that of actors such as Cranfield, MIT or Tsinghua. This has helped it demonstrate its weight both at a national level and with private partners. Maybe most interestingly, it helped it to reshape its research networks by identifying potential research partners with which it had close ties in education thanks to student exchange programmes, but no research relations; something particularly important in the case of Chinese institutions whose research potential they had underestimated.

Working from this basis, many other approaches can be undertaken. For example, rather than starting from publications, it is possible to ask specialists to identify key research topics that seem relevant to an institution such as X, and then extract relevant publications at a global level. Similarly, it is possible to start from a corpus of publications that are agreed to be relevant to the field (because they are published in a given journal or are the result of work within specific projects) and use this corpus as a baseline.

It is also possible to integrate a whole series of other indicators such as collaboration networks, citation impact or student evaluations of periods abroad[32] in order to build up a customised dashboard that can then be used as a key decision-making tool by the governing bodies of X.

The resulting tool may seem far from a classical ranking, but in many ways it is also far more powerful because it becomes a ranking aligned to X's mission.

Questioning Bibliometric Databases

Y is a comprehensive university that appears in different international rankings at on average around the 900th position. Situated in a highly competitive ecosystem, Y is unlikely to progress in any global ranking because it serves a large student population mostly at the undergraduate level and does not have the financial backing necessary to compete at a global level. For Y, rankings serve as an equivalent of a rating agency: being ranked justifies its status as a research university rather than a university of applied science, but its position within the ranking is secondary.

Y does not use the same quadrant as TU Delft (the fields in which it specialises identify strongly with the values of curiosity-driven research) but it wants to encourage research and teaching programmes that are more closely linked to the needs of its territory and aligned with major societal challenges. As a result, it is particularly interested in measuring its link to regional priorities and its alignment with the United Nations' (UN) Sustainable Development Goals (SDGs).

Rankings exist that try to measure both these dimensions, such as U-Multirank's Regional Engagement indicators or the *THE* Impact Rankings. However, the caveats we underlined in the first section are even greater in these cases.

The indicators used by U-Multirank to measure regional engagement are very interesting but both the quality of the data and more importantly its coherence make them almost impossible to exploit. To take some French examples (similar comments can be made for institutions from all countries and for most indicators):

- The indicator for 'Regional joint publications' lists 'The percentage of the university's research publications that list at least one co-author with an affiliate address located in the same spatial region (within a distance of 50 km)'. ENS Paris and the Paris School of Economics both have excellent scores on this indicator, despite being highly elitist institutions with a very strong international focus. This is because their research labs are all multi-institutional, thus ensuring that articles published by two researchers who share the same office will often count as being regional joint publications.
- Likewise, the top ten institutions according to the 'Regional publication with industrial partners' indicator are all Parisian (French companies usually have their headquarters in Paris).
- The French institution with the highest percentage of 'Bachelor graduates working in the region' is Montpellier SupAgro (94 per cent). Montpellier SupAgro is in fact a highly selective postgraduate institution, which recruits third-year students after a national competition, with a strong national and international focus, that delivers nearly exclusively postgraduate degrees. It scores so highly on this indicator because it has a handful of mostly older students studying vocational undergraduate degrees.
- The results for 'Student internships in the region' are basically aligned with city size, with Parisian institutions at the top and Université de Technologie de Troyes and IMT Mines Alès at the bottom.

Times Higher Education has made a remarkable effort to develop a detailed ranking of how universities around the world are committing to the 17 SDGs, but the results remain highly problematic. First and foremost, aggregating indicators to propose a compound score is perhaps even more questionable here than in other cases.[33] Secondly, this is compounded by the fact that many indicators are self-reported by universities and evaluated internally by the ranking agency. Finally, results cannot be compared at a global scale across institutions without speculative interpretation, even at the level of a single indicator.[34]

Rather than looking into these rankings we therefore mapped Y's research production against a set of different parameters. First, we relied not only on international databases (in this case Scopus) but also on a national database (in this case the open archive HAL[35]), which was more likely to contain articles with a more local or regional focus, and on the lists of publications provided by the laboratories for their national evaluation every five years. The result was eye-opening.

Although global bibliometric databases such as Web of Science or Scopus are used by all rankings to measure the research performance of an institution, they only capture a small part of the total production and one that is skewed in terms of both fields (predominance of hard sciences and medical sciences) and type of research (predominance of fundamental research geared to a global audience).

