



# Mapping of Clustering, Partners, and Geographic Distribution of Biotech SME Clusters Across the UK: A Case Study

Kayimolufe Femi-Balogun<sup>1</sup> · Somdutta Ghosh<sup>1</sup> · Andrew Paul Clarke<sup>2</sup> · Natalie Ferry<sup>1</sup>

Received: 22 January 2024 / Accepted: 5 October 2025  
© The Author(s) 2025

## Abstract

The purpose of this paper is to evaluate which universities spin out biotechnology SMEs, and why some do this successfully while others do not. The research question is: *how do institutional, contextual, and geographic factors shape biotechnology spin-out activity among UK universities?* A systematic review was carried out, which examined data from the websites of 26 UK universities in 10 geographic regions and 4 industry bodies. To supplement this review, a questionnaire was used to evaluate the factors which encourage universities to spin out. The results show that biotechnology spin-outs tend to be clustered around certain geographical locations. This clustering activity is not deliberate and exists as a by-product of activity. Interestingly, certain universities with good research backgrounds have been shown to produce little to no biotechnology spin-outs. Six themes were noted as drivers for the creation of biotechnology university spin-outs: increased support from universities; funding opportunities; research excellence framework and knowledge exchange framework metrics and impact; geographical location of universities; revenue and profit; a push on technology transfer and intellectual property. The geographical advantage of being near a biotechnology cluster is clear. However, by building a solid research base with an international reputation, a supportive Technology Transfer Office, education for academic staff in entrepreneurial attributes and behaviours, and engaging with biotechnology accelerators, a university can enhance its spin-out success rate even when that university does not have the benefit of geography and a close regional cluster.

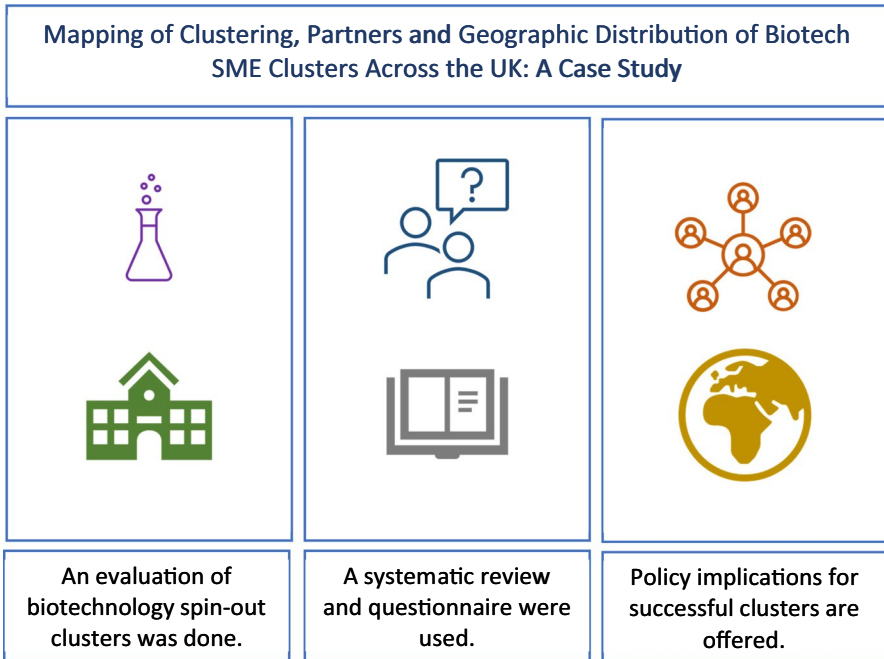
---

✉ Andrew Paul Clarke  
acl Clarke21@lancashire.ac.uk

<sup>1</sup> School of Science, Engineering and Environment, University of Salford, Salford, UK

<sup>2</sup> Business School, University of Lancashire, Preston, UK

## Graphical Abstract



## Highlights

- Biotechnology spin-outs cluster around certain geographical locations
- Clustering activity is not deliberate and exists as a by-product of activity
- Clustering promotes the formation of biotech companies normally within the clusters

**Keywords** Technology transfer · University-industry relations · Biotech clusters · University spin-outs

## Introduction

Case study research was carried out to evaluate the factors which influence the clustering activity of university biotechnology SME spin-out companies in the UK. A systematic review of the UK biotechnology sector using data from industry network websites and business and community data was carried out to identify trends and influencing factors. In addition, a questionnaire focused on exploring the

phenomenon of UK university spin-outs was adopted using open-ended questions to evaluate the experiences of respondents who ranged from technology transfer officers at universities to members of various science/research parks, pharmaceutical companies, and technology clusters across the UK.

Within UK higher education (HE), spin-outs tend in the main to come from science disciplines within universities. Generally, this has created an avenue for HE institutions in terms of commercialising research and securing industry collaborators. Steffensen et al. (2000) noted that spin-outs contribute to both wealth and employment opportunities, which all have benefits to the HE sector and the economy. Moreover, the UK government has designed policies to encourage the commercialisation of research such as Innovate UK, which offers research grants to research-led institutions. In 2017, Innovate UK grants totalled £28.4 M for spin-outs, with the life sciences sector receiving the highest number of grants and funding amounts (Beauhurst, 2025). Research England evaluates research from UK universities and provides funding to encourage the commercialisation of research ideas from HE providers (HEPs) through the Higher Education Innovation Fund (HEIF), Connecting Capability Fund (CCF), and Research England Development (RED) (Research England, 2020).

Spin-outs are a by-product of a parent organisation, arising as an avenue to develop intellectual property (IP) from that organisation (Dottore & Kassicieh, 2014; Richards & Richards, 2009). IP simply refers to the ownership of creations and inventions from ideas, employed for commercial purposes. Therefore, IP is seen as an essential key component for the commercialisation of academic innovations. But IP protection and costing limitations impose threats of piracy on academic spin-out products (Poticha & Duncan, 2019).

In the UK, spin-outs from multiple universities have generated momentum in the economy through their annual turnover of over £1Bn (Beauhurst, 2025), supporting technical commercialisation from universities.

In an analysis of spin-out trends from the University Spin-Outs (USO) database, Ulrichsen (2019) showed that the average university spin-outs generated per year ranged from 150 to 200 between the years 2003 and 2018. Between 2003 and 2018, approximately 3000 IP-focused spin-outs were generated in the UK (Ulrichsen, 2019). However, many universities still abstain from producing spin-out establishments or produce very few. Biotechnology academic spin-outs in particular have a more clustered approach, i.e. the universities that spin out biotechnology SMEs tend to be clustered. The largest biotechnology cluster is found in Cambridge, which produces over 185 biotechnology companies (Biopartner, 2007), followed by London and Oxford, the three forming the “Golden Triangle”.

Understanding university spin-outs will inform university policy to both encourage and discourage supporting spin-outs. While biotechnology clusters can boost the growth of the bioscience industry as they attract various entrepreneurs and investors, they may also be a barrier to smaller universities outside the clusters in producing spin-outs. This case study offers policy implications to university leadership teams in terms of guidance for strategic planning, and to network clusters in terms of future development.

