

Knowledge exchange clusters of higher education providers: allocating newly eligible and Northern Irish institutions to existing KE clusters

A technical report commissioned by Research England

TOMAS COATES ULRICHSEN



May 2026

Contents

1	Introduction	3
2	The existing knowledge exchange clusters.....	3
3	Assigning additional HEPs to existing KE clusters.....	6
3.1	About the HEPs.....	6
3.2	The approach	7
4	Results – KE cluster allocations	8
4.1	KE cluster allocations for specialist HEPs	8
4.2	KE cluster allocations for broad discipline-based HEPs	10
4.3	Updated KE cluster membership	10
5	Moving forward.....	12
	References	14
	Annex A – Variables used in KE cluster model	15

1 Introduction

Since 2018, English Higher Education Providers (HEPs) have been grouped into knowledge exchange (KE) clusters to support benchmarking of the sector and wider analytical efforts to inform policy and funding development and evaluation (Ulrichsen, 2018). The KE clusters grouped HEPs based on similarities in their underlying capabilities and assets that are believed to shape the scale and nature of opportunities for KE. The KE clusters were updated in 2023 to account for changes to HEP capabilities and assets as well as new entrants and HEP mergers that had occurred during this time (Ulrichsen, 2023).

A relatively large number of HEPs have since become eligible for England's Higher Education Innovation Funding (HEIF). As a result, there is a need to allocate these institutions to one of the KE clusters. In addition, this exercise considers the KE clusters into which two HEPs from Northern Ireland would be allocated, marking an opportune point to extend the framework to include Northern Irish institutions and strengthen future benchmarking and analysis in this region. Leveraging the existing KE cluster methodology developed in Ulrichsen (2018, 2023), this report provides recommendations on cluster allocations for these newly eligible HEPs and the two Northern Irish HEPs.

It is important to note that this is not a full re-clustering exercise; HEPs that have already been assigned to a KE cluster are not being re-examined.

2 The existing knowledge exchange clusters

The KE clusters were developed in 2018 to support fair(er) comparisons of KE performances within the English Higher Education (HE) sector as part of the effort by the then Higher Education Funding Council for England (now Research England) to develop the Knowledge Exchange Framework (KEF). The HE sector is diverse, with many types of institutions engaging in KE, delivering different types and scales of contributions to the economy and society. The potential of HEPs to contribute through KE is shaped in part by the resources, capabilities and assets they have available to work with partners and deliver KE. Recognising this diversity, the approach sought to cluster HEPs based on similarities in key structural characteristics likely to shape their opportunities for KE.

The conceptual model underpinning the KE clustering approach is shown in Figure 1. It isolates three key 'structural' dimensions which are likely to shape a HEP's opportunities for KE – the nature, scale, and intensity of: (i) the existing knowledge base, typically embodied in the people within the HEP; (ii) the new knowledge being generated by the HEP, recognising research portfolios can vary both in terms of disciplinary focus and types of problem being tackled; and (iii) the development of physical assets available to support these activities.

