



# Comparative assessment of London Knowledge Quarter and University College London research and innovation achievements

Key findings and methods: companion to the  
main findings dashboard, July 2024

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## About the Elsevier study for University College London and the London Knowledge Quarter

University College London (UCL) contacted Elsevier to ask for support in the provision of an analytical report assessing the research and innovation performance of London's Knowledge Quarter (KQ).

The KQ is a research and innovation district that spans from Camden Town to Holborn and Covent Garden in London and encompasses an area within approximately a one-mile radius of King's Cross. In recent years, this area has attracted a large number of academic, business, cultural, and media organisations focused on advancing and sharing knowledge. Today, it is home to a consortium of over 100 such organisations with over 70,000 employees, including scientific and knowledge-intensive institutions and companies.

As one of the board members that governs the KQ consortium, UCL is looking to increase understanding of the KQ research and innovation activities as a whole as well as UCL's own contribution to these activities.

In particular, UCL is interested in tracking KQ and UCL achievements in areas of research and innovation (R&I) falling under the eight UCL Grand Challenges, as well as in other priority areas for the national R&I community: areas from the UKRI 2022–2027 Strategy, the Science and Technology Framework list of critical technologies, and the Great Healthcare Challenges of the UK Government's Life Sciences Vision.

Achievements of particular interest were related to collaborative activity, responsible and sustainable research culture and research practices, as well as societal and economic impacts of research and innovation. To help in tracking attainments, a comparative approach was designed to benchmark the KQ against similar global innovation districts, and UCL against the key universities within each of those districts.

### Overview of key findings and guidelines for re-use of the study findings

- Given the multiplicity of priority areas investigated here, no single institution or district can be expected to top the rankings across the board. In Elsevier's long experience with evaluative bibliometrics and program evaluation, even top global organisations cannot maintain top-flight performances in all science and innovation areas.
- The key findings analysis has sought to identify patterns and clear strengths emerging within higher levels of aggregations, and additionally supported by clear strengths within a subset of priority areas.
- Against this background, KQ and UCL recorded top tier performances across a wide breadth of combinations of priority dimensions and priority areas. KQ and UCL rarely dropped to the 4th rank or lower in the comparisons for publication-based indicators.
- In particular, KQ and UCL recorded very strong performances in collaborative, research culture and impact dimensions. KQ and UCL frequently took the top ranking for collaboration with NGOs, with lower-middle income countries, and intra-district collaboration. In terms of research culture, KQ and UCL ranked first for OA availability of their publications, thematic relevance to the United Nations Sustainable Development Goals (UN SDGs), gender equality in publication authorship, and quality of the mentorship of early-career researchers. Finally, they also frequently ranked at the top for the specific dimensions of policy-related impacts and health impacts investigated.
- KQ partnerships and achievements appeared to be a real asset from the perspective of UCL. The comparative leads on collaboration, research culture and impact dimensions just mentioned tended to be even clearer at KQ level than at UCL level, building on already strong UCL-level performances.

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- KQ and UCL performances did not tend to distinguish themselves across the various indicators of economic readiness or economic impact, however. These findings may indicate potential avenues for organisational monitoring and improvement.

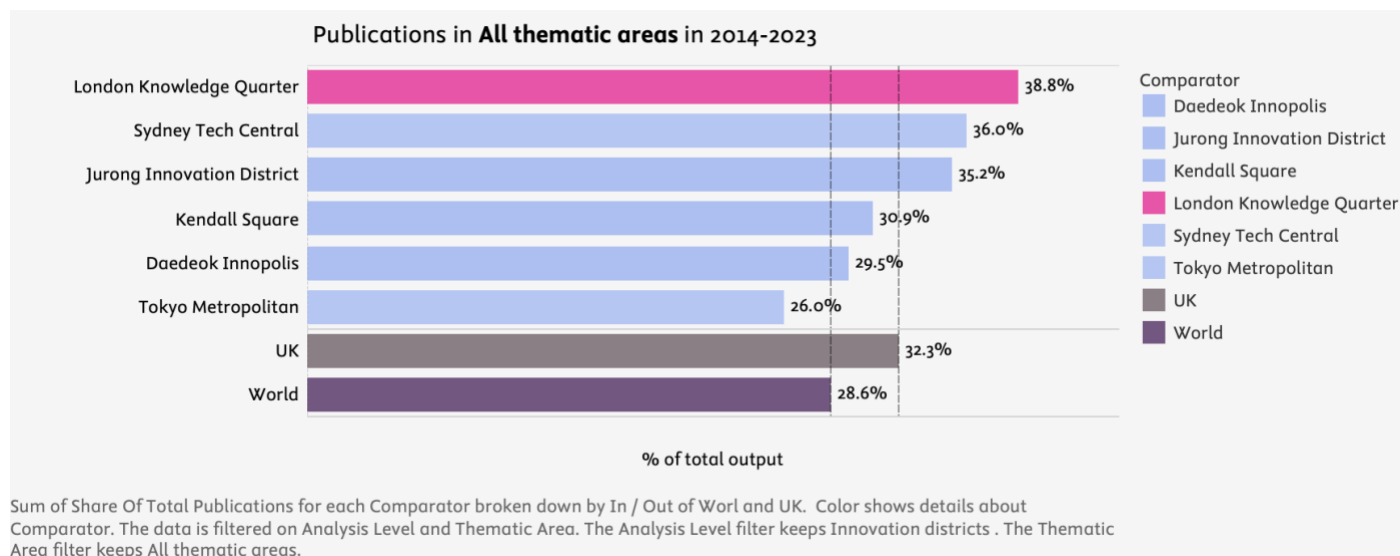
### **Notable features and achievements of the study**

#### **This study entailed:**

- Research and development work towards the implementation of emerging indicators including co-publication with NGOs, share of transdisciplinary publication, and share of publications for which underlying datasets have been openly shared.
- Creation of a broad-scope dashboard that allows multi-dimensional research analytics and innovation assessment extending far beyond the traditional focus on publication or patenting volumes and citation profiles.
- Large-language model and big data-enabled data processing (24 thematic priority areas, geocoding, for both publications and patents) provided a scope of investigated thematic areas that is typically only reserved only for large, multi-year projects entailing levels of effort an order of magnitude above those planned for this study.

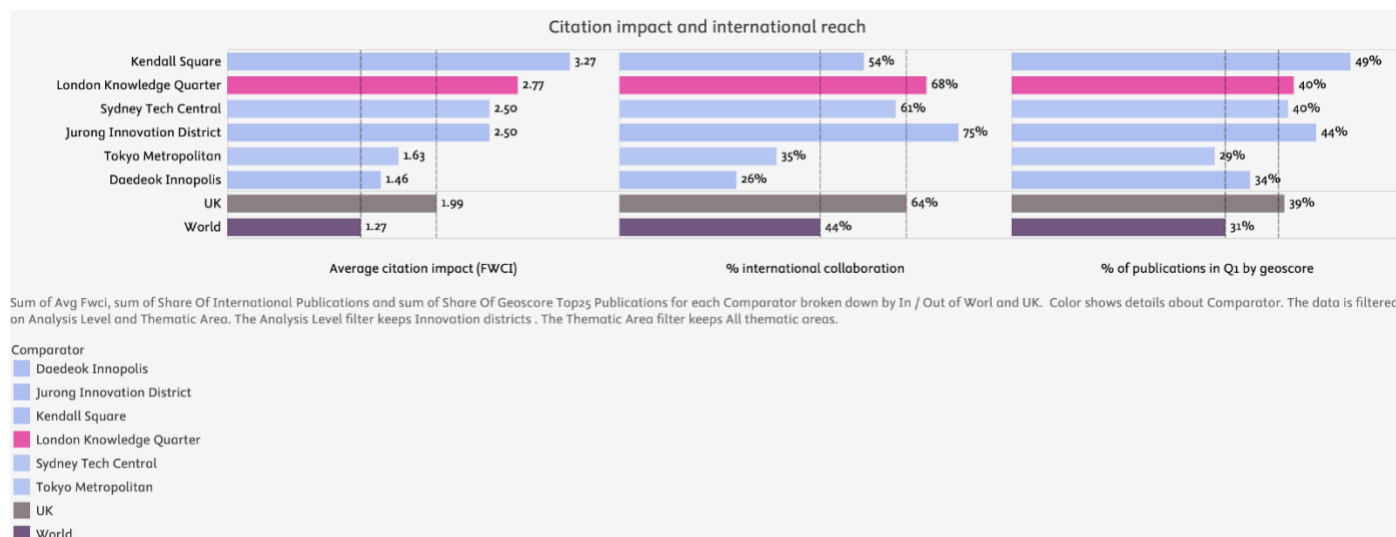
## Research excellence key findings

Both the KQ and UCL published the highest shares of publications thematically aligned with UK research priorities