This case study discusses the research excellence framework (REF), and the knowledge exchange framework (KEF). These are two of the British Government's university evaluation frameworks, with the third being the teaching excellence framework (TEF), and together they form the Framework Excellence System. These systems evaluate the quality and impact of academic research (REF), of university performance in knowledge exchange activities (KEF), and of undergraduate teaching and learning (TEF) (Pavlov & Pohrebniuk, 2020).

## Literature Review

Innovation ecosystems consist of interdependent stakeholders, such as universities, government agencies, spin-outs, investors, and support organisations, who operate within a shared network to co-create value and support innovation. Building on economic geography theory (EGT), the innovation ecosystem perspective evaluates relational interdependence, knowledge exchange, and institutional roles, making it useful for examining the mechanisms enabling or hindering spin-out activity (Bathelt & Glückler, 2003). The innovation ecosystem lens allows us to consider how spin-out activity is not only shaped by the internal capabilities of individual institutions, but also by the structure and coherence of the broader system in which these institutions are embedded. The concept of agglomeration economies within EGT highlights how geographic clustering can generate innovation benefits through shared resources, skilled labour markets, and knowledge spillovers (Duranton & Puga, 2004). As such, spin-out success is shaped by things like ecosystem alignment, resource accessibility, and collaborative infrastructure, rather than simply geographic proximity (Autio & Thomas, 2014). Universities are noted to be part of the wider regional and national innovation systems, and are responsible for knowledge generation focusing on early-stage technology developments (Prokop, 2021).

In the UK, university spin-outs are regarded as pivotal to both economic and societal development, with government policies and funding schemes supporting their growth (Lockett & Wright, 2005). The UK is the second-largest biotechnology economy globally and the largest in Europe (Cooke, 2001), with institutional biotech spin-outs forming a foundational part of its innovation landscape.

The Centre for Business Research of the University of Cambridge defines University Spin-outs (USOs) as, "*Spin-outs from universities are usually thought of as new firms commercialising a proprietary leading-edge technology from a university department and backed by venture capital*" (Druilhe & Garnsey, 2004 p.3). These UK HE institutes have the "magic wand" for both regional economic and social development. They can conduct research and design it accordingly for the commercial purpose of the public (Baines & Smith, 2019). For this reason, the UK Government favours making investments towards academic spin-outs (Lockett & Wright, 2005). After the USA, the UK is the second-largest biotechnology economy in the world and the largest in Europe (Cooke, 2001). Interestingly, in the UK, institutional biotech spin-outs are considered one of the national components of the economic skeletal structure (Cooke, 2001).

**Table 1** REF and research income of UK top universities

University	Research income	Ref results
University of Oxford	£769.2 M (2018–2019)	93%
University of Cambridge	£525 M (2017–2018)	87%
University College of London	£476 M (2017–2018)	82%
University of Edinburgh	£294 M (2017–2018)	91%
University of Dundee	£144 M (2019–2020)	94%
University of Glasgow	£257.88 M (2019)	79%
University of Aberdeen	£258.39 M (2019–2020)	83%

Retrieved from each university's official website (2021)

**Table 2** RDA of top five clusters in the UK

Region	RDA
Cambridge	East of England Development Agency
London	London Development Agency
Oxford	South East England Development Agency
Scotland	Scottish Enterprise
North West	Northwest Regional Development Agency

University spin-outs are noted to positively contribute to the competitive advantage of the region they are in Corsi and Prencipe (2018). The spin-out process is only successful if both the university and associated company have an understanding between them about their missions and values (Baines & Smith, 2019). Some of the UK geographical locations, such as Oxford, Cambridge, Glasgow, Dundee, Edinburgh, and Aberdeen, display denser clusters of biotechnology firms compared to regions like Surrey, Cardiff, and Swansea (Cooke, 2001). The three regions of Oxford, Cambridge, and Scotland were noted to be home to over a third of all the UK biotech industry (Smith & Romeo, 2016). Interestingly, Glasgow, Dundee, and Edinburgh are together termed the “Biotechnology Triangle” for the high volume of biotech clusters in that zone (Cooke, 2001). Table 1 below provides the research income and research excellence framework (REF, 2014) results of the specified universities.

These universities have both academic research excellence and high REF results, thereby allowing them to produce more spin-outs compared to other universities (Hendry & Brown 2006; Mueller et al., 2012). Additionally, the universities have access to financial services and innovative business models through established Research and Development Agencies (RDAs). Table 2 below lists the RDAs across the UK (Biopartner, 2007):

The UK university spin-out sector receives secondary support from certain biotechnology industry multipliers (Biopartner, 2007). Some of these multipliers include ERBI in Cambridge, London Biotechnology Network in London, South Healthcare Technology Alliance in Oxford, Nexxus in Scotland, and BioDundee and Edinburgh BioAlliance in Scotland (Biopartner, 2007). A hub for industrial

biotechnology was established in the northwest of England in 2023; the Industrial Biotechnology Innovation Cluster is an EPSRC investment and a collaboration of universities and industry in the region. Various factors have been highlighted in research papers that act as a hindrance to spin-out generation despite the tools available for success (Druilhe & Garnsey, 2004; Lockett & Wright, 2005). As biotechnology USOs require lump-sum capital funding, sometimes the USOs fail to generate significant profit from their launched product. Thus, this creates difficulty in convincing funders to invest at the initial stage of any bioscience project. Additionally, USOs can struggle to find resources such as staff or logistics due to their remote geographical locations (Lockett & Wright, 2005).

In universities, technology transfer offices (TTOs) are important in the generation of spin-outs (Djokovic & Souitaris, 2008; Dottore & Kassicieh, 2014; Rasmussen et al., 2014; Thursby et al., 2001), but surprisingly these TTOs can sometimes hinder the establishment of USOs. University TTOs are mostly non-profit bodies that transform academic innovations into their commercialisation (Russell Group, 2022). The functions of TTOs include facilitating university-industry collaboration, ensuring knowledge transfer to industry and society, commercialising university IP, and providing services of consultation and analytical testing (Russell Group, 2022). Failing to accomplish or implement any or some of these can lead to delays in the establishment of USOs. In addition, the lack of entrepreneurship skills and the cost of procuring IP by the spin-outs independently are factors that obstruct spin-out development (Druilhe & Garnsey, 2004).

In the latest published collaborative data from Beauhurst and the Royal Academy of Engineering (RAE), it was demonstrated that since 2020, when the COVID-19 pandemic worst affected the globe, there were a record number of 231 grants awarded exclusively towards pharmaceutical, medical technology, and clinical diagnostics spin-outs to upgrade the UK's healthcare and research infrastructure. These grants aimed to accelerate the establishment of new spin-outs along with the maintenance of existing ones (Newlands, 2021).

## Methodology

The case study focused on levels of research investment and any effects of clustering in geographical regions in the UK.