In the case of Y, just over 60 per cent of total production (as measured by the combination of both databases) was indexed by Scopus and, even more surprisingly, only 7.6 per cent of publications were indexed by both HAL and Scopus (Figure 35.5).

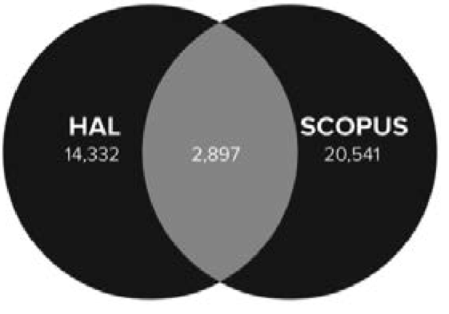


Figure 35.5 Total number of publications from institution Y gathered from HAL, Scopus and common to the two sources, respectively, for the period 2009–18

Articles indexed in Scopus but not in HAL largely belong to the medical and science and technology fields. In this case, scholars presumably do not consider it worthwhile to upload their publications to HAL. On the contrary, many articles indexed in HAL but not in Scopus belong to the humanities and social sciences.

This discrepancy between coverage in different fields is further underlined when comparing coverage in Scopus with the list of publications provided by all laboratories for their national evaluation. Despite the list only containing key articles selected by each researcher, only a tiny percentage of the articles (often under 5 per cent per research unit) are referenced by Scopus (Figure 35.6).

This discrepancy, furthermore, is not limited to the humanities. The publications in fields such as science and engineering least likely to appear in major global databases are precisely those which are most closely related to local issues or involve collaboration with small companies.

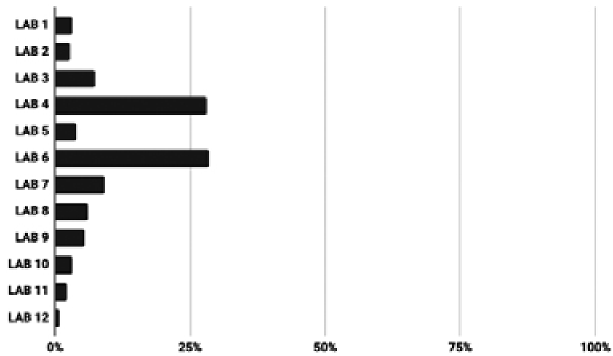
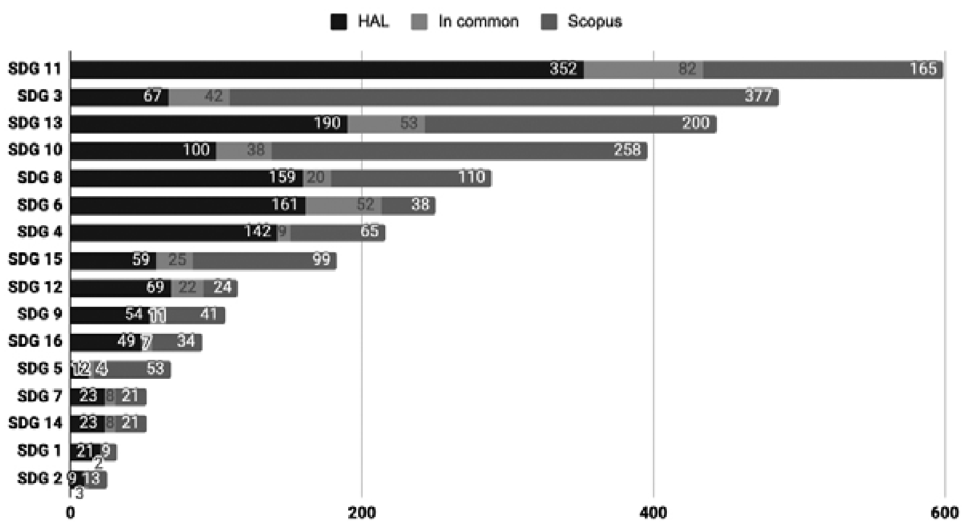


Figure 35.6 Percentage of publications that the 12 research units specialised in humanities and social sciences selected as being key publications that are indexed by Scopus



Note: Note the low number of publications indexed in both datasets.