- A share of 39% of KQ publications were related to at least one of 24 (excluding two overall aggregate) research priorities set by either UCL or the UK government. This was above a UK level of 32% and well above the world level (all countries, all disciplines) of 29% of publications within Scopus overall falling within these priorities, denoting greater specialisation of the KQ in these key topics.
- Roughly the same conclusions can be reached at UCL-level with a share of 36% of its publications relevant to key research areas.
- While ranking first in this analysis, KQ and UCL's achievements were closely trailed by those of Nanyang Technological University / Jurong Innovation District and University of Sydney / Sydney Tech Central performances. UCL and KQ's lead over these other institutions is probably too small to have any certainty it will hold in the future.
- A limitation of this analysis is that UK research priorities may not map onto equivalent national priorities in the other countries included in the analysis. Therefore, this analysis may be inherently biased towards UCL and KQ as UK-based entities. Nevertheless, it is Elsevier's experience that the priorities analysed here also tend to be adopted in similar forms by other national systems of research and innovation, including by the NSF TIP and the European Commission Framework Programmes.

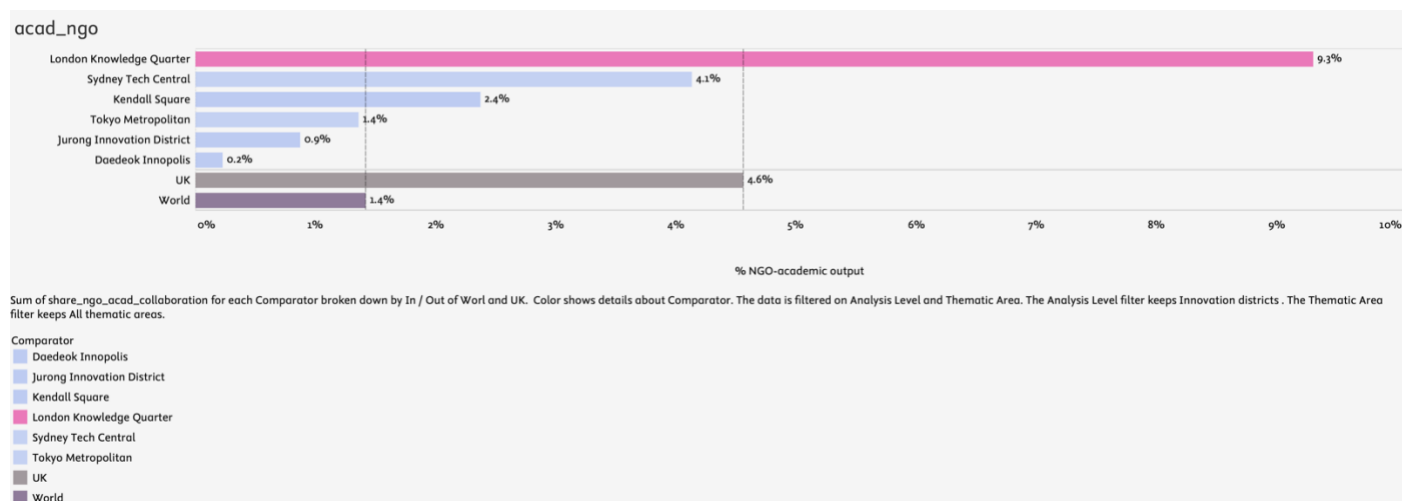
## KQ and UCL tend towards second rank for citation impact



- With a field-weighted citation index (FWCI) of 2.19, KQ publications on average recorded more than twice the expected level of relative citations (normalised for year, subfield and document type). This ranked the KQ second in the district comparison. The FWCI rose to 2.77 when restricting publications to only those in the 24 thematic priorities, although the expected (world level) also rises slightly in these research fronts (1.27 instead of 1.00, indicating these fronts tend to attract more citations).
- KQ publications also tended to take second place for citation impact in the individual priority areas, in 14 areas out of 24. KQ publications fell below 3rd place in only four out of 24 areas.
- UCL publications also took second place in the institutional comparisons in all subject areas or in all priority areas, with scores functionally equivalent to KQ achievements.
- Within individual priority areas, however, UCL publications saw more variability between 1st and 4th place. For instance, UCL Tackling Infections publications recorded a very high FWCI performance of 5.40 (more than four times the world level), far ahead of the next best performance at 4.77 for the University of Tokyo.

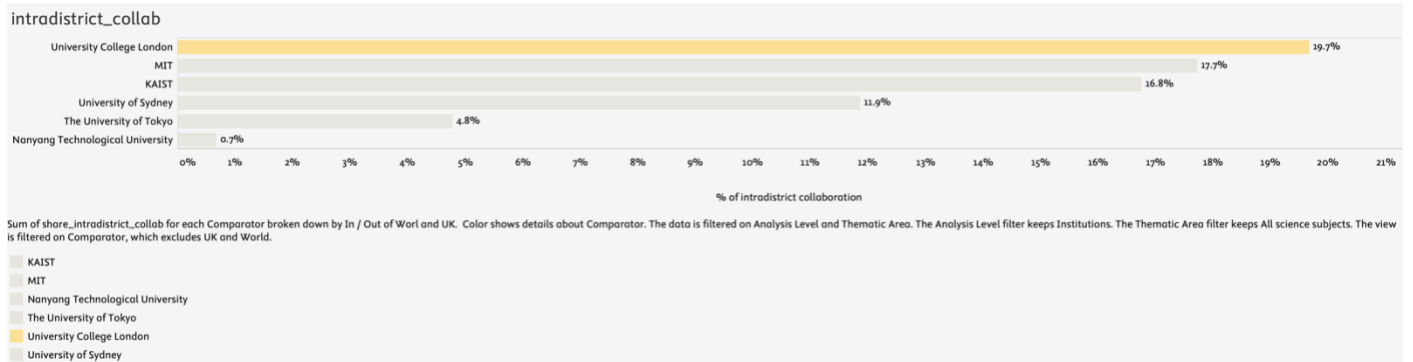
## Collaboration key findings

### KQ and UCL both recorded the strongest levels of co-publications with NGOs



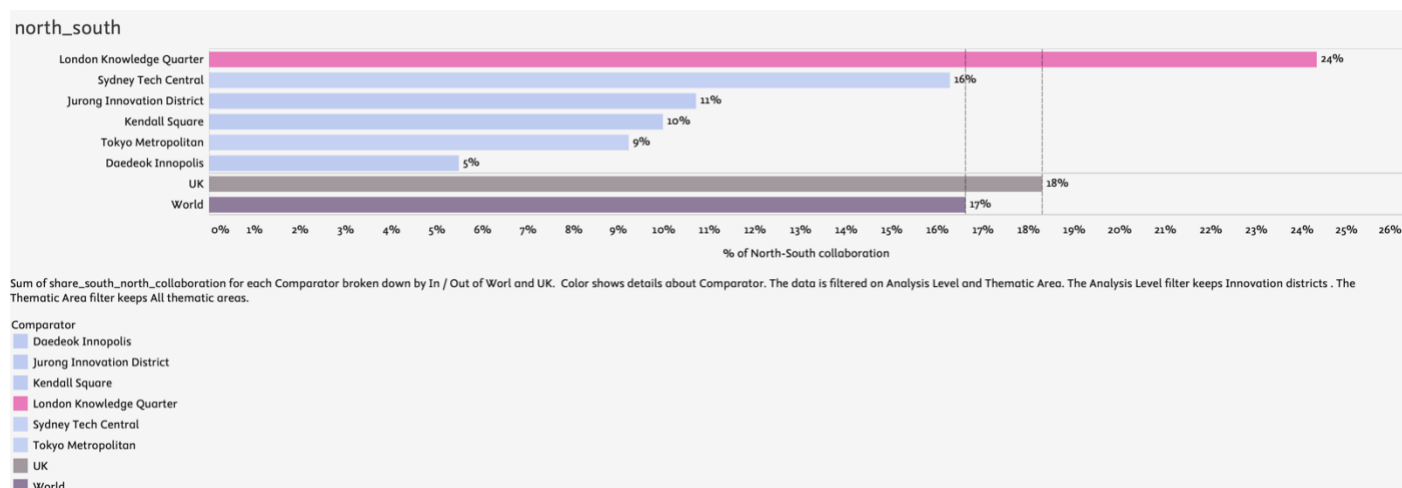
- Of all KQ publications in the priority areas, 9.3% were written as co-publications between KQ academic authors and NGO-based authors. This placed the KQ twice above the UK level of 4.6% and the next best comparing district, Sydney Tech Central, for which 4.1% of publications were recorded as academic-NGO co-publications.
- This proportion fell somewhat, to 7.2%, when only UCL publications within the combined priority areas were considered, with the University of Sydney following at 5.0%.
- Frequent NGO partners on those priority area co-publications were affiliated with the Public Health Foundation of India, the Bill and Melinda Gates Foundation, and Médecins Sans Frontières.
- Some specific areas saw higher levels of NGO co-publication driving the overall figures, such as for KQ's publications in the area of the UCL Grand Challenge on Global Health. Here, 22.5% of KQ publications were co-publications with NGOs, although this can partly be explained by disciplinary trends given that all comparator scores, the UK levels and the world levels were also higher in this priority than elsewhere.
- For the research topics captured by the priority on Creating Opportunities, the proportion of NGO-collaborative co-publications was 17.5%, driven by some of the organisations already mentioned and also the Population Council and Save the Children.
- For the priority of Vaccine Discovery, Development and Manufacture, 15.7% of publications were NGO-collaborative, with the Bill and Melinda Gates Foundation accounting for a good part of this figure.