## Systematic Review

To map the activity of clusters in the UK biotechnology industry, a systematic review of the UK biotechnology sector was employed using citation analysis and the bibliometric method (Deveci, 2022; Zupic & Cater, 2015). This includes academic institutions, geography, and industry bodies, and uses quantitative data to evaluate spin-out activity and track technology transfer. The scope and boundaries of the review were based on geographic regions in the UK, with purposive sampling to identify the academic institutions and industry bodies. Key terms established

the boundary conditions: biotechnology, UK institution, spin-out active. To guide the systematic review, carefully selected search terms were developed to reflect the study's core themes. These included combinations of keywords such as biotechnologyclustering, UK institution, UK University spin-out, spin-out active, and tech transfer. These terms were chosen to capture literature and data sources relevant to the commercialisation of academic research through biotechnology spin-outs within the UK context. Boolean operators and phrase searching were used where appropriate to refine the results and ensure relevance.

The systematic literature review drew on data from academic literature databases and approved business and institutional sources, including HESA, HE-BCI, MINTEL, FAME, HEIF, BioNow, and IN-PART, covering the period from 2010 to 2023, and focusing on variables such as university affiliation, spin-out activity, biotechnology focus, regional clustering, and technology transfer performance.

The inclusion criteria for this review were designed to identify literature and data that specifically focused on UK-based biotechnology spin-outs, with an emphasis on institutional involvement, regional clustering, and the role of higher education in commercialisation. Only sources published in English between 2010 and 2023 were considered, ensuring that the data reflected contemporary trends and policy contexts. Academic journal articles, policy reports, institutional white papers, and databases containing empirical data on UK spin-outs were included.

Conversely, sources were excluded if they were not directly related to biotechnology or if they examined spin-outs outside of the UK, as these would not contribute to the research aim of exploring the UK's innovation ecosystem. Editorial opinion pieces and articles lacking empirical grounding were also excluded to maintain academic rigour and focus. This approach enabled a consistent and transparent review process, ensuring that the literature selected was both thematically relevant and methodologically sound.

These boundaries then allowed a transparent process of analysis. Qualitative analysis using published literature that addresses the topic being investigated, approved business databases (HE Business and Community/HESA, MINTEL, FAME, HEIF), and official websites (Bionow and IN-PART) was evaluated. Reviewing a wide range of secondary data from other researchers allows for the identification of any potential trends on a larger scale, spanning a longer timescale and location.

## **Questionnaire**

A questionnaire focused on exploring the phenomenon of UK university spin-outs was used. The questionnaire was designed to fit the research conducted, while following the guide provided by Malterud et al. (2016) on the sample size required. Using retrospective interview methods (Côté et al., 2005), the questions for the interview were structured around the following research question: how do institutional, contextual, and geographic factors shape biotechnology spin-out activity among UK universities? Using the questionnaire created, an interview was carried out, and an online survey was created and circulated in English to UK academic institutions and industry bodies (20) via email, accompanied by

a participant information sheet (PIS), noting that participation was voluntary. The questionnaire was developed for this purpose and disseminated using a JISC online survey tool (Joint Information Systems Committee) over a two-week period. Consent was obtained at the start of the questionnaire, and participants were informed they could withdraw at any point by closing the questionnaire. Data collected was fully anonymised in the process.

The response rate yielded a population size of  $n = 6/20$ , or 30%. While noting the response size, this aligns with typical response rates for purposive expert sampling in qualitative research (Malterud et al., 2016). Potential non-response bias is noted, however, the targeted nature of the sample and the expertise of respondents—ranging from TTO professionals to industry representatives—provide valuable insights.

Purposive sampling was used, as the participants in this survey were chosen based on their link to or knowledge of the commercialisation of scientific research and the formation of spin-outs from universities. The respondents ranged from technology transfer officers at universities to members of various science/research parks, pharmaceutical companies, and tech clusters across the UK.

The questionnaire used open-ended questions. The selection of participants was based on previously known data using purposive criterion sampling, as the sector experience in the sample population is relevant. All respondents were working in UK academic institutions, UK academic technology transfer offices, biotechnology industry trade bodies, or in UK-based biotechnology SMEs. Respondents were anonymous and therefore did not impose any bias. The data from this survey provide a broader scope of the biotechnology university spin-outs in the UK. The questionnaire is as follows:

- *How would you define university spin-outs (USOs)?*
- *Advances in bioscience and biotechnology have led to an increasing creation of spin-outs. Why is there a push for UK universities to develop spin-outs?*
- *Why do some UK higher research institutes have the dilemma of capital investment in the establishment of biotech USOs?*
- *Are you associated with a university that has produced any biotech USOs?*
- *Does this reflect research investment at the university level?*
- *In your opinion, is there a clustering of UK biotech USOs at certain geographical locations in the UK?*
- *If yes, then what do you think is/are the reason(s) behind the formation of these clusters?*
- *Does the Biotechnology Triangle in the UK exist, in your opinion, in terms of Biotech USOs?*
- *Are you aware of the percentage of the conversion rate of university research to commercial product in the UK?*
  - *Is that a satisfactory percentage in your opinion?*
  - *If not, in what ways can we level up the success scale rate?*

## Results

The first set of analyses examined the generation of biotechnology spin-outs from UK universities. Using the systematic literature review performed for this case study, the universities which generated the greatest number of biotechnology spin-outs were extracted. The data was compiled by looking at the regions these universities originate from to better understand their clustering activity. Table 3 shows the biotechnology university spin-out geography in the UK, aggregated into the regions, an approximate number of biotechnology spin-outs generated, and the universities in these regions that produce the spin-outs.

There is an obvious clustering of activity in the South East of England, comprising universities located in Cambridge, London, and Oxford. Additionally, other upcoming micro-scale clusters are observed in regions including Scotland, Northern Ireland, and the Midlands of England. There is a concentration on therapeutics

**Table 3** Biotechnology spin-outs generated in different UK regions

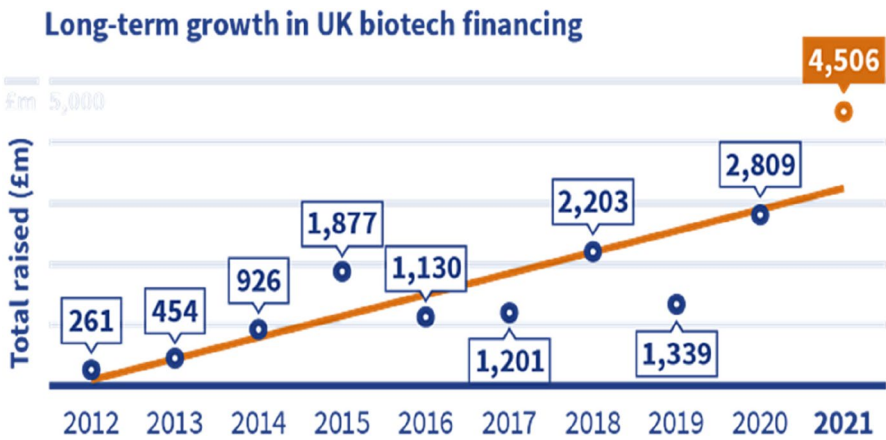
Region	Approximate no. of biotech spin-outs	Universities in the regions	Category of biotech spinout
Oxford	~ 75	University of Oxford	Therapeutics, diagnostics, and others
Cambridge	~ 60	University of Cambridge	Therapeutics, diagnostics, and others
London	~ 60	UCL Kings College London Imperial College London	Therapeutics, diagnostics, and others
Midlands	39	University of Nottingham University of Birmingham Coventry University University of Staffordshire University of Warwick Newcastle University	Therapeutics, diagnostics, R&D, and others
Scotland	39	University of Glasgow University of Aberdeen University of Edinburgh University of Dundee University of Strathclyde	Therapeutics, diagnostics, and others
Northern Ireland	19	Queen University of Belfast Ulster university	Diagnostics, therapeutics, and others
Yorkshire	17	University of Leeds University of York	Therapeutics, diagnostics, and others
Wales	11	Cardiff University Swansea University	Therapeutics, diagnostics, and others
Southwest	10	University of Bristol	Diagnostics and others
Northwest	7	University of Manchester MMU Lancaster university	Therapeutics, diagnostics, and cell culture