Figure 1 Conceptual framework

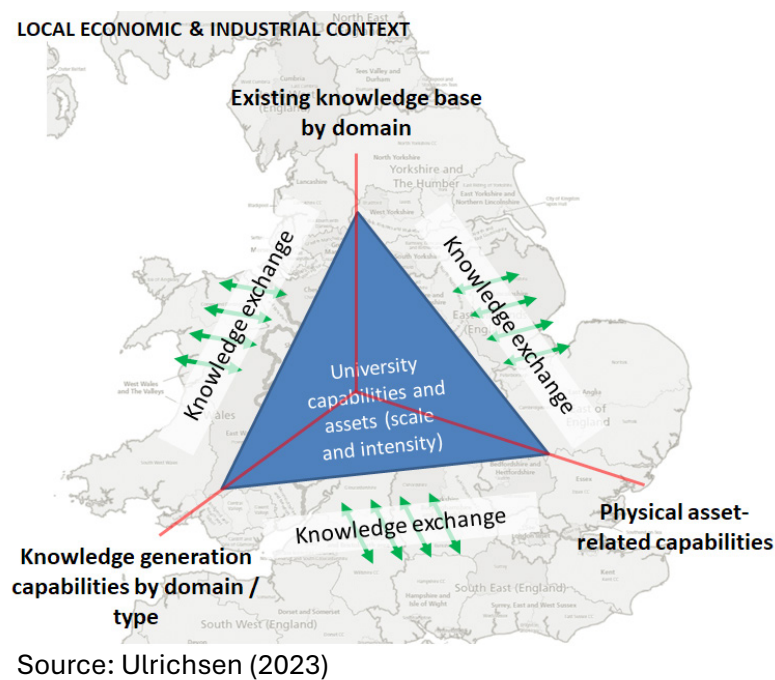
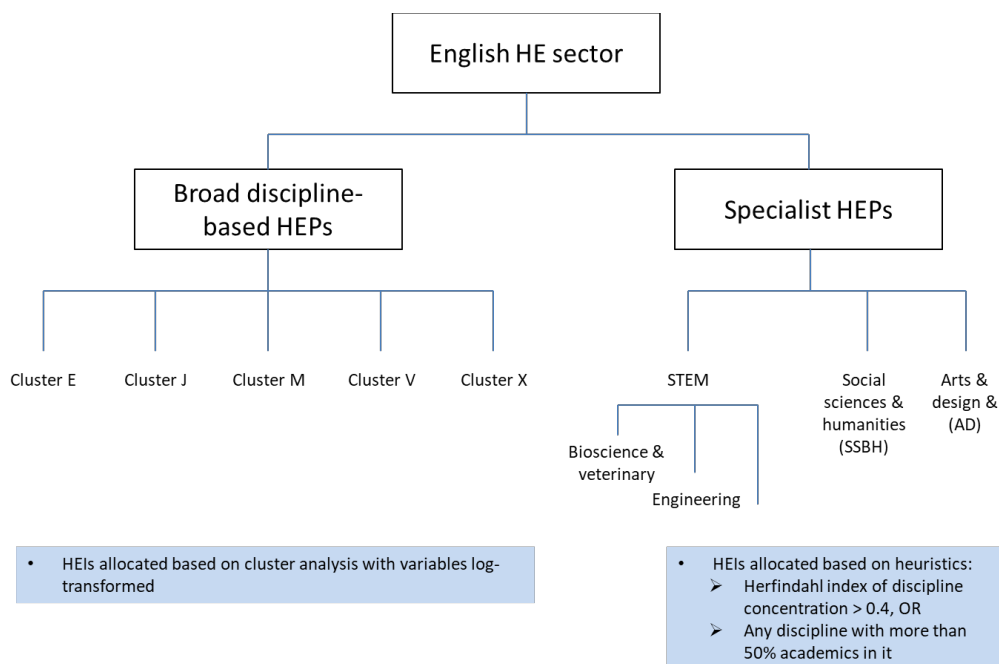


Figure 2 Segmenting the English HE sector



The clustering approach first segmented the English HE sector into broad discipline-based HEPs and specialist HEPs with a narrow focus on specific disciplines (Figure 2). It then deployed a two-step statistical clustering method to allocate broad-based discipline HEPs into five clusters based on similarities in their more structural capabilities and assets. Specialist HEPs were allocated into three clusters based on a set of heuristics looking at their disciplinary focus: providers focusing on the arts and design; science, technology, engineering and mathematics; and those focusing on social sciences, business and the humanities.

Descriptions of each of the broad-based discipline clusters are provided in Table 1.

Table 1 *Cluster characteristics for broad-discipline HEPs*

Cluster	Characteristics
Cluster E	• Large universities with broad discipline portfolio across both STEM and non-STEM excellent research across all disciplines. • Many academics have both a teaching and research focus or teaching only focus • Significant amount of research funded by government bodies/hospitals (cluster average 45%); 9% from industry and 12% from charities. • Large proportion of part-time undergraduate students. Smaller postgraduate population dominated by taught postgraduates.
Cluster J	• Mid-sized universities with a more teaching focus (although research is still in evidence). • Academic activity across STEM and non-STEM including other health, computer sciences, social sciences and humanities • Research activity funded largely by government bodies/hospitals (41%) and charities (20%); 9% from industry. • Smaller postgraduate population dominated by taught postgraduates.
Cluster M	• Smaller universities, often with a teaching focus. Few research-only academics • Academic activity across disciplines, particularly in other health domains, social sciences and humanities. • Research activity typically funded by non-UKRI sources, covering government bodies/hospitals (38%) and industry (27%); 14% from charities.
Cluster V	• Very large, very high research intensive and broad-discipline universities undertaking significant amounts of excellent research. • High proportion of research-only academic staff • Research funded by range of sources including UKRI (34%), other government bodies (26%), charities (24%) and industry (11%). • Significant activity in clinical medicine and STEM disciplines • Student body includes significant numbers of taught and research postgraduates.
Cluster X	• Large, high research intensive and broad-discipline universities undertaking a significant amount of excellent research. • High proportion of research-only academic staff • High proportion of research funded by UKRI (45%); 29% from other government bodies; 8% from industry and 12% from charities. • Discipline portfolio balanced across STEM and non-STEM although less or no clinical medicine activity. • Large proportion of taught postgraduates in student population