Figure 35.7 Contribution from publications in HAL and Scopus dataset to each SDG (total number of publications)

Most interesting is that whereas the Scopus–HAL difference in coverage largely corresponded with disciplinary fields, this was not true when publications were analysed through an SDG prism.[36] In most cases, SDG-focused publications were distributed fairly evenly between the two datasets,[37] as well as being transversal to the internal departments and research units within the university. This is because an SDG approach cuts across traditional disciplinary boundaries and understanding of research impact.

Table 35.7 Example of a possible link between a given question and specific indicators

What?	What optional courses and activities do our students choose and why?
Why does it matter?	By understanding this better, we can adapt our offer to better address student needs and increase teaching quality and societal relevance.
How? (always in national comparison and with reference universities as benchmark)	Analysis of the choice of optional and supplementary activities (internships, mobility abroad, sandwich courses, etc.) to understand the paths which are particularly attractive. Analysis of the student's needs (e.g., support in disciplinary fundamentals, opening to other disciplines, soft skills, professional or international experiences). Analysis of the choices from Bachelor to Master to understand the trends (e.g., generalisation or specialisation).
Indicators (examples)	Optionals within curriculum Soft skills chosen Disciplinary support courses chosen Disciplinary opening chosen

Figure 35.7 thus reflects the impact of all disciplinary fields to improve sustainability in cities and communities (SDG 11) with humanities and social sciences more present in darker tone and sciences and health in lighter tone. It also provides University Y with a much better understanding of how it contributes not only in terms of ground-breaking research but also through reports that describe a concrete initiative with a local company.

The previous analysis has reinforced Y's discourse as an 'engaged' university, deeply involved with the local territory and aligned with global priorities. Using this as a basis, it is currently setting up a long-term roadmap to further integrate and align research, innovation and educational programmes. The indicators that it will use to track its progress will be customised to its specific priorities but will enable it to compare its progress to other universities around the world.

After considering existing approaches such as *THE* Impact Rankings, Y has chosen to define its own because it feels that the indicators chosen by *THE* were not adapted to its identity or strategy. For example, for SDG 11 it felt that although publishing research papers in the top 10 per cent of journals as defined by CiteScore was a good objective, measuring the proportion of papers in these journals, as *THE* does, could easily lead to a race for research excellence to the detriment of local impact. Similarly, although Y underlines the importance of supporting arts and heritage and expenditure on arts and heritage (37.9 per cent of the total score for SDG 11 in *THE* Impact Rankings), its local reality in the suburbs of a global city with an extremely diverse population and major socio-economic issues, meant that other priorities needed to be taken into account to measure its impact on this SDG, such as community engagement or cohort studies.

From Data to Question-Driven Approaches

University Z is ranked in the world's top 50 by most major rankings, but this fact is of limited informative value because of the vast number of assumptions that underlie each ranking. To be useful, indicators and rankings need to be contextualised and interpreted with respect to the wider challenges and strategic questions that the university is facing (which can be very different from those of other universities).

This approach requires a major effort in terms of both logical modelling and expert knowledge. Indeed, building a conceptual model is per se a strategic process that forces the university to unambiguously formalise decisions which may be valid for it, but may not be for other universities. This model can then be explored to build different and personalised indicators, according to different questions (Table 35.7).

In order to connect the conceptual model with data, University Z decided to use an ontology-based approach. An ontology is a conceptual model of a domain of interest, where domain knowledge is represented in the form of concepts, properties and relationships. The ontology is then linked to the sources using declarative 'mappings'. These make explicit the way the connection is made, and the user can then extract the information of interest, using terms familiar to them from the ontology. The user query is then translated into appropriate accesses to the different data sources, and the answers are combined to provide the answer to the user, using the ontology itself and the mapping (Daraio et al., 2016; Mosca et al., 2018).