Data collated from different university official websites and Biopartner (2007)

**Table 4** Comparison of spin-outs from universities by HEP type using HE-BCI database data

HEI category	No. of USO formed	Percentage (%) of USO by HEI type
Largest 6 research universities	677	17
Other research focused universities	1207	30
Medium research-focused universities	632	16
Smaller research-focused universities	1181	29
Specialist STEM universities	111	3
Art, social science, and other universities	244	6

Retrieved from Ulrichsen (2019) analysis of HE-BCI surveys



**Fig. 1** Long-term funds raised in the UK Biotechnology sector (<https://www.bioindustry.org/policy/finance-tax-and-investment/finance-report-2021.html>)

and diagnostic spin-out companies leading the category of biotechnology spin-outs produced. Based on this table, the majority of the universities listed are research-oriented; the type of university (either teaching-led or research-led) was analysed to see how this impacts their generation of spin-outs. Table 4 shows the distinction between the university type and the category of biotechnology spin-outs produced. This was carried out using the analysis performed by Ulrichsen (2019) in conjunction with data in Table 3.

Out of all the spin-outs generated in these universities, there is a focus on the Biotechnology and pharmaceutical industries. As shown in Fig. 1, there has been a steady increase in funding and investment in the Biotechnology sector in the past decade.

Figure 1 shows the funding raised by approximately 17.3 times between 2012 and 2021, and the investment doubled in 2020/2021 compared to 2019/2020. The 2021 review report from DDW evaluated GovGrant's university spin-outs and stated that in the last decade, the net worth valuation of the top 10 UK USOs is estimated to be

approximately £4.08 billion, of which more than £3.14 billion (~70%) accounted for the combined valuation of biotechnology and pharma USOs. A further breakdown of the GovGrant (2021) report projected that in the last two decades, about £2.6 billion and £1.2 billion were raised by pharma and biotechnology UK USOs, respectively.

## Websites and Database Analysis

The commercialisation of research is one mechanism for academics to increase impact (Perkmann et al., 2013). Various platforms that provide a link between companies and universities for the commercialisation of research were analysed. These platforms act as key multipliers and provide support to universities that want to spin out, creating an avenue to encourage research commercialisation. This provided information on what these platforms do, how they achieve their aims, and the universities they partner with.

### IN-PART

This is a platform that serves as an intermediary between academia and industry, using in-house algorithms. Launched in 2014, this platform has reportedly facilitated over 4000 discussions between universities and their available lists of industry professionals. IN-PART follows a two-step procedure to achieve its aims, as shown in Table 5.

IN-PART is partnered with multiple universities both within and outside the UK. Some of these universities include the University of Leicester, University of Nottingham, University of Cambridge, University of Birmingham, University of Manchester, University of Oxford, Queen's University Belfast, and the University of Exeter.

### Bionow

Bionow supports the biomedical, pharma, and life sciences sectors across the North of England. It functions to support business growth, competitiveness, and innovation within the life sciences sector. This platform possesses its own advisory board that suggests strategies and guidance to the organisation for better quality and sustainable communication among young entrepreneurs and Bionow-partnered universities and funders. Table 6 shows a list of universities partnered with this company and certain sponsors in the bioscience field.

**HESA** The Higher Education Statistics Agency (HESA) collects and assimilates data about higher education in the UK. For the academic year 2020–2021, HESA data show the spinout activity under the metric of the number of active firms, with a focus on the spin-outs generated with HEP ownership, as represented below.

Table 7 represents the number of spinout companies based on universities' IP, the turnover and employment of university spin-outs, and the spin-outs that are

**Table 5** Working process and output of IN-PART

Procedure	What is it	How does it work	Activity
IN-PART	A platform for university-industry collaboration	By creating an account, universities and organisations gain access to R&D decision-makers and academics all over the globe	Over 250 universities and research industries are on IN-PART
Discover	Custom-made scouting service	R&D teams can use the network to identify new opportunities for commercialisation or request proposals for new research	R&D teams have access to over 1200 universities and research institutes spanning 6 continents

Retrieved from the IN-PART's official website, [2021](#)

**Table 6** Partner universities and sponsors of Bionow

Affiliated universities	Sponsors
Durham University	BioPartner
Newcastle University	Alderley Park
The University of Manchester	Bruntwood SciTech
University of Liverpool	Bio2Business Ltd
Keele University	Manchester Science Partnerships
University of Leeds	AstraZeneca
Lancaster University	Thermo Fisher Scientific Inc

Retrieved from Bionow's official website, 2021

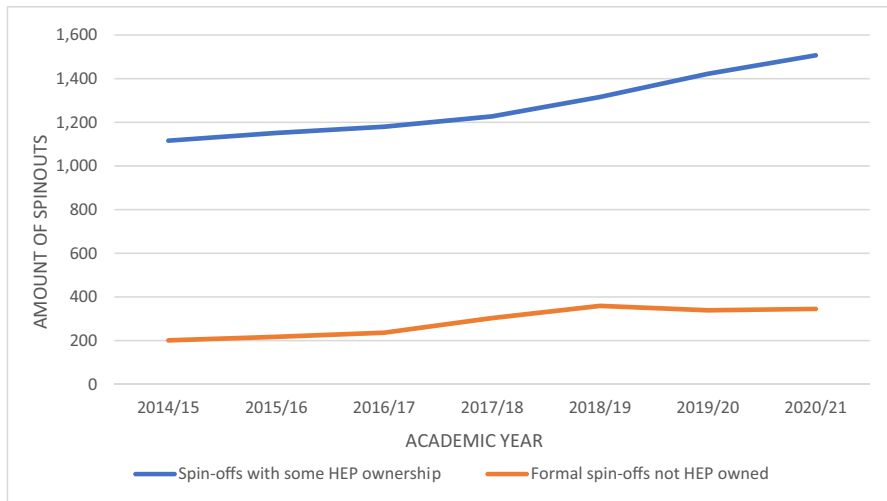
**Table 7** Top 10 universities generating spin-outs in the UK

HE provider	Spin-outs with some HEP ownership	Formal spin-offs, not HEP owned
The University of Oxford	168	0
The University of Cambridge	130	52
Imperial College of Science, Technology and Medicine	79	13
University College London	79	0
The University of Manchester	62	13
The University of Bristol	60	24
The University of Edinburgh	42	0
Royal College of Art	41	2
Queen's University Belfast	38	15
The University of Glasgow	35	6

Data retrieved from HESA database, 2022

still active in the chosen academic year. Spin-outs with higher education provider (HEP) ownership are those companies formed from universities' IP and where the HEP still has some degree of ownership. In formal spin-outs, the HE provider has relinquished ownership through the sale of shares or IP; spin-outs with HEP ownership are more predominant among these universities. However, while this database provided information about spin-outs from IP, retrieving data about biotechnology spin-outs specifically was not achieved. This data was therefore compared to the initial analysis (Table 4) to show any potential relationships.