## KQ and UCL saw excellent levels of collaboration with other district organisations



- In all subject subjects combined, UCL ranked first for its share of publications co-authored with a partner from another district organisation. A share of 19.7% of UCL publications integrated such a form of local collaboration. This was moderately above the next best performance amongst comparators, with 17.7% of MIT's publications written collaboratively with other Kendall Square organisations.
- UCL took second place when publications were restricted to the 24 priority areas, although with a higher measurement recorded, at 20.7%. KQ took second place within the comparison on the intra-district co-publication dimension, both considering all subject areas and within the priority areas.
- KQ took the top spot on this dimension in specific priority areas:
  - semiconductors, with a proportion of 27.3% of intradistrict co-publications, twice or more above the level of comparator districts.
  - quantum technologies, with a proportion of 19.8% of co-publications, twice or more the scores recorded by other districts.
  - artificial intelligence, where 11.3% of publications were intradistrict co-publications, versus 7.3% for Daedeok Innopolis and Kendall Square publications, tying for second place.

## KQ and UCL recorded the highest levels of collaboration with South country amongst comparators

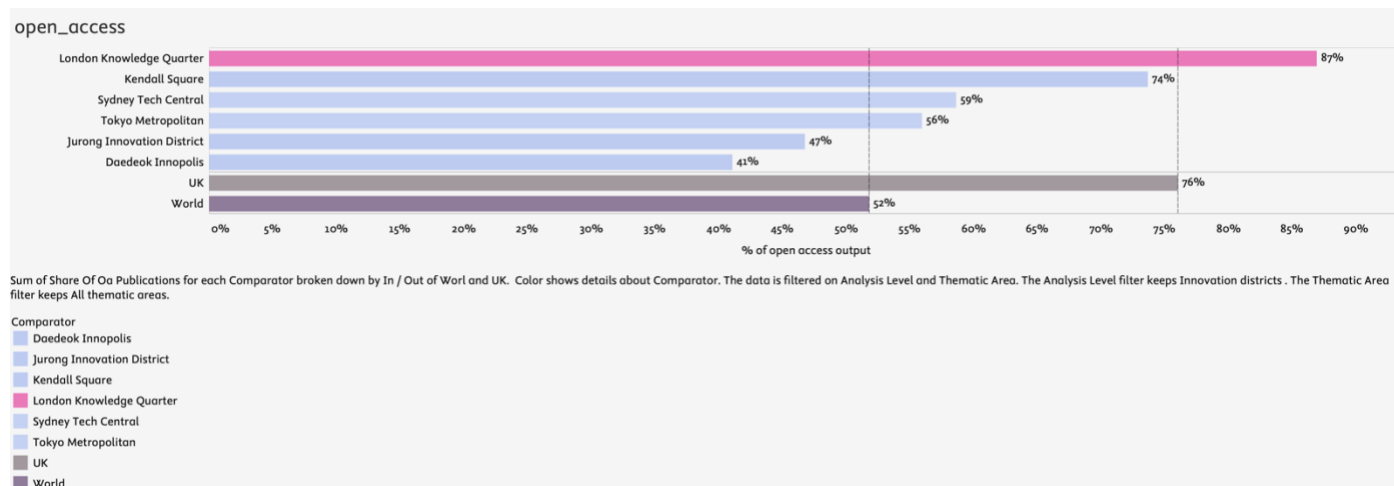


- Within priority area publications, 24% of KQ publications were written as co-publications with authors affiliated with a South (defined as low or middle income country, LMIC), potentially capturing knowledge transfer or international cooperation processes. This placed the KQ in the top ranking, above a UK level of 18% and world level of 17%, and also above the next best comparator, the Sydney Tech Central district (16%).
- UCL also took top position within the institution-level comparison, even with a share (16%) slightly below UK and world levels.
- In the area captured by the UCL Grand Challenge on Global Health, this measurement jumped to 63% for KQ, against a UK level of 52% and world level of 44%. Biomedical priority areas drove much of the collaboration, with the KQ score in the area of Respiratory Diseases at 46% and at 42% for Vaccines publications.
- KQ publications also saw higher-than-expected, top-ranked measurements in social science and humanities priorities where North-South collaborations could be expected.
  - A share of 19% of KQ publications were written as co-publications with LMIC-based collaborators in the area of the UCL Grand Challenge on Cultural Understanding (compared to the world level, 14%, or 16% for Kendall Square, the next best comparator).
  - KQ publications were LMIC co-publications in 17% of cases in the area of the UCL Grand Challenge on Justice and Equality. By contrast, the second-best performance was 14% for Tokyo Metropolitan and 11% at world level.