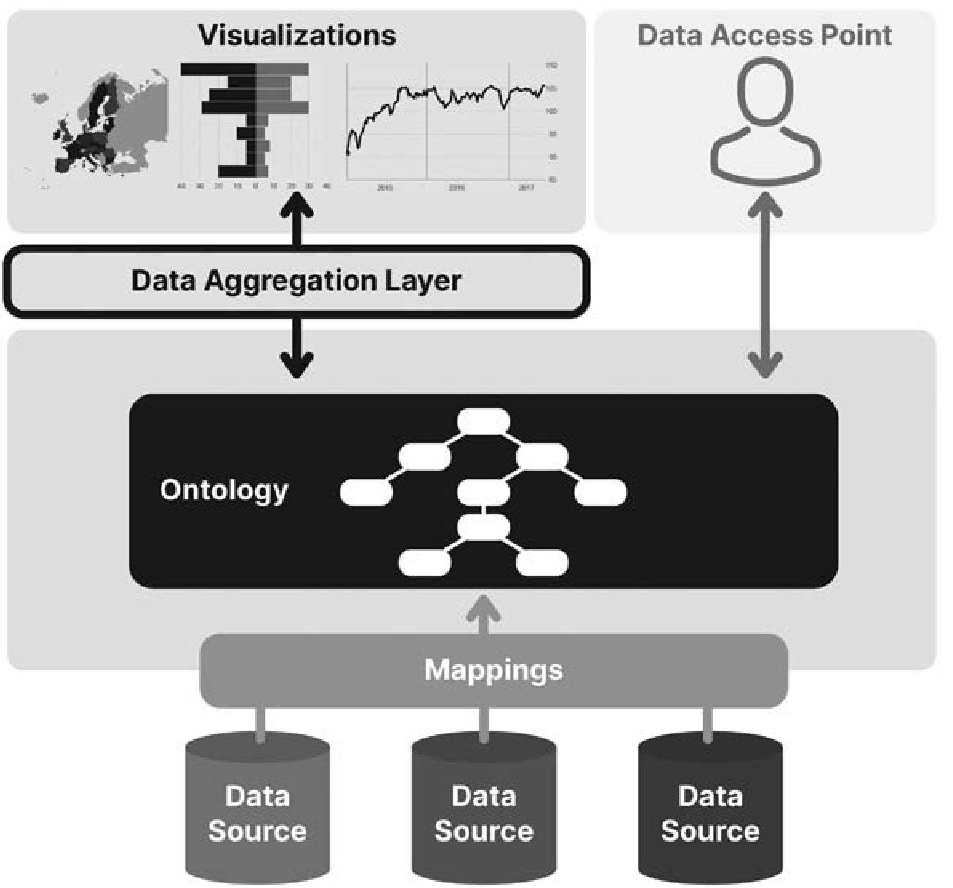


Figure 35.8 Example of an ontology-based approach developed for the Tuscan Regional Government

The strategic dashboard of University Z uses a few selected indicators extracted from rankings and chosen for their robustness and relevance. These are then fully integrated with a wide variety of data sources, both internal and external, in order to create a tool that enables the university to query data on the basis of its own strategic questions.

Such an approach can be used for any actor involved in the world of higher education and research, as the example from a regional government in Figure 35.8 shows.

In a classical data-driven approach, an institution reacts to being ranked 342nd in the world by analysing the ranking and defining institutional actions that will improve this ranking. Success is measured according to externally defined indicators, which are prone to gaming and often misaligned with institutional mission.

In a mission-driven approach, an institution starts from questions and proceeds to search for data, which can help answer these questions. Individual indicators from rankings are used instrumentally like any other source of data. The fact of being ranked is interesting not because of the ranking but because it enables contextualised comparisons.

Of course, such an approach requires tailor-made solutions that are ill-suited to the 'one size fits all' model promoted by many university rankings. However, if football teams define their own models despite all competing for the same goal (winning the league), then it is hard to argue that the same should not be true for universities, when their missions are so diverse and they operate in such different regulatory environments.

Back to the Future

When Ying Cheng and Nan Cai Liu created the ARWU ranking in 2004, they wanted to answer a precise question about the competitiveness of a small group of research-intensive Chinese universities (Liu and Cheng, 2005). A semantic approach would have been theoretically ideal, but was practically impossible to implement because of the cost of developing a conceptual model of higher education and research for this type of institution, and the difficulty of retrieving data that would have been relevant to the model. This is why they started from the data rather than the model, searching for data that measured aspects of research performance, and avoiding debating what research performance is, independently from available data.

As universities become conscious that strategy requires more complex self-assessment and benchmarking they will increasingly need to build their own conceptual models. They can do this thanks to the growing availability of data (and in particular open data) and the awareness of the importance of contextualisation and benchmarking, two phenomena that owe a lot to the remarkable development of rankings over the last 15 years.