Figure 2 shows the number of active firms within the UK within 7 years. While there is an increase over the years in the number of spin-outs generated, the increase is not a significant rise, and it stays within a close range of values. However, it is worth noting that the number of spin-outs with HEP ownership has been on a consistent increase since the 2017–2018 academic year.



**Fig. 2** Spinout companies and activity from the 2014/2015 academic year to 2020/2021 (retrieved from HESA database, 2022)

## HEIF Data

The contribution of higher education to the economy and society through research is regulated through knowledge exchange. The Biotechnology and Biological Sciences Research Council (BBSRC) research funder considers multiple drivers and opportunities to optimise benefits to the economy (Chaix et al., 2019). Some spinouts utilise their IP from investments by the BBSRC (specifically in the bioscience sector), which are available to a wide range of universities. Support and funding are generally achieved via the Higher Education Innovation Fund (HEIF) from Research England (part of UKRI). On average, about 16% of the HEIF funding allocated to universities is invested in spinout generation and licensing (Research England, 2020). In allocating this fund for the 2020–2021 session, three major data sources were used, as shown in Table 8.

**Table 8** Data sources for HEIF 2020/2021

Indicator	Sources of data
Income from contract research, consultancy, facilities and equipment, regeneration, and intellectual property	HESA Higher Education–Business and Community Interaction (HE-BCI) survey
Income from knowledge transfer partnerships (KTPs)	Innovate UK
Income from non-credit bearing course fees	HESA finance record and Office for Students annual financial return

Data retrieved from Research England (2022)



An analysis of the questionnaire provides a broader scope of biotechnology university spin-outs in the UK. Using frequency tallies and thematic analysis (Braun & Clarke, 2006), six major themes were extrapolated from the survey questionnaire:

- Increased support from universities
- Funding opportunities
- REF and KEF metric and impact
- Geographical location of universities
- Revenue and profit
- Push on tech transfer IP

### **Increased Support from Universities**

A major theme that came up when exploring Biotechnology spinout formation in the UK was the effect that university support plays. Spin-outs have multiple advantages such as the creation of jobs and opportunities, the improvement of science and innovations, and the enhancement of the economy. Specifically, 40% of respondents highlighted that the support provided within universities greatly impacts the production of USOs.

Additionally, 40% of participants also noted that increased support from universities can help level up the conversion matrix of university research to commercial products in the UK. As earlier noted, support from universities greatly encourages spinout formation, and it is notable in universities within the Golden Triangle. By offering training sessions on business and commercialisation skills, building leadership, and providing expert networks, the success rate of Biotech spin-outs greatly increases (Clarke et al., 2020). Interestingly, one respondent noted that the support is not only within each university but can spread to other universities as well. A levelling-up agenda can be achieved with leading universities that have access to better circular capital, connections and networks, and public investment, by diversifying these resources to upcoming and neighbouring institutes.

### **Funding and Investment Opportunities**

Overall, 40% of respondents noted that government and other private funders contribute to spinout formation to mitigate restricted industry funding. The UK government's ambition is to promote policies and investments that generate research, close the industrial R&D market gap, and contribute to the rise in the GDP percentage for research to 2.4%. These metrics highlight how funding opportunities from different avenues, especially the government, can contribute to the push for spinout formation in the biotechnology sector.

This theme is also observed when participants were asked about the dilemma of capital investment in the establishment of Biotech USOs, and if the presence of these USOs reflects research investment at the university level. Almost two-thirds of the participants (64%) answered positively reporting that there was a correlation between the two. One participant attributed a significant part of spinout success to

funding from agencies such as BBSRC and MHRC through the UK government. Another also highlighted schemes such as angel investment which universities organise, showing the relation between both university support and funding opportunities to spinout success. 60% of respondents opine that universities with a strong track record in research tend to attract more funding for research. Access to these funding opportunities coupled with multiple other factors contribute to more USOs generation as is evident with the Golden Triangle.

### **REF and KEF Metric and Impact**

A total of 30% of participants highlighted that the return metrics and impact of both REF and KEF serve as a significant deciding factor in the push for USO generation. The impact of REF and research income on spinout generation has previously been highlighted, where the universities with high REF results tend to produce more spin-outs as they have a solid research background. In addition to this, one participant noted the relationship between REF and the lack of capital investment for some universities to generate spin-outs. As the primary function of a university is education, some universities may be reluctant to venture into and invest in spin-outs, opting to focus on and gain their revenue from education primarily. This is reflected by the teaching excellence framework (TEF) and tends to be a major focus for some universities. The universities may in turn have lower REF results, which can be a reason why they produce fewer spin-outs, as they may struggle to generate investments and attract funding.

### **Geographical Location**

This theme is generally observed when evaluating the formation of different clusters, i.e. the Golden Triangle and Biotechnology Triangle. Out of all participants, 85% explained that the geographical location of universities contributes to Biotech USOs generation, concurring with Heredero et al. (2022). Universities that are geographically located around legacy infrastructure from R&D investment, within the Golden Triangle, close to science parks, and local infrastructures tend to produce more Biotech spin-outs and contribute to the clustering activity observed with USOs. Similarly, 70% of participants confirmed the existence of the Biotechnology Triangle, with one participant in particular noting that this cluster formation seems to be more accidental than strategic. A key trend that is observed from the cluster formation is that it emerges in geographical locations where universities can co-associate with hospitals.

### **Revenue and Profit**

A total of 60% of respondents noted that the generation of revenue and profit shares serves as a motivational factor for universities to encourage more spinout generation. Specifically, two respondents noted that within the HEP, the biotechnology sector is

high-risk, which may prevent many universities from venturing into it, however, it has a potentially higher reward compared to other sectors.

## Discussion

### Type of University: Research or Teaching-Led?

There is a clear relationship between the type of university and its generation of spin-outs. Ulrichsen (2019) showed that the conversion of UK universities' research for commercial gain is greatly influenced by the research ability of the university. The research income and research excellence framework (REF) of certain top universities in Table 1 were shown. These universities are also found to have the highest turnover results for spinning out SMEs in all regions (Rothaermel et al., 2007), and specifically in the biotechnology sector. As highlighted from the interviews conducted, a strong research track record increases the REF of these universities. This generates a subsequent increase in government resources provided, as it attracts investments. In addition to their research capacity, these research universities have built relationships with clinical communities and R&D centres in their location, which contributes to the positive effect on spinout generation and its performance (Walter et al., 2006).