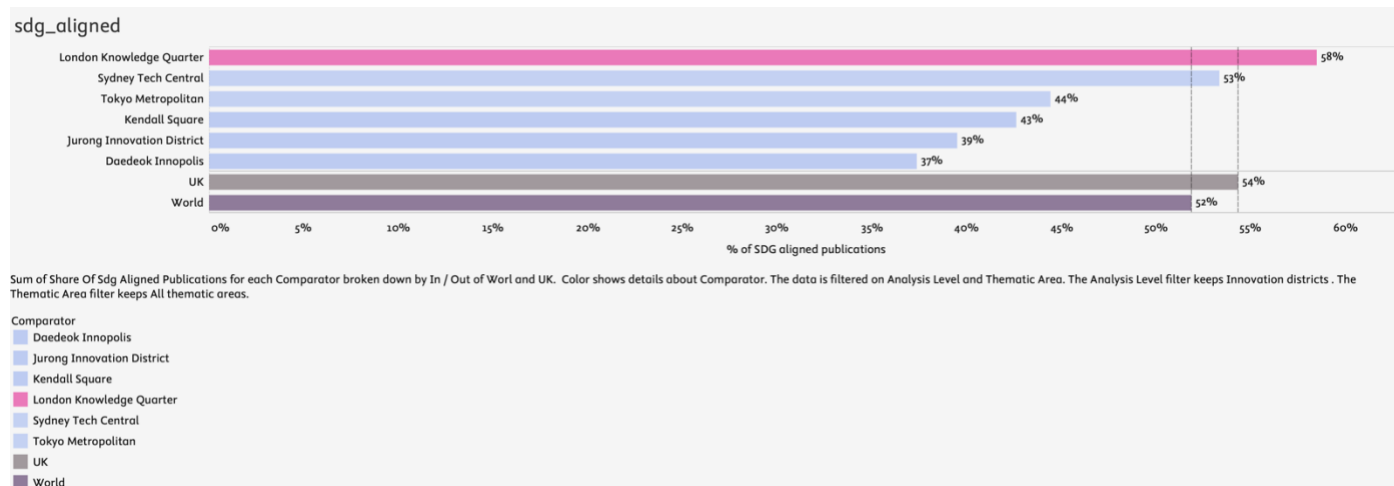
## Research culture

### KQ and UCL systematically ranked first for their share of publications available under an open access modality



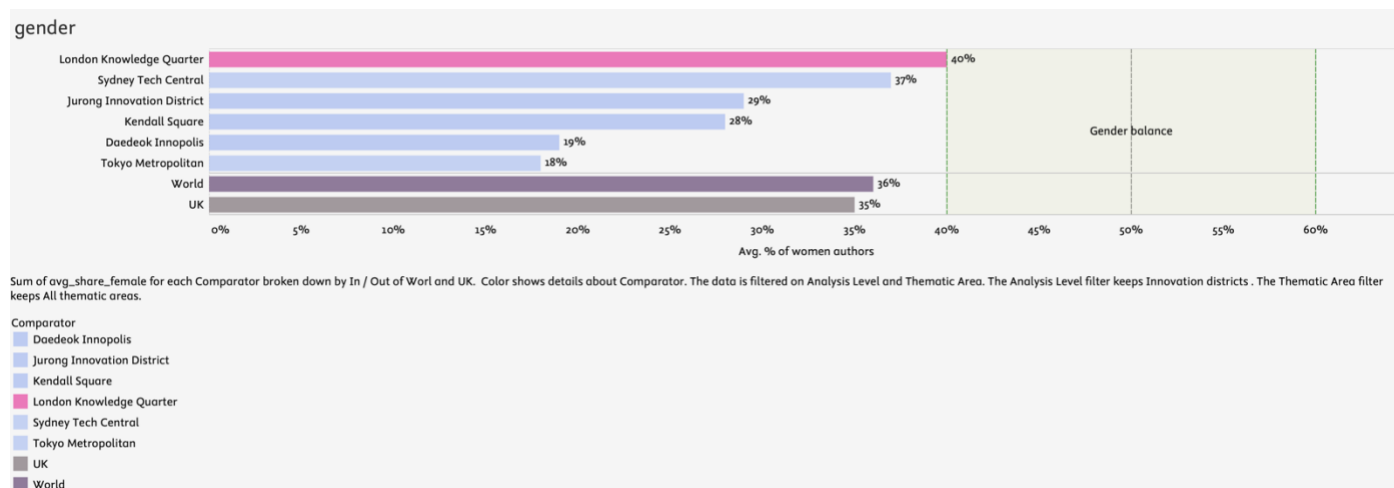
- A share of 87% of KQ publications within the priority areas were made available under any open access modality (gold, bronze, hybrid, or green) as recorded by Unpaywall. This score was well above the very high UK level, 76%, with the world level on this indicator at 52%. The UCL figure was identical in this dimension.
- KQ's top-ranking position was replicated in almost all the priority areas investigated, whereas UCL's top position was still to be found in the majority of priority areas.
- KQ publications' strongest achievements on OA publications came from the priority areas of Respiratory Diseases and the UCL Grand Challenge on Global Health, where 93% of publications were made available under an OA modality.

## KQ publications were more often related to issues and themes of relevance to the United Nations Sustainable Development Goals than those of comparators



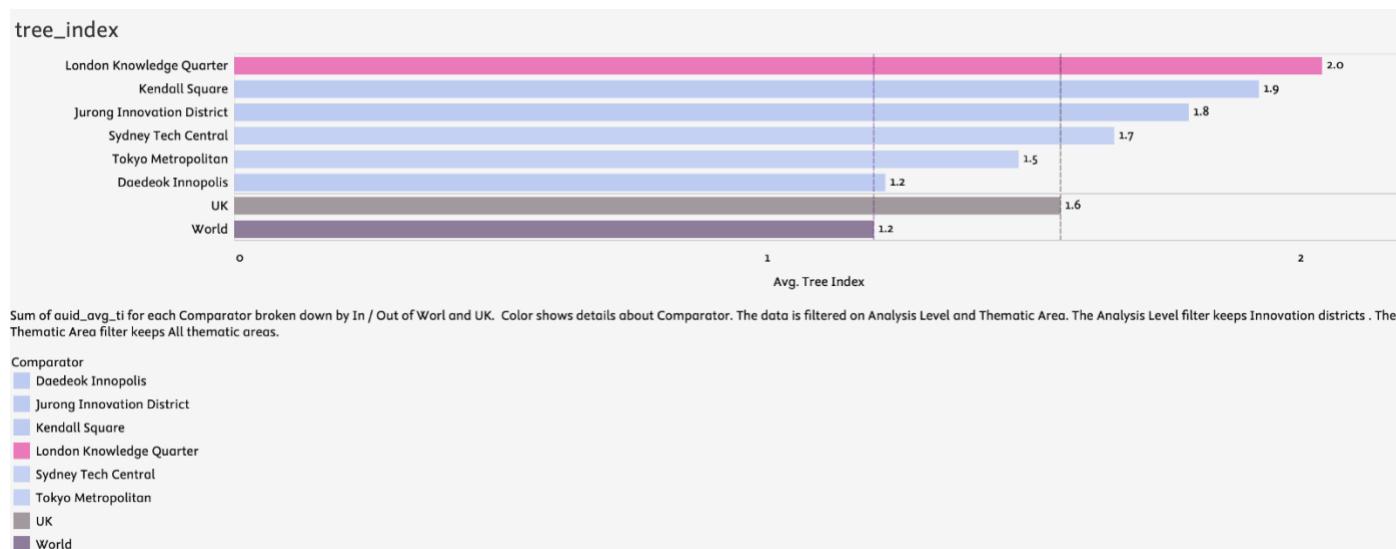
- The proportion of KQ publications within the priority areas that were found to focus on topics of potential interest towards the UN SDGs was measured at 58%. This compared to a score of 54% at the UK level, 52% at the world level, and 53% for the Sydney Tech Central district, the next best-performing comparator.
- UCL's score on this dimension was a negligible distance from both the UK and world levels at 53%, and also roughly equivalent to the top-ranking performance of 55% for the University of Sydney. This score still placed UCL well ahead of the other comparators, with MIT following from some distance, with 45% of its publications thematically aligned with one or more SDGs.
- The priority area on Tackling Infections was where KQ publications' lead on this dimension was clearest, with 75% of publications SDG-aligned, against 65% at the UK level and between 61% and 63% for the next four district comparators.
- In other areas, the KQ lead was less clear, and in some cases, multiple comparators clustered together within the top group. KQ's lead on this dimension is therefore determined by specificities of the aggregation from all priority areas, potentially as well as the distribution of publications amongst high-performing and lower-performing areas as a whole.
- It can be noted that world levels vary greatly by area on this indicator. Indeed, it is to be expected that Semiconductors research is less inherently oriented towards SDG-related topics, whereas Hydrogen-Based Renewables research, by definition, tends to be SDG-relevant.

## KQ and UCL publications were amongst the closest to reach a minimal gender balance threshold within authorship



- A desirable gender balance range for the distribution of authorships among researchers could in principle be placed between 40% and 60%. The average share of authorships taken up by women authors in KQ priority area publications was 40%, just on this threshold. This was slightly above an average of 37% of women authors on Sydney Tech Central publications, 36% at the world level, and 35% at the UK level.
- Other district comparators recorded levels of women's authorship of their publications much below the world level, between 18% and 29%.
- Within UCL publications, the average share of women authors was 38%, slightly below the University of Sydney's share of 40%.
- Gender balance in publication authorship was achieved for KQ but also other comparators in specific priority areas: UCL Grand Challenge on Cultural Understanding (55%), Creating Opportunities (52%), UCL Grand Challenge on Mental Health and Wellbeing (51%), Vaccines (49%), UCL Grand Challenge on Global Health (45%), Ageing (41%), Tackling Infections (41%), and Respiratory Diseases (40%). In the UCL Grand Challenge on Justice and Equality, women authors actually constitute a majority above the 60% threshold (at 62%).