By doing this, they will be following the path that leading football teams have taken with their analytic units that study in detail every parameter of a match, model the game and simulate the potential result of a decision. And, just like in football, each university's model will be unique, tailor-made to answer specific questions, and ensure that the university fulfils its missions as successfully as possible. Rankings will become what they were initially built to be: tools to help institutions think, not league tables.

Jean Chambaz, president of Sorbonne University, recently provided a good example of what this can mean, when he declared: 'I will be happy when Sorbonne University loses positions in the Shanghai Ranking, as it is today, because this will mean that we are successfully implementing our policy of open science' (News Tank, 2019). In this, universities do not resemble football teams but countries, trying to free themselves from the shackles of gross domestic product-based policymaking.

NOTES

1. According to https://understat.com/league/Ligue_1 (accessed 8 June 2020).
2. See: https://wikieducator.org/Sport_Informatics_and_Analytics/Performance_Monitoring/Expected_Goals#2018 (accessed 8 June 2020), for a summary of the literature.
3. https://www.statsperform.com/ (accessed 8 June 2020).
4. Controversies exist in football, of course, but they are about clearly defined concrete issues. When two clubs have the same number of points at the end of the season, should their ranking depend on head-to-head results or on goal average? Should a victory be worth 3 points or 2 points if a draw is worth 1 point?
5. Funnily enough, this is what *Times Higher Education* used to do: '*THE*'s World University Rankings examine only a globally competitive, research-led elite group of institutions ... the official ranking only comprises the first 200 placed universities ... the final rankings list is restricted specifically to undermine the notion that everyone should aspire to the same model' (Baty, 2014).
6. As Alex Usher (2018) underlines, storytelling is key 'to the process of creating an institutional identity'. Here, we use the term 'stories' to underline the importance of interpretation.
7. While (a) seems to run counter to current knowledge and is clearly unexpected amongst research-intensive universities, (b) is even stranger since it undermines the whole field of bibliometrics (when expanded to universities ranked between 101st and 200th, there is actually a strong negative correlation between research and citations of -0.7).
8. We compared the score of the 96 United Kingdom universities for which data is available in both the National Student Survey (NSS, 2020) and *THE* World University Rankings 2021. For the National Student Survey, we used question 27, 'Overall I am satisfied with the quality of the course', which is the most general question asked.
9. Bill Anderson (2015) nicely describes the way scholars fill in reputational surveys:
   Obviously the large, well-established (old), and well-publicized institutions are going to get picked, places like MIT, UC Berkeley, Georgia Tech, and a few others here and there. In some ways, this can boil down to a name-recognition survey. I suspect most survey respondents are like me and don't spend more than a minute or two on this.
10. French universities lacked visibility compared to *grandes écoles* such as École Normale Supérieure and École Polytechnique (the top-ranked French institutions in *THE*'s 2015 ranking) and national research organisations such as the CNRS. In the case of Université Paris 7 – Paris Diderot, it is not difficult to imagine an international scholar wanting to cite the Parisian institution in which a colleague worked in a reputational survey, getting confused by numbers and French philosophers' names and deciding to cite Harvard or MIT instead.
11. This is well illustrated by comparing the QS World University Rankings 2021 of institutions situated in the same country according to citations per faculty (which counts for 20 per cent of total score) and according to academic reputation (which counts for 40 per cent of total score on a country-by-country basis); we selected the leading institution on each criteria for each country. See Table 35A.1 in the Appendix. Similar examples can be obtained comparing mid-ranked universities situated in the same city, as the examples in Table 35A.2 in the Appendix show. Leaving aside the major methodological issues of indicators such as 'Citations per faculty', it is clear that universities named after well-known cities are systematically more cited in reputational surveys than universities with less well-known names, and that this is true both at a country and a city level. In other words, one of the main reasons for which academics consider a university to be one of the best in the world is not because of the quality or the impact of the scientific work being done by the researchers in this university, but simply because the name of the city is famous (of course, brand recognition also exists for a handful of institutions, such as Harvard, but it is very limited).
12. The other alumnus with a Nobel Prize from TU Delft is Jacobus Henricus van't Hoff. He won the first Nobel Prize in Chemistry in 1901 (too early to be awarded points by ARWU). Jacobus was

from Rotterdam and studied chemical technology at Delft as an undergraduate, probably because this was the closest university at the time (Erasmus University was created later). He left Delft after two years to pursue his studies and career in more fundamental research universities such as Leiden, Bonn, Paris, Utrecht, Amsterdam and Berlin.