The universities within the Golden Triangle are the Universities of Cambridge, Oxford, and Imperial College London, with Glasgow, Dundee, and Edinburgh forming the Biotechnology Triangle; these universities are mostly research-focused (Table 4). This shows the potential impact of the type of university on producing spin-outs. More research-based universities generate a higher number of spinout SMEs from research and have access to better funding. This has been previously noted by Nicolaou and Birley (2003) in their work developing a trichotomous categorisation of university spin-outs.

There is a notable disparity in the rate of spinout generation between universities located within the Golden Triangle and those outside major innovation clusters. As highlighted earlier, institutions such as Oxford, Cambridge, and Imperial College London benefit from a combination of factors that support the creation of spin-outs. These include access to significant research income, high REF scores, and well-established partnerships with clinical communities and R&D centres. Furthermore, their location within densely networked innovation ecosystems contributes to improved access to investors, incubators, and sector-specific industry bodies. This ecosystemic advantage allows these universities to consistently outperform others in terms of spinout productivity, particularly in the biotechnology sector.

In contrast, universities located outside these clusters, including institutions such as Leicester, Manchester Metropolitan University (MMU), Aberystwyth, and Nottingham Trent, have been shown to produce fewer biotechnology spin-outs. Despite having the potential to engage in spinout activity, these institutions may lack the entrepreneurial orientation, infrastructure, or geographic advantages necessary to sustain a strong pipeline of spin-outs. As suggested by Adamides and Karfaki

(2022), the variance in venture performance may reflect differing levels of entrepreneurial engagement across academic staff and institutional leadership.

Interestingly, while a positive correlation exists between high REF performance and spinout generation, this is not always consistent. Some high-REF universities still produce fewer spin-outs than expected. This can be attributed to several factors. Firstly, the research strengths of some institutions may lie in disciplines where commercialisation opportunities are less direct, such as the humanities or theoretical sciences. Secondly, even within research-led institutions, the presence of an entrepreneurial culture is not guaranteed. In cases where the TTO lacks capacity, experience, or strategic focus, even high-quality research may not result in successful spinout ventures (Lockett & Wright, 2005; Powers & McDougall, 2005).

Furthermore, the presence of entrepreneurial academics plays a vital role. As noted by Rasmussen et al. (2014) and Panagopoulos et al. (2019), spinout performance is influenced by the engagement of individuals with the motivation and capability to commercialise research. Without this academic drive, the potential for converting research into viable commercial products may be diminished, regardless of institutional metrics.

Ulrichsen (2019) in a study of spinout phenomena in the UK showed that over half of the spinout companies produced from UK universities are from research-oriented universities. The volume of spinout companies produced from UK universities is categorised based on the university type (Table 4). The universities in the top six each individually produce more spin-outs than the other universities. This data is further corroborated by the survey carried out, where some respondents noted that more government resources are available to universities with higher REF scores, which translates into more research at the Universities. This will in turn attract investment from multiple other sources, all contributing to the clustering activity. Overall, the analysis suggests that while high REF scores and research capacity are important, they do not singularly determine spinout productivity. The broader ecosystem, institutional orientation, and internal infrastructure all play a crucial role in supporting or limiting spinout activity across the UK university sector.

The relationship between university type, geographic location, and spinout performance can be viewed through the lens of Economic Geography Theory (EGT), which examines how spatial and institutional dynamics shape economic activity. Universities located within established innovation hubs benefit from agglomeration economies, where geographic clustering leads to advantages such as shared infrastructure, access to skilled labour, and knowledge spillovers (Duranton & Puga, 2004; Glaeser & Gottlieb, 2009). These clustered environments form the foundation for innovation ecosystems, networks of interdependent stakeholders, including universities, investors, incubators, and R&D partners, that collaborate to co-create value and support commercialisation (Autio & Thomas.). While research excellence and high REF scores are important, this case study shows that spinout success also depends on a university's embeddedness within such ecosystems, as well as the strength of its internal support structures like TTOs and academic entrepreneurial culture. As such, EGT not only explains the clustering of spinout activity but also highlights how spatial and relational factors together shape the uneven distribution of innovation capacity across the UK university sector.

## Conversion of Research to Spinout Companies

UK universities between 2003 and 2018 have produced approximately 3000 IP spinout companies (Ulrichsen, 2019), and there has also been an increase in spinout investments from both private and public sources since the early 2012s. This implies that as long as there is a need for research and the potential for positive results, spin-outs will be generated.

The current system of spinout generation has thus far been successful in producing spin-outs from UK universities. Technology incubators such as Bionow (Table 6) and technology transfer offices in various universities have been shown to positively affect the rate of spinning out university research, aligning with Djokovic and Souitaris (2008) and Dottore and Kassicieh (2014). While the results on their effectiveness are inconclusive, analysis in this case study has shown that universities that have partnered with these industry multipliers in the biotechnology sector are more successful in generating spin-outs. Spinout activity is greatly influenced by the effectiveness and experience of a University TTOs (Lockett & Wright, 2005; Powers & McDougall, 2005).

## Spin-outs from Universities Outside Clusters

Universities such as Leicester, Manchester Metropolitan University (MMU), Aberystwyth University, and Nottingham Trent are shown to have one or fewer biotechnology spin-outs in their business innovation sectors. From the interviews and survey conducted, some respondents opined that this could be the university's choice to focus on teaching. Most universities might have the opportunity to produce spin-outs but instead opt to focus on education and not entrepreneurial actions (Adamides & Karfaki, 2022); a significant variance in new venture performance is noted among academics with enhanced entrepreneurial attributes (Rasmussen et al., 2014; Panagopoulos et al., 2019).

## Conclusion and Policy Implications

An enhanced understanding of the success factors of university spin-outs is undoubtedly of interest to UK academia who wish to push metrics in the REF and KEF, particularly for funding policymakers and senior management within UK universities.

In generating spin-outs, various factors can be taken into consideration to ensure they are successful:

- **A solid technology transfer office:** The importance and impact of the TTO has been highlighted. This shows the need for more universities to invest in their TTO, which can have a positive impact on their ability to commercialise their research. Research-intensive universities may already have structured TTOs in

place, but teaching-led or non-cluster institutions should prioritise investment in their TTO capability to increase their potential for commercialising research.