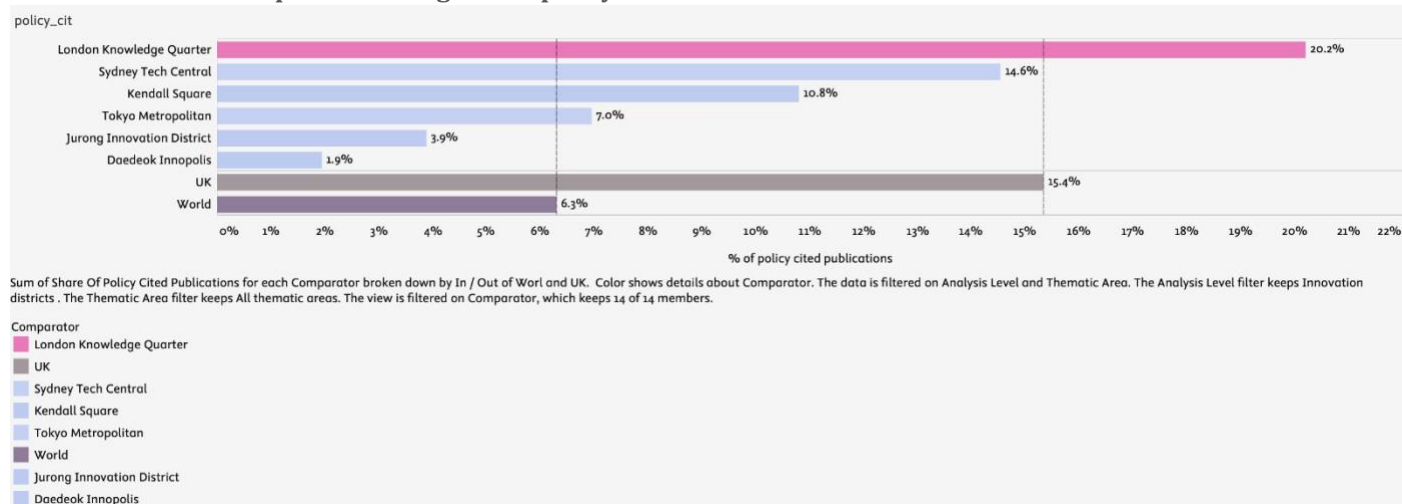
## KQ and UCL senior researchers were often amongst the most adept at cultivating research excellence in graduate students and early-career researchers



- The mentorship quality index, based on the tree index methodology to organize co-authorship networks, measures the average research excellence performances of early-career researchers mentored by senior researchers located at an institution or within a district of interest.
- The priority area publications by KQ senior researchers captured a degree of mentorship quality (2.0) that was well above that of the world (1.2) and UK (1.6) levels. Put differently, the subsequent performances of early-career researchers trained within the KQ was 66% above expected (world level) and 25% above the UK level.
- The KQ was closely trailed by Kendall Square, Jurong Innovation District, and Sydney Tech Central on this dimension, with mentorship indices of 1.9 to 1.7, meaning KQ's lead on these comparators cannot be taken for granted.
- UCL's mentorship index as measured in priority area publications was also 2.0, although in the institution-level comparison this placed the organisation in the middle of a top tier pack also comprising MIT (2.1), KAIST (1.9), and Nanyang Technological University (1.8).

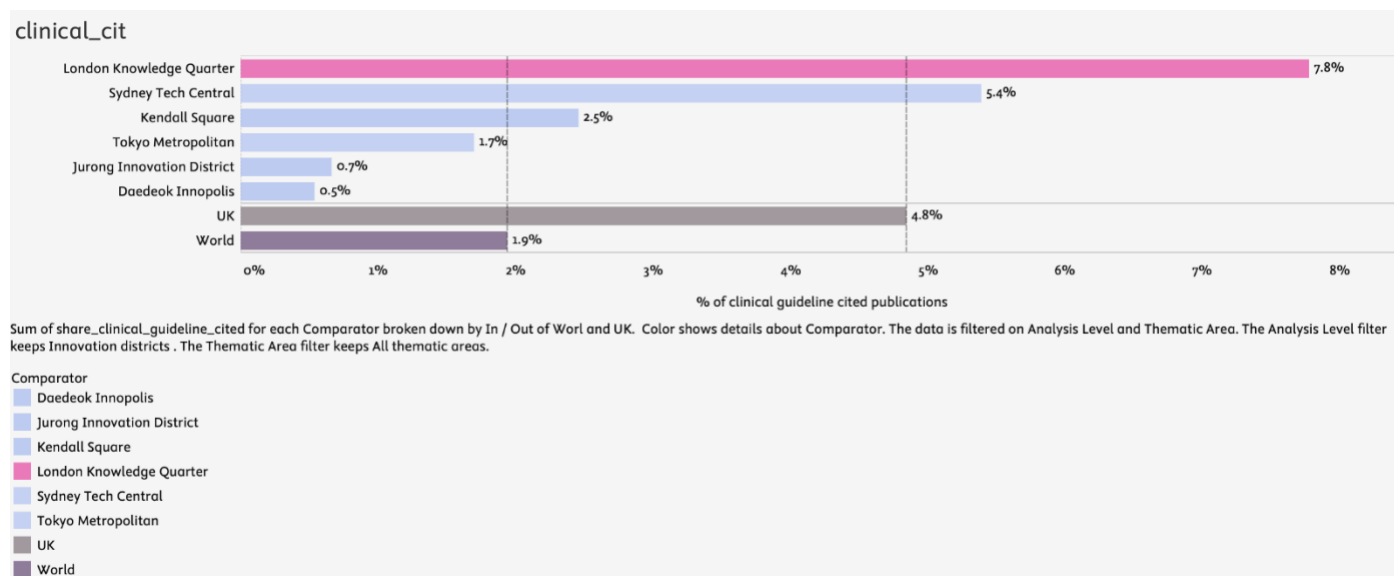
## Societal and economic impacts

### Publications from UCL, and particularly those from KQ, frequently achieve the highest rankings for uptake in online dissemination platforms targeted at policymakers



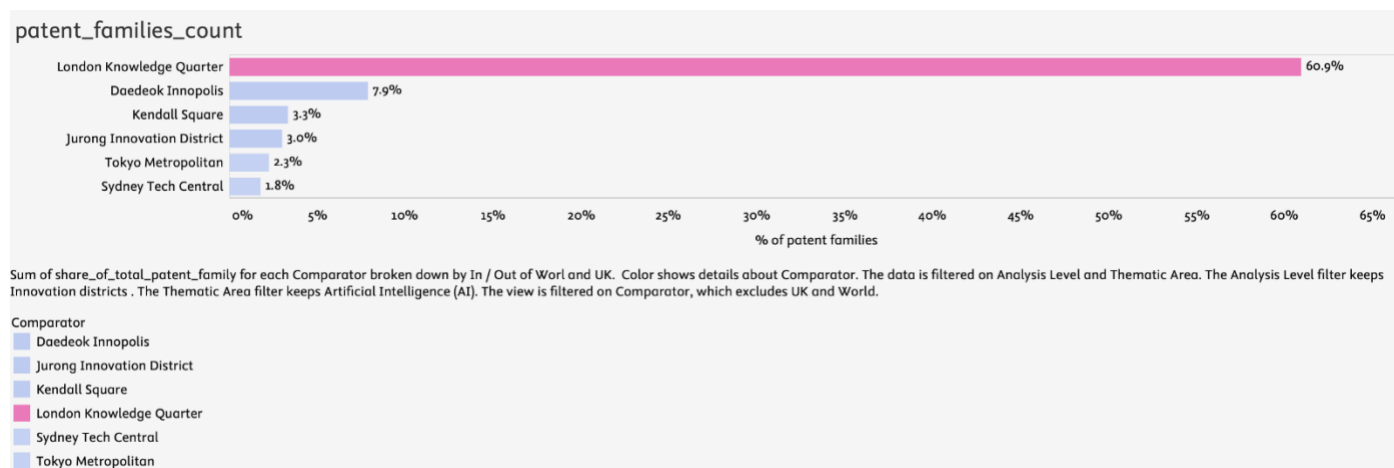
- Amongst the combined priority thematic areas, the share of KQ publications cited at least once in policy-related outlets was 20.2%. This was 25% above the average UK level and also above or much above scores by any district-level comparator. KQ held a very clear lead on this indication.
- UCL publications also recorded strong levels of uptake on this impact dimension, if slightly lower than the KQ performance, at 17.8%. This put the institution at the same level as the University of Sydney (17.2%) and slightly above the UK level of 15.4%.
- These achievements were underpinned by multiple correspondingly strong achievements and leads in individual priority areas, particularly for KQ publications. To take just a few examples:
  - UCL Grand Challenge on Climate Crisis and Building a Green Future (29.5% of KQ publications with at least one policy-related citation)
  - UCL Grand Challenge on Sustainable Cities (29.5%)
  - Tackling Infections (28.5%)
  - Respiratory Diseases (27.8%)
  - UCL Grand Challenge on Justice and Quality (24.7%)
  - UCL Grand Challenge on Cultural Understanding (19.8%)