13. For example, over one-quarter of the fields defined in the Essential Science Indicators used by Clarivates are linked to the health sector (clinical medicine, immunology, microbiology, molecular biology and genetics, pharmacology, psychiatry and psychology). Logically TU Delft will never have any highly cited researchers in these fields. In comparison, the two closest universities to TU Delft have respectively five out of ten (Leiden) and three out of nine (Erasmus Rotterdam) highly cited researchers in these fields.
14. Which includes engineering schools such as the École des Mines, Chimie ParisTech and ESPCI.
15. QS has increased transparency over the last few years and provides a breakdown of respondents of the academic survey by broad subject area (http://www.iu.qs.com/academic-survey-responses/), and the employer survey by industry (http://www.iu.qs.com/employer-survey-responses/).
16. In 2021, four universities out of 1187 achieved a perfect score of 100 for citations: King Abdullah University of Science and Technology, Indian Institute of Science, Princeton and Gwangju Institute of Science and Technology. Three of these are specialised in engineering. The same is true for at a country level (in the United States, the best-ranked universities for citations after Princeton are GeorgiaTech, CalTech and MIT).
17. https://www.tudelft.nl/en/about-tu-delft/facts-and-figures/tu-delft-in-international-rankings/ (accessed 27 June 2020).
18. https://www.nobelprize.org/prizes/physics/1984/meer/biographical/.
19. This said, the list of leading universities according to this indicator invites scepticism.
20. https://graphics.reuters.com/AMERS-REUTERS%20RANKING-INNOVATIVE-UNIVERSITIES/0100B2JN1VY/index.html.
21. Reuters at least explicitly acknowledges this. In the case of many other rankings a change in baseline would result in massive shifts in the rankings of individual universities.
22. https://www.universiteitleiden.nl/en/research/about-our-research/quality-and-integrity/rankings#:~:text=Reuters%20Top%20100%3A%20Europe's%20Most,KU%20Leuven%20heads%20the%20list.
23. https://www.tudelft.nl/en/about-tu-delft/facts-and-figures/tu-delft-in-international-rankings/.
24. We discussed all existing rankings that concerned aerospace and aeronautical engineering with a group of experts from W. They chose to focus on ShanghaiRanking's Global Ranking of Academic Subjects for the field, because the universities which were ranked and the order of the ranking made intuitive sense to them as specialists, whereas this was not the case for the other rankings.
25. The methodology and individual indicators used by ShanghaiRanking Consultancy are all public and transparent, which enables its rankings to be reconstructed independently. In this case, we worked with Domingo Docampo from the University of Vigo, who proved that the Shanghai Ranking was reproducible (Docampo, 2013). The first simulation was carried out in 2017 and updated in 2018. ARWU only ranks the top 50 in aerospace engineering.
26. A surprisingly high percentage of author affiliations contain mistakes. This is true even in the case of highly cited researchers, where we have found up to 50 per cent of error in the affiliations indicated for some institutions (for example, with researchers employed by a university, citing the university hospital where they work as their affiliation).
27. Two classical examples would be Penn State, which is considered by ranking agencies sometimes as a single university and sometimes as a series of separate institutions (ARWU ranks 'University Park'); and Toronto University, which is usually considered as a single entity (ARWU ranks the university as a whole) but for which some rankings distinguish the three main campuses (Saint George, Manitoba and Scarborough).
28. ShanghaiRanking's Global Ranking of Academic Subjects takes into account five criteria: PUB (number of papers indexed in the field), CNCI (category normalised citation impact), IC (international collaboration), TOP (number of papers in top journals) and AWARD (number of awards). For aeronautical engineering, the indicator AWARD is not used and IC only counts one-fifth of the other three. ShanghaiRanking is still tweaking its methodology and in 2020 replaced PUB by