- **Building partnerships with the clinical community:** Some universities have the privilege of being located close to clinical or research facilities. When not presented with this, universities can try to form partnerships within their geographical area that can help generate more biotechnology spin-outs. Non-cluster universities can still generate successful spin-outs by forming strategic partnerships with local NHS Trusts, innovation districts, science parks, or regional R&D centres, for example.
- **Enhancing academic research:** Universities that are highly successful in establishing spin-outs also have a strong research background. The research background of the university helps to analyse the impact and sustainability of the project at an initial level. For universities with developing research profiles, enhancing institutional support for applied and interdisciplinary research can contribute significantly to spinout potential. This includes pursuing grants, building research leadership, and integrating impact pathways from the start of the research process.
- **Conducting entrepreneurship training programmes:** Entrepreneurial attributes enhance the leadership and administrative business skills of bioscience graduates or researchers, which leads to a greater understanding of a commercial context. Teaching-focused institutions can particularly benefit from embedding entrepreneurship education across postgraduate and professional development programmes. Equipping staff and students with commercial awareness and new venture creation skills can stimulate a pipeline of spinout ideas even in environments without a history of spin-outs.
- **Collaborating with your own generated spin-outs:** This will benefit the university in two ways: firstly, commercial profit, and secondly, this initiative can inspire young biotech entrepreneurial minds. For research-led universities with existing spin-outs, maintaining relationships with those companies can bring dual benefits: continued commercial profit and an inspiring culture of enterprise that encourages future entrepreneurial activity.
- **Recognising and addressing the trade-offs of clustering:** While clusters offer advantages such as shared infrastructure, proximity to funders, and dense networks of innovation stakeholders, they can also reinforce regional inequality and make it harder for non-cluster universities to access the same opportunities. Policy responses and institutional strategies should therefore focus not only on replicating the benefits of clustering, but also on redistributing resources and building inclusive innovation ecosystems that support diverse types of institutions across the UK.

This case study was undertaken to understand the phenomenon of biotechnology spin-out clusters in UK universities and evaluate how this affects, both positively and negatively, the UK economy. One of the more significant findings to emerge from this study is that the existence of biotechnology spinout clusters can be considered a double-edged sword. There is strength in developing these spinout SMEs at specific locations, which can promote and attract various

innovators and investors. However, these clusters can also pose a hindrance to other universities outside them. Various funding schemes available have been shown to provide investment to eligible universities in spinout generation, which mitigates the problem of funding. This work contributes to existing knowledge of Biotechnology spin-outs by providing additional evidence concerning the clustering activity of these spin-outs within UK universities. Although the study has successfully demonstrated that biotechnology clusters exist, highlighting the drivers for them and how they translate to the economy, it has certain limitations. This study did not include the analysis of certain databases like MINTEL, HEIF, and FAME due to a lack of access, which lessened the quantity of data retrieved. A natural progression of this work would be a thorough analysis of the phenomenon of certain top universities not generating a large number of biotechnology spin-outs.

The geographical advantage of being near a biotechnology cluster is clear in terms of the success of university spinout companies. However, by building a solid research base with an international reputation, with the addition of a supportive Technology Transfer Office, and combining education for academic staff in entrepreneurial attributes and behaviours, a university can enhance its spinout success rate even when that university does not have the benefit of geography and a close regional cluster.

## Limitations

It is important to note that some limitations may have affected the findings in this study. The relatively low response rate to the questionnaire (30%) could mean the range of views collected was limited. Also, some useful information, such as details about funding or the success of specific spin-outs, was not publicly available or could not be accessed due to confidentiality policies in institutions. These access issues may have made it harder to fully understand the differences in spinout activity across all UK universities. Even so, the data that was collected still provides useful insights into the overall trends and patterns in the biotechnology spinout sector.

**Author Contribution** Kayimolufe Femi-Balogun and Somdutta Ghosh share first authorship. All authors contributed to the study conception and design. Material preparation, data collection, and analysis were performed by Kayimolufe Femi-Balogun and Somdutta Ghosh. The first draft of the manuscript was written by Kayimolufe Femi-Balogun and Somdutta Ghosh, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

**Data Availability** Not applicable.

## Declarations

**Ethics Approval and Consent to Participate** Not applicable.

**Competing interests** The authors declare no competing interests.

**Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

## References

- Adamides, E. D., & Karfaki, E. (2022). Transitional practices in the pre-start-up phase of academic spin-off creation: An explanatory case study. *International Journal of Entrepreneurship and Innovation Management*, 26(1/2), 1. <https://doi.org/10.1504/ijeim.2022.120878>
- Autio, E., & Thomas, L. D. W. (2014). *Innovation ecosystems: Implications for Innovation management*. The Oxford handbook of innovation management.
- Baines, N., & Smith, H. L. (2019). Key driving factors for product and service innovations in UK university spin-offs. *Industry and Higher Education*, 33(3), 161–171. <https://doi.org/10.1177/0950422219825579>
- Bathelt, H., & Glückler, J. (2003). Toward a relational economic geography. *Journal of Economic Geography*, 3(2), 117–144. <https://doi.org/10.1093/jeg/3.2.117>
- Beauhurst. (2025). Spotlight on spinouts. Retrieved from <https://www.spinoutsuk.co.uk>. Accessed 16 Jan 2024.
- Bionow. (2021). Enabling the potential of business. Retrieved from <https://bionow.co.uk/>. Accessed 16 Jan 2024.
- Biopartner. (2007) Biotechnology clusters: Supporting the UK as Europe's no 1 in Bioscience. (2007). *Life Science Clusters*, 1(1), 36–38. <https://doi.org/10.1023/A:1011193531172>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. <https://doi.org/10.1191/1478088706qp063oa>
- Chaix, A., Harrison, C., Jones, G., Sundquist, J., Purvis, J., Hughes, M., Hendry, D., & Harris, J. (2019). The making of bioscience spinout companies in the UK. Retrieved from <https://www.spinoutsuk.co.uk/>. Accessed 16 Jan 2024.
- Clarke, A., Cornes, C., & Ferry, N. (2020). The use of self-reflection for enhanced enterprise education: A case study. *Education + Training*, 62(5), 581–598. <https://doi.org/10.1108/ET-03-2019-0050>
- Cooke, P. (2001). Biotechnology clusters in the UK: Lessons from localisation in the commercialisation of science. *Small Business Economics*, 17(1), 43–59. <https://doi.org/10.1023/A:1011193531172>
- Corsi, C., & Prencipe, A. (2018). The contribution of university spin-offs to the competitive advantage of regions. *Journal of the Knowledge Economy*, 9(2), 473–499. <https://doi.org/10.1007/s13132-017-0501-1>
- Côté, J., Ericsson, K. A., & Law, M. P. (2005). Tracing the development of athletes using retrospective interview methods: A proposed interview and validation procedure for reported information. *Journal of Applied Sport Psychology*, 17(1), 1–19. <https://doi.org/10.1080/10413200590907531>
- Deveci, İ. (2022). Review of entrepreneurship education literature in educational contexts: Bibliometric analysis. *Participatory Educational Research*, 9(1), 214–232. <https://doi.org/10.17275/per.22.12.9.1>
- Djokovic, D., & Souitaris, V. (2008). Spinouts from academic institutions: A literature review with suggestions for further research. *The Journal of Technology Transfer*, 33(3), 225–247. <https://doi.org/10.1007/s10961-006-9000-4>
- Dottore, A., & Kassicieh, S. K. (2014). University patent holders as entrepreneurs: Factors that influence spinout activity. *Journal of the Knowledge Economy*, 5(4), 863–891. <https://doi.org/10.1007/s13132-014-0224-5>
- Druilhe, C., & Garnsey, E. (2004). Do academic spin-outs differ and does it matter? *The Journal of Technology Transfer*, 29(3), 269–285. <https://doi.org/10.2139/ssrn.1923144>
- Durantón, G., & Puga, D. (2004). Micro-foundations of urban agglomeration economies. In *Handbook of Regional and Urban Economics* (Vol. 4, pp. 2063–2117). <https://doi.org/10.3386/w9931>