Source: Ulrichsen (2023)

3 Assigning additional HEPs to existing KE clusters

3.1 About the HEPs

This report seeks to allocate twenty-six English and two Northern Irish HEPs to the existing KE clusters. Short descriptions of these HEPs are provided in Table 2.

Table 2 *English HEPs requiring KE cluster assignment*

University Name	Final description
The Place	A creative centre for contemporary dance focusing on artist development, performance, and education. Home to London Contemporary Dance School, The Place prioritises professional dance training, choreographic research, public engagement, and access to dance for diverse audiences.
University of London	A federal university focused on collaborative teaching, research and knowledge exchange across its member institutions, with priorities including distance and digital education, humanities research, interdisciplinary scholarship, and public engagement.
National Centre for Circus Arts	Specialises in professional higher education and training in contemporary circus, combining physical training, creative practice, performance, outreach, and artist development.
Northern School of Contemporary Dance	A specialist higher education institution dedicated to contemporary dance, focusing on intensive professional training, creative development, inclusion, and preparation for dance careers.
Central School of Ballet	A vocational higher education provider specialising in classical ballet and contemporary dance, with a focus on professional performance training and artistic development.
Rambert School	A specialist conservatoire delivering professional training in ballet, contemporary dance, and choreography, emphasising artistic excellence, innovation, and research-informed practice.
The University of Law	A professionally focused university specialising in practice-based education in law and related professional disciplines including business, aligned closely to employer and career outcomes.
The Metanoia Institute	A specialist provider focused on counselling, psychotherapy, counselling psychology, and applied psychological disciplines, emphasising professional accreditation and clinical practice.
Sotheby's Institute of Art – London	Specialises in education at the intersection of art, luxury, and business, with a focus on the global art market, art history, curation, and professional practice.
Point Blank Music College	A specialist provider focused on music production and the contemporary music industry, including sound engineering, DJ performance, songwriting, and music business.
St Mellitus College	A higher education provider specialising in theology, ministry and missional leadership, combining academic study with work-based and church-embedded learning.
Escape Studios	A specialist creative industries provider focused on animation, visual effects, game art, and motion graphics, with strong industry-aligned, practice-based training.
Institute of Contemporary Music Performance	Specialises in contemporary music education, focusing on performance, songwriting, music production, and music business with strong industry engagement.
ThinkSpace Education	A digital-first higher education provider specialising in music and sound-design for film, games and television, bringing professional working composers, orchestrators and sound designers together with students looking to enter the film, games and TV industries.
The Queen's Foundation for Ecumenical Theological Education	A specialist theological institution focusing on ecumenical Christian education, ministry formation, inter-faith dialogue, and applied research.
Northeastern University London	A UK campus of Northeastern University focused on interdisciplinary undergraduate education in liberal arts and social sciences with experiential learning.
Waverley Abbey College	A specialist provider focused on theological education, pastoral ministry, and mission, integrating academic study with practical ministry training.
Central Film School	A specialist creative institution focused on film, television and screen industries, emphasising hands-on professional filmmaking training.

The Engineering and Design Institute, London	A specialist higher education provider focusing on engineering and design through interdisciplinary, project-based education addressing real-world challenges. It is now part of Arizona State University London.
New Model Institute for Technology and Engineering (NMITE)	A specialist institution focused on practice-based engineering education co-designed with industry, emphasising innovation and employability.
Cliff College	A higher education provider specialising in theology, mission, and ministry, grounded in applied theology and practitioner training.
London School of Theology	A specialist theological institution focusing on evangelical Christian theology, biblical studies, mission, and ministry training.
Chicken Shed Theatre Company	A theatre organisation focused on inclusive performance, creative education, community engagement, and social impact through the arts.
Academy of Live Technology Ltd	A specialist provider focused on live events, music performance, and production, offering practice-based industry training.
UA92	A higher education institution focused on employability-driven undergraduate education in football, sport, media, digital and business.
The Academy of Contemporary Music	A specialist higher education provider focused on creative industries with expertise across music, games, production, performance, business and technical arts and strong industry integration and professional practice.
Queen's University Belfast	A member of the Russell Group, QUB is a global, research-intensive institution with strong civic responsibility, focused on addressing societal challenges, supporting social and economic recovery in Northern Ireland, and delivering impact through partnerships, innovation, inclusion and sustainability in education and research.
Ulster University	As a multi-campus, regionally embedded university, Ulster emphasises widening access, social mobility and civic engagement, alongside strong commitments to teaching and research excellence.