Q1 to restrict the number of publications counted to those published in top quartile journals (http://www.shanghairanking.com/shanghairanking-subject-rankings/Methodology-for-ShanghaiRanking-Global-Ranking-of-Academic-Subjects-2019.html, accessed 8 June 2020).
29. In 2020, TOP takes into account articles published in the following four journals: *Journal of Spacecraft and Rockets*, *AIAA Journal*, *Journal of Propulsion and Power* and *Journal of Aircraft*.
30. In the country where this institution is situated, promotion depends on an evaluation carried out by a national committee, which evaluates researchers on the basis of publications in a restricted list of journals defined on a disciplinary basis (that in this case did not include ARWU's TOP journals in aviation science).
31. This is one of the rare cases when shifting towards interdisciplinary challenges can have a positive impact on ranking indicators. In most cases, the contrary would be true. In a large comprehensive university, a strategy focused on improving subject rankings in ARWU (or any other subject ranking) would risk having counterproductive effects precisely because it could easily lead to incentives for researchers to publish in journals indexed in a specific disciplinary field rather than interdisciplinary journals.
32. These can be particularly useful. When analysing performance in aeronautical/aerospace engineering with another institution (W), we realised that its students' evaluations of their compulsory year abroad were completely at odds with the subject rankings: for example, in the United Kingdom (UK), Cranfield and Strathclyde Universities were systematically those best evaluated by students from W who spent a semester there, yet they are not considered as UK leaders by the subject rankings for aeronautical/aerospace engineering, even according to indicators that are meant to measure teaching.
33. For example, to rank universities on SDG3 (Good health and well-being), *THE* combines the following indicators: Research in the field (27 per cent), Proportion of health graduates (34.6 per cent), and Collaborations and health services (38.4 per cent). The first indicator is supposed to measure research in the field (with strange subindicators such as 'proportion of research papers that are viewed or downloaded'), the second indicator simply measures the specialisation of the university in the field, whereas the third indicator is supposed to measure university policy (with subindicators such as 'smoke-free policy', 8 per cent, that usually depend not on the university but on national law). These three families of indicators are neither related nor correlated, and should thus not be aggregated. Together, they end up favouring universities that are: research-intensive, specialised exclusively in medicine, and with budgets that enable them to finance good services (such as 'free mental health support for students and staff', 7 per cent). The fact that RCSI University of Medicine and Health Sciences is ranked 1st in the world is not a surprise. It does not mean that RCSI University of Medicine and Health Sciences is well aligned with the UN's SDG 3.
34. To take just two examples: a gender balance of 55 per cent male to 45 per cent female in a Japanese engineering school is a far greater achievement than a perfect 50 per cent balance in a comprehensive Swedish university; whereas energy use per square metre of floor space is correlated with factors such as the presence of large research equipment (which uses energy), geographical location (climate plays a part in energy bills) and university budget (enabling or not renovation of buildings). Similar examples can easily be found for most of the indicators, rendering the overall ranking deeply misleading (which does not mean that it is not useful, simply that each indicator and each individual performance needs to be analysed and interpreted on a case-by-case basis). On these questions see also Hazelkorn (2020).
35. https://hal.archives-ouvertes.fr/ (accessed 8 June 2020).
36. For a virtual essay on our approach to categorising SDGs see: http://science4sdgs.sirisacademic.com/. The vocabulary is published in open format on zenodo (Duran-Silva et al., 2019).
37. SDG 3 (Good health and well-being) is an exception, with six times more publications in Scopus than HAL, due to the important number of medical papers that are relevant to this SDG.

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APPENDIX

Table 35A.1 Best-ranked institution per country (QS Academic Reputation indicator versus QS Citation per Faculty indicator)

Country	Institution	Rank (academic reputation)	Rank (citations per faculty)
Canada	University of Toronto	15	263
	Western University	281	59
China	Peking University	16	103
	University of Science and Technology of China	141	7
Denmark	University of Copenhagen	83	431
	Technical University of Denmark	269	96

Table 35A.2 Best-ranked institution per city (QS Academic Reputation indicator versus QS Citation per Faculty indicator)

City	Institution	Rank (Academic Reputation)	Rank (Citations per Faculty)
Barcelona	University of Barcelona	86	376
	Pompeu Fabra University	267	124
Boston	Boston University	109	173
	Tufts University	407	269
Shanghai	East China University of Science and Technology	Not ranked	138
	Shanghai University	345	584