- Glaeser, E. L., & Gottlieb, J. D. (2009). The wealth of cities: Agglomeration economies and spatial equilibrium in the United States. *Journal of Economic Literature*, 47(4), 983–1028.
- GovGrant. (2021). The University Spinout Report 2021: Which UK universities top the rankings for the turning innovation into commercial success? Retrieved from <https://www.govgrant.co.uk>. Accessed 16 Jan 2024.
- Hendry, C., & Brown, J. (2006). Organizational networking in UK biotechnology clusters. *British Journal of Management*, 17(1), 55–73. <https://doi.org/10.1111/j.1467-8551.2005.00464.x>
- Heredero, C. D. P., Jimenez, F. J. B., & Ochoa, C. P. G. (2022). The role of business accelerators in generating dynamic capabilities within startups. *International Journal of Entrepreneurship and Innovation Management*, 26(1/2), 25. <https://doi.org/10.1504/ijeim.2022.10045041>
- In-part. (2021). A digital partnering platform connecting university research with industry R&D. Retrieved from <https://in-part.com>. Accessed 16 Jan 2024.
- Lockett, A., & Wright, M. (2005). Resources, capabilities, risk capital and the creation of university spin-out companies. *Research Policy*, 34(7), 1043–1057. <https://doi.org/10.1016/j.respol.2005.05.006>
- Malterud, K., Siersma, V. D., & Guassora, A. D. (2016). Sample size in qualitative interview studies: Guided by information power. *Qualitative Health Research*, 26(13), 1753–1760. <https://doi.org/10.1177/1049732315617444>
- Mueller, C., Westhead, P., & Wright, M. (2012). Formal venture capital acquisition: Can entrepreneurs compensate for the spatial proximity benefits of South East England and 'star' golden-triangle universities? *Environment and Planning A*, 44(2), 281–296. <https://doi.org/10.1068/a44268>
- Newlands, E. (2021). Scotland gets top marks for producing university spin-outs. The Scotsman. Retrieved from <https://www.scotsman.com>. Accessed 16 Jan 2024.
- Nicolaou, N., & Birley, S. (2003). Academic networks in a trichotomous categorisation of university spinouts. *Journal of Business Venturing*, 18(3), 333–359. [https://doi.org/10.1016/s0883-9026\(02\)00118-0](https://doi.org/10.1016/s0883-9026(02)00118-0)
- Panagopoulos, A., Rozakis, S., Sideri, K., & Anagnosti, A. (2019). University technology transfer and agricultural science entrepreneurial education: A view from inside. *Journal of the Knowledge Economy*, 10(4), 1466–1481. <https://doi.org/10.1007/s13132-018-0562-9>
- Pavlov, V., & Pohrebniuk, M. (2020). Evaluation framework of university based on excellence framework system. *Asia-Pacific Journal of Educational Management Research*, 5(1), 57–70. <https://doi.org/10.21742/ajemr.2020.5.1.06>
- Perkmann, M., Perkmann, M., Tartari, V., McKelvey, M., Autio, E., Broström, A., D'Este, P., Fini, R., Geuna, A., Grimaldi, R., Hughes, A., Krabel, S., Kitson, M., Llerena, P., Lissoni, F., Salter, A., & Sobrero, M. (2013). Academic engagement and commercialisation: A review of the literature on university–industry relations. *Research Policy*, 42(2), 423–442. <https://doi.org/10.1016/j.respol.2012.09.007>
- Poticha, D., & Duncan, M. W. (2019). Intellectual property—The foundation of innovation: A scientist's guide to intellectual property. *Journal of Mass Spectrometry*, 54(3), 288–300. <https://doi.org/10.1002/jms.4331>
- Powers, J. B., & McDougall, P. P. (2005). University start-up formation and technology licensing with firms that go public: A resource-based view of academic entrepreneurship. *Journal of Business Venturing*, 20(3), 291–311. <https://doi.org/10.1016/j.jbusvent.2003.12.008>
- Prokop, D. (2021). Innovation ecosystems: Implications for innovation management. *Technovation*, 107, Article 102286. <https://doi.org/10.1016/j.technovation.2021.102286>
- Rasmussen, E., Mosey, S., & Wright, M. (2014). The influence of university departments on the evolution of entrepreneurial competencies in spin-off ventures. *Research Policy*, 43(1), 92–106. <https://doi.org/10.1016/j.respol.2013.06.007>
- Research England. (2020). How we fund higher education providers: Supporting healthy and dynamic research and knowledge exchange in HEPs. Retrieved from <https://re.ukri.org>. Accessed 16 Jan 2024.
- Research Excellence Framework. (2014). Research excellence framework. Retrieved from <https://results.ref.ac.uk>. Accessed 16 Jan 2024.
- Richards, G., & Richards, W. G. (2009). *Spin-outs: Creating businesses from university intellectual property*. Harriman House Limited.
- Rothaermel, F. T., Agung, S. D., & Jiang, L. (2007). University entrepreneurship: A taxonomy of the literature. *Industrial and Corporate Change*, 16(4), 691–791. <https://doi.org/10.1093/icc/dtm023>
- Russell Group. (2022). *University spinouts: A British success story*. Retrieved from <https://russellgroup.ac.uk>. Accessed 16 Jan 2024.

- Smith, H. L., & Romeo, S. (2016). Regional environments and sector developments: The biotech sector in Oxfordshire. *Journal of the Knowledge Economy*, 7(4), 905–919. <https://doi.org/10.1007/s13132-015-0303-2>
- Steffensen, M., Rogers, E. M., & Speakman, K. (2000). Spin-offs from research centers at a research university. *Journal of Business Venturing*, 15(1), 93–111. [https://doi.org/10.1016/s0883-9026\(98\)00006-8](https://doi.org/10.1016/s0883-9026(98)00006-8)
- Thursby, J. G., Jensen, R., & Thursby, M. C. (2001). Objectives, characteristics and outcomes of university licensing: A survey of major U.S. universities. *The Journal of Technology Transfer*, 26(1–2), 59–72. <https://doi.org/10.1023/a:1007884111883>
- Ulrichsen, T. C. (2019). Developing university spinouts in the UK: Key trends in spinout activity, investments and investor involvement. Retrieved from <https://re.ukri.org>. Accessed 16 Jan 2024.
- Ulrichsen, T. C. (2020). Assessing the Gross Additional Impacts of the Higher Education Innovation Fund (HEIF): An update for the period 2015/16 – 2018/19. Retrieved from <https://re.ukri.org>. Accessed 16 Jan 2024.
- Walter, A., Auer, M., & Ritter, T. (2006). The impact of network capabilities and entrepreneurial orientation on university spin-off performance. *Journal of Business Venturing*, 21(4), 541–567. [https://doi.org/10.1007/978-3-8349-8929-1\\_2](https://doi.org/10.1007/978-3-8349-8929-1_2)
- Zupic, I., & Cater, T. (2015). Bibliometric methods in management and organization. *Organizational Research Methods*, 18(3), 429–472.

**Publisher's Note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.