## Publications from both UCL and the KQ often took top rankings for citations in practice or medical guidelines



- Amongst the areas captured by the UCL Grand Challenge on Human Wellbeing, 10.8% of KQ publications were cited at least once in a practice or medical guideline. This compared to 9.5% of Sydney Tech Central publications and 5.4% for Kendall Square publications. The UK level on this indicator was 9.0%.
- It is more appropriate to use the UCL Grand Challenge on Human Wellbeing overarching category for this indicator as a baseline disciplinary filter, given that we do not expect semiconductor or quantum technology research to have relevance to medical or practice guidelines.
- UCL's achievement on this dimension was measured at 10.7%, which was roughly equivalent to the University of Sydney's 10.2% but was well above all other comparators, well above the world level, and modestly above the UK level.
- These achievements were underpinned by multiple correspondingly strong achievements and leads in individual priority areas. To take just a few examples:
  - Respiratory Diseases (14.2% of KQ publications with one or more guideline citations, but comparing to a higher UK level than above)
  - Tackling Infections (12.9%)
  - Cardiovascular Diseases (12.8%)
  - Creating Opportunities (9.3%, comparing to a lower UK baseline level than above)

## KQ patents performed strongly on specific combinations of indicators and priority areas



- More than 60% of patents from the KQ have some degree of relevance to the Artificial Intelligence priority area (keeping in mind that patents often project multiple areas of potential application for any single technological improvement), driven by the many patents contributed by DeepMind.
- This specialisation likely drove a second position in terms of technology relevance for KQ patents relevant to the UCL Grand Challenge on Transformative Technology, with an index score of 1.81. This was above Jurong Innovation District's 1.36 score, the next-best performance. Kendall Square led from quite a distance in this analysis at 3.22.
- KQ patents led for their degree of market coverage, a proxy measure of value, in the priority area of Hydrogen-Based Renewables. The index score was 3.47 here, against a next-best score of 1.76 for Tokyo Metropolitan.
- UCL patents in Quantum Technologies were highly cited by other patents, indicating high technology relevance (index of 4.80). This score compared to 2.97 for MIT patents in the area, the next best performance.

## Dashboard walkthrough and methods

Dashboard link (this is a public link so circulate with caution):

<https://public.tableau.com/app/profile/dmitrii.malkov/viz/UCLDashboardV2/Researchexcellence>

### General comments:

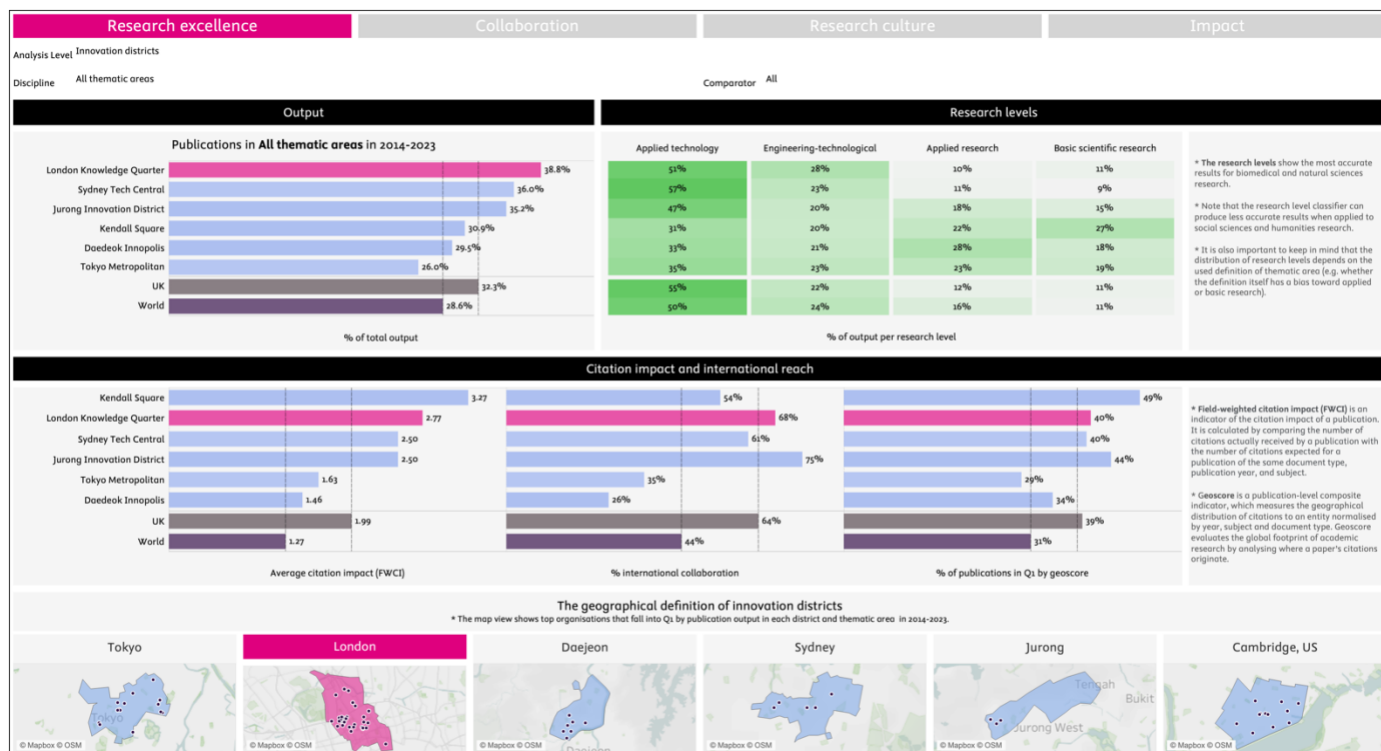
- The Tokyo Metropolitan district definition drew from but ultimately was narrowed from the definition of the Greater Tokyo Innovation Ecosystem. The GTIE proved to encompass much too large an area to be comparable to the other innovation districts retained. Instead, the areas around the University of Tokyo and Waseda University, as two of the three core universities leading the GTIE, were retained.
- As expected and mentioned in the Statement of Work, not all priority areas could be implemented for patenting activities. By definition, patenting does not apply to areas such as the UCL Grand Challenge on Cultural Understanding. Additionally, due to technical limitations, an area such as the UCL Grand Challenge on Global Health could not be applied to patents with a robust level of precision (there were an excessive number of false positives, which would have required a level of manual curation beyond the scope of this study to filter out). Boxes for patenting indicators will be empty in those cases.
- Co-patenting is a sparse phenomenon, given that firms typically apply for IPR as a competitive strategy to protect their internal assets and collaboration may endanger this advantage. Findings on this indicator have turned out to be even sparser than expected, and therefore lists of top co-patenters may be empty or contain fewer than five organisations. Typically, counts of patents applied for jointly are found in the single digits.

### General navigation

- Use the "research excellence", "collaboration", "impact" and "research culture" tabs to navigate between panels of indicators.
- When clicking on the KQ map of the research excellence tab (under the heading of London), you will be taken to a page presenting the distribution of publications across the priority areas. Keep in mind some priority areas have overlapping definitions and therefore publications can fall in multiple areas. Click the "back" button above left to come back to the four main tabs.
- Use the "analysis level" dropdown to switch between 1) the comparison of six innovation districts and 2) the comparison of six universities. UK and world levels are provided as additional references (the average of scores on this dimension for the whole of the UK or the world). These are low-level benchmarks. Scoring above the UK or world level is rather expected. Instead, a red flag might be raised where UCL scores well below the UK or, especially, the world level.
- Use the "Discipline" (that should be changed to another term, however) dropdown to select between currently available priority thematic areas. Thematic areas are still being finalized, particularly areas with a large scope such as "UCL Grand Challenge on Human Wellbeing" which will be wholly derived from the aggregation of other thematic areas.
- You could use the comparator dropdown to select fewer comparators within one of the analysis levels, but this does not lead to visually pleasing results. I am not sure this is really needed but let us know if it is.