3.2 The approach

The key requirement for this exercise was that these HEPs are to be allocated to the existing KE clusters. To do this, the approach developed for the previous clustering exercises was followed, whereby the HEPs were first separated into specialist institutions and broad discipline-based HEPs based on a set of heuristics driven by the focus of their academic staff.

Allocating specialists

Specialist HEPs were identified based on the following approach developed in Ulrichsen (2023):

- An assessment of the degree of concentration of academic activity across the 45 discipline groups provided by HESA (proxied by cost centres) using:
 - The Herfindahl Index (which measures concentration) based on the number of full-time equivalent academics in different disciplines of greater than 0.4
- OR
- A share of academics of greater than 50% in any single discipline (based on the 45-way split provided by HESA)

The specialist institutions were then allocated to one of three groups – specialist arts and design institutions; specialist social science (including business and management) and humanities institutions, and specialist science, technology and engineering and mathematics (STEM) institutions. Building on insights from the previous clustering exercises, a decision was made – in agreement with Research England – that HEPs with a specialist focus on media studies (including for example film and live events productions) would be grouped with arts and

design specialists rather than with other social science-focused HEPs such as those focused on law, education and theology. While media studies is formally a social science, the types of KE opportunities and external partners were likely to be more similar to those focused on the creative arts.

Given the growing number and diversity of specialist HEPs, the data-driven allocations were also checked against web-based information on the strategic focus of each HEP.

Allocating broad discipline-based HEPs

The remaining broad discipline-based HEPs were then allocated to one of the five KE clusters based on the ‘distance’ between their set of characteristics and the ‘centroid’ of the cluster – a measure of similarity between the characteristics of each HEP and the average for the cluster. It does this by calculating the squared Euclidean distance between the set of normalised characteristics for the HEP and the average for the KE cluster and selecting the cluster with the smallest distance.

The approach uses the same set of variables as the previous exercises, developed and normalised in the same way. In addition, in order to maintain the existing cluster structures, the approach compares the characteristics of the additional HEPs to the cluster averages from the previous exercise (Ulrichsen, 2023). As a robustness check, the full statistical model was re-run to see how these additional HEPs would group.

To drive the analysis, data was collected on each of the variables that drove the 2023 exercise (see Annex A), using the most up-to-date information available from the Higher Education Statistics Agency (HESA, part of Jisc). Note that at the time of delivering this exercise, staff and student data was available for up until the year 2024-25, while finance data was only available until 2023/24.

4 Results – KE cluster allocations

Of the 28 HEPs needing to be allocated to a KE cluster, 24 were identified as a specialist HEP and 4 as broad discipline-based HEPs.

4.1 KE cluster allocations for specialist HEPs

For the majority of specialist HEPs, the allocation to a specialist sub-cluster was data-driven based on the concentration of their academic staff within specific HESA cost centres. However, for three HEPs, the manual validation checks revealed that the suggested allocation based on this approach was poorly aligned with what we know about these institutions. In particular:

- **Escape Studios** – they return their academic staff within the *IT, systems sciences & computer software engineering* cost centre. Web searches suggest it focuses on animation, visual effects, game art, and motion graphics. I recommend it be included in the **specialist arts, design and media specialist cluster**.
- **Waverley Abbey College** – they return their academic staff to HESA under the *Psychology & behavioural sciences* cost centre. Web searches suggest their focus is

around theological education, pastoral ministry, and mission, integrating academic study with practical ministry training. Albeit from different traditions, this HEP appears to have some similarity in focus with the Metanoia Institute (which focuses on providing training in counselling, psychotherapy, counselling psychology, and applied psychological disciplines, emphasising professional accreditation and clinical practice). The Metanoia Institute returns their academics under the *Education* cost centre. Digging deeper into these institutions, I would suggest they should be part of the same specialist sub-cluster and would recommend they are both returned within the **social science and humanities specialist cluster**.