## Research excellence tab



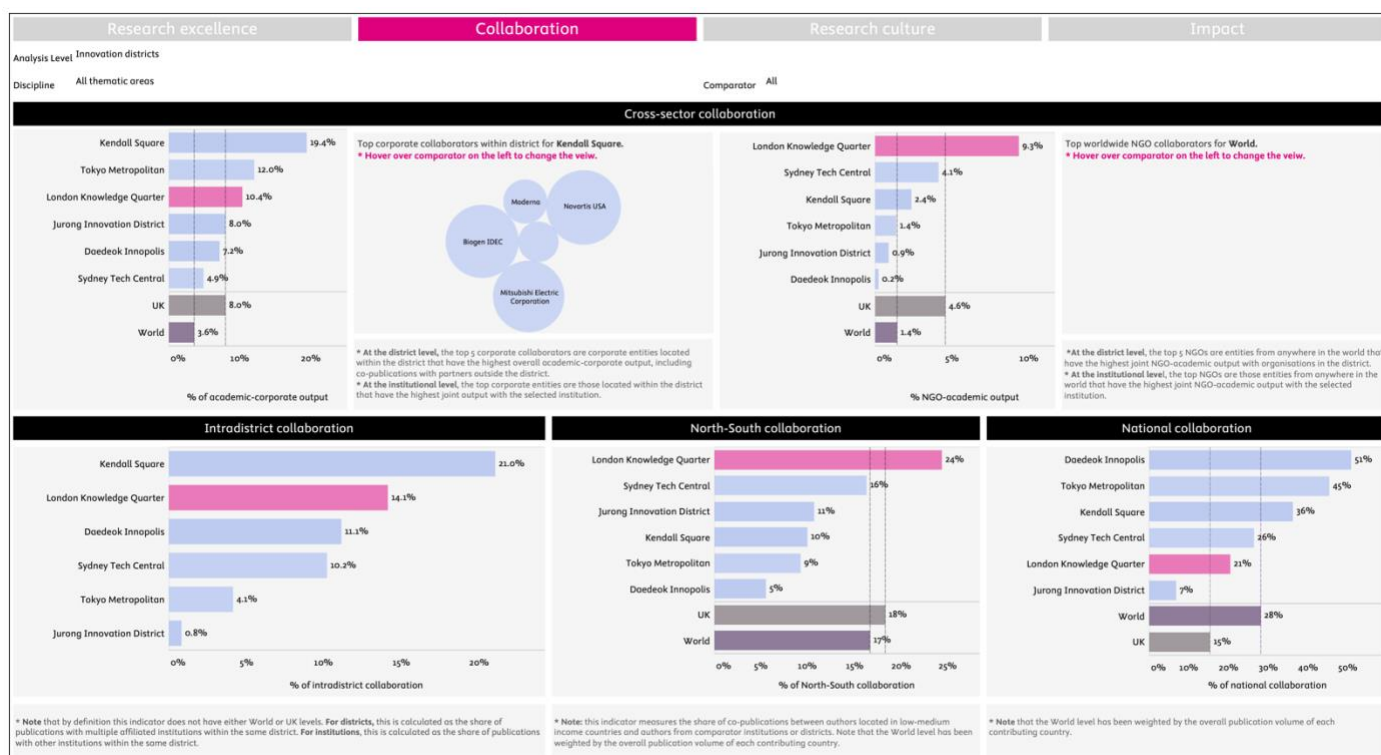
- **% of total output:** the percentage share (proportion) of the university or district overall volume of publications that falls within the selected thematic area. When all thematic areas are selected instead, this is the percentage share of an institution or district's volume of publications that falls within at least one of the priority areas (assignment of publications to priority areas is not mutually exclusive, a single publication could count towards the quantum and semiconductors priorities).
- **% of output per research level:** distribution of publications from the basic-to-applied continuum. Mutually exclusive categories that sum up to 100%. Based on the work of Boyack et al 2014, <https://doi.org/10.1016/j.joi.2013.10.005>.
- **Average citation impact (FWCI, field-weighted citation impact):** this is a normalised count of citations, to account for differences in citation practices and patterns between disciplines (on average bioinformatics papers might have hypothetically received 19 citations after three years, law papers 2 citations), years and document types (reviews on average receive many more citations than research articles, whereas the vast majority of conference proceeding papers never receive any citation). This is an index normalised to one for the world level, so a score above one is above the world average, 1 is the world average and between 1 and 0 is below the world average.
- **% of international collaborations:** percentage share of publications in the area and for an institution or district that is written as a co-publication between at least two authors and where at least two authors are affiliated with institutions in different countries. Authors with affiliations in multiple countries only count towards this if there is at least one other author on the publication affiliated with an institution in a different country.
- **% of publications in Q1 by geoscore:** the percentage share of publications placing amongst the top quartile of publications from the geographic spread of citations they have received (the higher, the more international the citation profile).
- **Geographical definition of innovation districts:** This is a foundational definition rather than a research excellence indicator, but we needed to fit this somewhere and the research excellence tab was less busy. The map also shows the top organisations in the district, in the selected thematic area, for publication volume (top quartile of volume). Again, as we discussed verbally, it is important to consider that the maps offer an approximation of the area we can implement in publications and patents. The

level of precision we get in this map is imperfectly transferred to publications and patents, because affiliations provided in publications and patents are not as granular as the maps. For instance, all UCL publications (irrespective of Bloomsbury or East campus origin) are associated with the institution's main address (Bloomsbury).

## London Knowledge Quarter deep dive

- **Accessible by clicking the London subheading in the maps at the bottom of the research excellence tab**
- This contains descriptive statistics on the distribution of KQ publications across the thematic areas, and across the organisations in the district.
- In the vertical bar graphs containing the shares of KQ publications by thematic area, notice the dashed line representing the world level in this area. Where UCL or KQ publications go beyond and above the dashed line, this means UCL or KQ is relatively specialised in this area (a greater proportion of its publications fall within this area than expected at world level). Note that where UCL or KQ is not specialised in an area, the dashed line will be right of the bar limit.
- Click on the back button to return to the four main tabs.

## Collaboration tab



- **Cross-sector collaboration, % of academic-NGO collaboration:** percentage share of co-publications between 1) institutions or district public organisation researchers and 2) non-governmental organisations, defined as organisations in the voluntary sector, the charitable sector, community organisations, community well-being and civic engagement initiatives, or other organisations focusing on relief or social development. Non-profit think tanks and organisations with a strong research mandate in principle were not tagged as NGOs, however many organisations do combine research activities with volunteer or charitable initiatives and therefore this boundary is sometimes complex to implement.
- **Cross-sector collaboration, % of academic-corporate collaboration:** percentage share of co-publications between 1) institutions or district public organisation researchers and 2) private industry,

with a focus on larger corporations rather than small-medium enterprises (which tend to publish much less). This indicator could be a proxy for technology transfer, although it also simultaneously falls in the "economic readiness" of research dimension.

- **Intradistrict collaboration:** percentage share of publications written as co-publications between authors affiliated with two different organisations within a district. Where presented at the institution level, one of the organisations is necessarily the institution under evaluation.
- **North-South collaboration:** percentage share of co-publications between authors located in low or middle income countries and authors from our institutions or districts, in a given thematic area. A proxy for international cooperation and aid, or knowledge transfer towards low or middle income countries, via joint research projects. Based on affiliation information and the World Bank classification of the country's income levels.
- **National collaboration:** percentage share of publications written as co-publications between authors affiliated with two different organisations within the country of the institution or district.

## Research culture tab



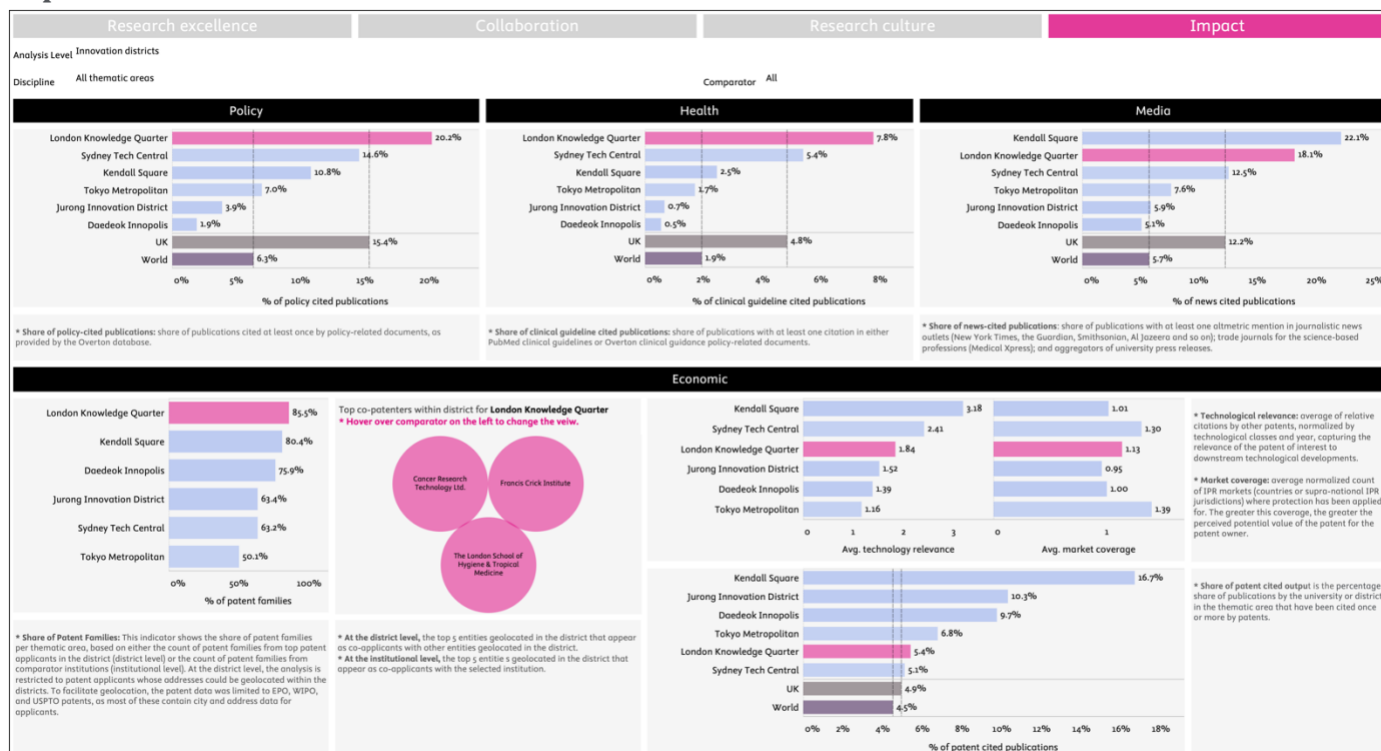
- With the term "**Research culture**", we try to refer to some of the dimensions referred previously as "research environment" in REF (although research culture appears to be the new terminology), that is, the fairness, openness, and responsibility level of research practices themselves. That said, it is also known that these good research practices can in turn lead to an increased likelihood of societal and economic impact. Therefore, we are now arguing that indicators of research culture also double as indicators of "impact-readiness".
- **% of highly interdisciplinary output:** the percent share of publications by a university or district, in a thematic area, that falls amongst the top decile of interdisciplinarity for its subfield, year and document type. Interdisciplinarity here is defined as the disciplinary diversity of cited references. Indexed to 10% as the world level (in our definition of disciplines, noting that our thematic areas do not map to disciplines).
- **% of highly multidisciplinary output:** the percent share of publications by a university or district, in a thematic area, that falls amongst the top decile of multidisciplinarity for its subfield, year and document

type. Multidisciplinarity here is defined as the disciplinary diversity amongst contributing authors (based on their past publication profiles), so it is really an indicator of collaboration; rather than interdisciplinarity, which is an indicator of intellectual integration. A paper authored by a single researcher could score very highly on interdisciplinarity while obtaining a score of 0 for multidisciplinary (by definition, single-author papers are not multidisciplinary). Indexed to 10% as the world level (in our definition of disciplines, noting that our thematic areas do not map to disciplines).

- **% of transdisciplinary output:** proportion of publications capturing outcomes from transdisciplinary research projects, on the basis of keyword analysis of article titles, abstracts and keywords. Transdisciplinarity has been defined here as either 1) problem-oriented research with a participatory, consultative, or citizen science component; or, 2) theoretical frameworks for such approaches; or, 3) their critical assessment.
- **% of open access output:** percentage share of publications by an institution or district in a thematic area that is available under any (gold, bronze, hybrid, or green) open access modality. Derived from Unpaywall.
- **% of output with data sharing:** percentage share of publications for which a formal data availability statement subsection was identified, and within which a mention of an open repository or dataset unique identifier was found. Identification of these markers in an article very likely indicates that the underlying data underpinning the article has been openly shared on said repositories. Data availability statements are not standard metadata and therefore this indicator was computed only for 2018–2023 due to data availability constraints.
- **SDG alignment:** percentage share of institution or district publications, in a thematic area, that are thematically aligned with at least one of the United Nations Sustainable Development Goals. Note that the definitions include rather distal, fundamental research with the potential to contribute to future SDG-proximate innovation (for example, nuclear fusion energy research as part of SDG 7). **An important limitation** of this indicator as part of this project is that some thematic priority areas inherently overlap with the SDG definitions, while others are inherently farther removed from this orientation. For example, semiconductor research has much less chance of being SDG-aligned (unless one argues they should all be green semiconductors by now and that this sustainability component would need to be actively discussed in all semiconductor publications). By contrast, cancer immunotherapy research falls within SDG 3 on Health by definition.
- **Average % of women authors:** average percentage share of female authors in an institution or district's publications within a thematic area. Based on the NamSor prediction software. Predictions are less reliable for Asian names, especially Chinese and Korean names. Careful interpretation is therefore warranted in comparisons to the Asian institutions and districts.
- **Mentorship quality, average tree index:** The Tree Index (TI) is a way to measure the mentorship contribution of senior researchers. It captures, for each senior researcher, the number of mentees, the size of the mentees' subsequent collaboration network, as well as the volume and impact of the mentees' subsequent publication output accounting for field and time differences. Mentorship plays a pivotal role in shaping the research community. Senior researchers, as mentors, guide and support junior colleagues and students throughout their academic journey. Recognizing and quantifying mentorship contributions is essential for promoting a healthy academic environment. Effective mentorship fosters research integrity and builds capacity and skills transfer. Research leaders can use mentorship indicators to get insights related to the research capacity health and how resilient it is for the longer term.

See our approach: Yury Kashnitsky, Guillaume Roberge, Jingwen Mu, Kevin Kang, Weiwei Wang, Maurice Vanderfeesten, Maxime Rivest, Savvas Chamezopoulos, Robert Jaworek, Maéva Vignes, Bamini Jayabalasingham, Finne Boonen, Chris James, Marius Doornenbal, Isabelle Labrosse; Evaluating approaches to identifying research supporting the United Nations Sustainable Development Goals. *Quantitative Science Studies* 2024; 5 (2): 408–425. doi: [https://doi.org/10.1162/qss\\_a\\_00304](https://doi.org/10.1162/qss_a_00304).

## Impact tab



- Policy, % of policy-cited publications:** percentage share of publications cited at least once by policy-related documents, as provided by the Overton database. Note that policy-related documents include a large scope of both parliamentary and policymaking documents, but also evidence syntheses and mandated reports written by scientists and scholars for a policymaking audience (but with no guarantee they will have effectively reached this audience). Therefore, this indicator covers a broad swath of the complex continuum between science and policy. Legislative and other governmental documents do not tend to directly cite the scientific literature, but rather evidence reviews as those produced in the UK by the Parliamentary Office of Science and Technology (Overton does capture citations from POST towards the scientific literature, however). Overton's coverage is skewed towards English-language documents, which introduces some bias towards the UK and the US. So the comparison here should be interpreted carefully, especially against Tokyo, Daejeon and Singapore.
- Health, % of practice or medical guideline-cited publications.** Percentage share of publications cited once or more within the medical guidelines and practice guidelines collection of Overton and PlumX combined. This metric may capture transfer of biological or medical knowledge as evidence to be used to guide clinical interventions or the organisation of health systems.
- Media, % of news-cited publications:** altmetric mentions of the publications in journalistic news outlets (*New York Times*, the *Guardian*, *Smithsonian*, *Al Jazeera* and so on); trade journals for the science-based professions (*Medical Xpress*); but also some aggregators of university press releases. I consider those press release aggregators to be more noise than signal, but in my tests they do not actually pollute the core signal much, so this does translate into an indicator of online dissemination of findings towards the science-curious public, or of dissemination towards professional practice. Here again is some coverage of sources in Asian countries but the comparison might be asymmetric for comparators from this region.
- Economic, % of patent cited publications:** percentage share of publications by the university or district in the thematic area that have been cited once or more by patents. This indicator is a proxy for one specific subset of technological transfer trajectories, although it obviously does not cover all potential pathways through which technology transfer happens (for instance, it is known many if not

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most innovations by small and medium enterprises may be protected by industrial secret rather than formal IPR).

- **Economic, % share of patent families:** proportion of an institution or district's patent families that fall within a priority area. The higher the rank of the institution or district, the more it is specialised in the area compared to the other comparators. Patent families are clusters of technically highly similar patents applied for mostly strategic reasons. Clustering these patents and counting only the priority patent per family allows a de-duplication of sorts and focus of the analysis on the key patents.
- **Economic, technology relevance index:** average of relative citations by other patents, normalised by technological classes and year, capturing the relevance of the patent of interest to downstream technological developments.
- **Economic, market coverage index:** average normalised count of IPR markets (countries or supra-national IPR jurisdictions) where protection has been applied for. The greater this coverage, the greater the perceived potential value of the patent for the patent owner.

# About

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# Authors and project contributions

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