- **Academy of Live Technology Ltd** – they return most of their academic staff in the *IT, systems sciences & computer software engineering* cost centre. Web searches suggest it is more focused on live events, music performance, and production. I recommend it be included in the **specialist arts, design and media specialist cluster**.

ThinkSpace Education did not report any academic staff broken down by HESA cost centre (they report academic staff within the academic services cost centre). As a result, this HEP was allocated to a specialist sub-cluster based on information available on the web. This revealed specialisms in music and sound-design for film, games and television. As a result, I recommend it be included in the **specialist arts, design and media specialist cluster**

The final KE cluster allocations of each of the specialist HEPs are provided in Table 3.

Table 3 Cluster allocations for specialist HEPs

Final allocation	University Name
Arts, Design and Media	The Place
	National Centre for Circus Arts
	Northern School of Contemporary Dance
	Central School of Ballet
	Rambert School
	Sotheby's Institute of Art – London
	Point Blank Music College
	Institute of Contemporary Music Performance
	Chicken Shed Theatre Company
	Academy of Live Technology Ltd*
	The Academy of Contemporary Music
	Escape Studios*
	ThinkSpace Education*
	Central Film School
Social sciences and humanities	The Metanoia Institute
	The University of Law
	UA92
	St Mellitus College
	The Queen's Foundation for Ecumenical Theological Education
	Waverley Abbey College*
	Cliff College
STEM - Engineering	London School of Theology
	The Engineering and Design Institute, London
	New Model Institute for Technology and Engineering (NMITE)

* Specialist sub-cluster allocation based on manual allocation

4.2 KE cluster allocations for broad discipline-based HEPs

The remaining four HEPs (University of London, Northeastern University London, Queen's University Belfast and Ulster University) were allocated to one of the five KE clusters for broad discipline-based HEPs. The allocation was based on the distance of their set of characteristics to the centroids of each of the clusters. The lower the distance measure suggests greater similarity between the HEP and a particular cluster; the higher the distance measure suggests greater dissimilarity.

Based on this approach, the HEPs are allocated as follows:

- Northeastern University London – **Cluster M**
- University of London – **Cluster M**
- Queen's University Belfast – **Cluster V**
- Ulster University – **Cluster E**. This HEP appears to be near the border between clusters E and X, but it is a bit closer to the centroid of cluster E than cluster X

The University of London presented a particularly challenging case to allocate to a cluster. It is a university that reports very few full-time equivalent academic staff to HESA (85 in 2024/25, the majority of which are across social sciences and humanities disciplines), yet has a relatively large total income (£206 million in 2023/24) and a research income of £1.8 million in 2023/24. Using the main approach to assigning the additional universities to one of the KE clusters places the University of London in cluster M. Re-running the full statistical model including these additional HEPs also placed it in the same cluster. Looking across the suite of variables driving the model and comparing it to HEPs in other clusters, suggests that in many areas of the model it shares similarities with cluster M institutions. However, on the research *intensity* measure (although not on research *scale*) it appears to be more similar with universities in cluster X.

The recent merger of the universities of Kent (previously cluster X) and Greenwich (previously cluster E) raises questions about how this might affect its KE cluster assignment. One way to explore this is to treat these two institutions as a combined institution, aggregating their data across each characteristic in the cluster model. We can then examine which cluster the resulting combined institution is closest to in the same way as above. This approach would suggest the closest KE cluster is **cluster E**, although, as with Ulster University, it appears to be close to the border with cluster X.

4.3 Updated KE cluster membership

The number of HEPs in each cluster is shown in Table 4. Note that two social science and humanities focused HEPs were identified in previous clustering exercises but were manually allocated to one of the five broad discipline KE clusters. These HEPs are not included in the SSH cluster numbers in this table.

Figure 3 and Figure 4 provide the updated KE cluster membership for all eligible HEPs, incorporating the latest additions is provided in below. The new additions are highlighted in bold.

Table 4 Numbers of HEPs in each KE cluster

KE Cluster	Number of HEPs
V	18
X	18
E	34
J	14
M	19
Specialists - STEM	11
Specialists – Arts, design and media	35
Specialists – Social sciences and humanities*	10

* Two social science and humanities focused HEPs were included in previous clustering exercises. These were manually allocated to one of the five broad discipline KE clusters and hence are not included in the SSH cluster numbers in this table.

Figure 3 Cluster membership for broad discipline-based HEPs

Cluster E	Cluster J	Cluster M	Cluster V	Cluster X
• Anglia Ruskin • Aston • B'ham City • Bournemouth • Bradford • Brighton • Lancashire • Coventry • De Montfort • Goldsmiths • Greenwich • Hertfordshire • Huddersfield • Kingston • Leeds Beckett • Lincoln • John Moores • South Bank • Manchester Met • Middlesex • Northumbria • N'ham Trent • Open • Oxford Brookes • Plymouth • Portsmouth • Salford • Sheffield Hallam • Teesside • Ulster • UWE • Westminster • Wolverhampton	• Bath Spa • Bedfordshire • Canterbury • Chester • Derby • East London • Edge Hill • Gloucestershire • Northampton • Roehampton • SOAS • Staffordshire • Sunderland • Worcester	• UC Birmingham • Greater Manchester • Buck's New • Chichester • Cumbria • Falmouth • Leeds Trinity • Liverpool Hope • Uni London • London Met • Newman • Northeastern • St Mary Tw'ham • Solent • Marjon • Suffolk • West London • Winchester • York St John	• Birmingham • Bristol • Cambridge • Exeter • Imperial • King's College • Leeds • Liverpool • Manchester • Newcastle • Nottingham • Oxford • Queen Mary • Queen's Belfast • Sheffield • Southampton • UCL • Warwick	• Bath • Birkbeck • Brunel • City St George's • Durham • East Anglia • Essex • Hull • Keele • Kent • Lancaster • Leicester • LSE • Loughborough • Reading • Royal Holloway • Surrey • Sussex • York

Figure 4 Cluster membership for specialist HEPs

Specialists: STEM *		Specialists: Social sciences & humanities	Specialists: Arts, design & media	
BIO/VET	• Health Sciences • ICR • Liver Trop Med • LSHTM • Royal Vet Coll	• Metanoia Institute • University of Law • UA92 • St Mellitus College • Ecum Theol • Waverley Abbey College • Cliff College • Ldn Theology • Bishop G'teste <i>(manually assigned to cluster M in 2018 & 2023)</i> • L'don Business <i>(manually assigned to cluster V in 2018 & 2023)</i>	• Arts B'mouth • Courtauld • Creative Arts • National Film • Guildhall • LAMDA • Leeds Art • Leeds Conservatoire • Liver Perf Arts • Arts London • Norwich Arts • Plymouth Art • RADA • Ravensbourne • Rose Bruford • Royal Ac Music • Royal Coll Art • Royal Coll Mus • Speech & Drama • RNCM • Trinity Laban	• Cen Sch of Ballet • Nat Cen for Circus Arts • The Place • Rambert School • Northern School of Contemporary Dance • Institute of Art - London • Point Blank Music School • ICMP • Chicken Shed Theatre Company • Academy of Live Technology • ACM Guildford • Escape Studios • ThinkSpace • Central Film School London
ENG	• Cranfield • TEDI London • NMITE			
AGR	• Harper Adams • Hartpury Uni • Royal Agr Coll			

* BIO/VET: biosciences and veterinary sciences; ENG: engineering; AGR: agriculture

5 Moving forward

This report provides recommendations on KE cluster allocations for English HEPs newly eligible for Research England's Higher Education Innovation Funding, and for two Northern Irish HEPs. Many of these HEPs are specialist institutions with an arts, design and media focus or a social science and humanities focus. Four institutions were allocated to one of the five clusters of broad discipline-based HEPs.

The report presents the approach for allocating additional HEPs to existing KE clusters that was developed and implemented for this exercise. For the 24 specialist HEPs requiring cluster allocations, this continues to be based on a set of heuristics aimed at identifying the particular disciplinary niches of these institutions and allocating them to one of three specialist sub-clusters: (1) science and engineering; (2) social sciences and humanities; and (3) arts, design and media. For the four broad discipline-focused institutions, the clusters were selected based on finding the 'closest' KE cluster across the set of variables driving the statistical model. It does this by calculating the squared Euclidean distance between the set of normalised characteristics for the HEP and the average for the KE cluster and selecting the cluster with the smallest distance. In a few instances, the distance of the HEP to two clusters was very similar. In these cases, further checks were undertaken, including comparing the HEP to other HEPs in each of the two clusters, and specific web searches to better understand the institution, to explore similarities with other institutions and ensure the appropriate cluster was selected.

In previous clustering exercises, just two of the specialist HEPs had a social science and humanities focus. The decision was made at the time not to create a specialist sub-cluster with such few institutions, and these HEPs were manually allocated to one of the broad discipline-based clusters. However, with the significant increase in the number of specialist HEPs in this

area (now ten institutions), the creation of a dedicated specialist sub-cluster focused on the social sciences and humanities could be justified. Furthermore, with the number of specialist HEPs (across all areas of focus) rising to 56 (almost one third of the 159 HEPs included in the KE clusters), it may also be time to explore whether there may be other, perhaps more meaningful ways to cluster to these institutions from a KE perspective.

The approach presented in this report could be replicated in future years should additional HEPs need to be allocated to one of the existing clusters before a full re-clustering exercise takes place.

References

- Ulrichsen, T. C. (2018). *Knowledge Exchange Framework Metrics: A Cluster Analysis of Higher Education Institutions* (p. 28).
- Ulrichsen, T. C. (2023). *Knowledge Exchange Clusters of English Higher Education Providers: An Update* [A technical report for Research England].

Annex A – Variables used in KE cluster model

The variables and data used in this exercise replicate the 2023 and 2018 clustering exercises. They were developed to capture characteristics along the three key dimensions of the model:

1. Scale, focus and intensity of existing knowledge base
2. Scale, focus and intensity of knowledge generation
3. Investment in physical assets

Scale and focus of existing knowledge base

Table A.1 Variables within dimension 1: scale and focus of existing knowledge base

Category	Variables	Source
Number of academics by function	- Teaching/research - Teaching only - Research only	HESA
Portfolio of academics by discipline (proportion)	- Clinical medicine - Allied health other medical, and dentistry - Agriculture, forestry and veterinary science - Physical sciences and mathematics - Biological sciences - Engineering and materials science - Computer science - Architecture and planning - Social sciences and law - Business and management studies - Humanities, languages and education - Creative and performing arts, and design	HESA
Educational focus of HEPs	- Student FTEs at undergraduate level (full-time/part-time) - Student FTEs involved in taught postgraduate (full-time/part-time) - Student FTEs involved in research postgraduate (full-time/part-time)	HESA

Scale and focus of knowledge generation

Table A.2 Variables within dimension 2: scale and focus of knowledge generation

Category	Variables	Source
Scale of knowledge generation by domain		
Scale of knowledge generation activity in different knowledge domains	- Recurrent research income (QR) - Research grants and contracts income by STEM, SSB, AH - Research quality by STEM, SSB, AH (number of academic FTEs getting 4* publications in REF2021)	HESA
Scale of knowledge generation of different types	- Research grants and contracts from different sources: - UK research councils - Charities - Government bodies / local authorities, health/hospital authorities	HESA

	Industry	
Scale of international linkages in research	Research grants from overseas	HESA
Intensity of knowledge generation by domain		
Knowledge generation intensity	- Proportion of academic FTEs submitting to REF - Proportion of students undertaking postgraduate research	HESA
Knowledge generation intensity by discipline	- Research grants and contracts income per academic by STEM, SSB, AH - Proportion of researchers generating 4* publications in REF2021 by STEM, SSB, AH	HESA, REF2021
Knowledge generation type intensity	Research grants and contracts income from different sources (RCs, charities, gov't, industry) per academic	HESA
Research internationalisation intensity	Research grants and contracts income from overseas per academic	HESA

Physical assets

Table A.3 Variables within dimension 3: scale and intensity of physical asset investment

Category	Variables	Source
Scale of physical asset investment	Scale of spending on research-related capital infrastructure	HESA
Intensity of physical asset investment	Intensity of research capital spending (spend per academic FTE)	HESA

To replicate the approach used in the previous 2018 and 2023 exercises, the variables were first transformed using the natural logarithm to discriminate HEPs more fully at the lower ends of the distributions of variables where many HEPs are clustered. A principal component analysis (with oblique rotation and kaiser normalisation) was then run on the variables within each dimension to deal with correlations between variables. This process results in standardised components being used in the model. Where only one variable exists on a particular dimension, the variable was standardized to a mean of zero and standard deviation of one. The resulting number of components and the proportion of variance captured are shown in Figure A.1.

Figure A.1 Results of principal component analysis based on logged variables where appropriate

