

# Joining the Dots Business Clusters in Galway/Mayo and the UK

Evidence and Recommendations: December 2020

Professor Jonathan Levie, National University of Ireland Galway  
Dr Majella Giblin, National University of Ireland Galway  
Professor Mark Hart, Enterprise Research Centre, UK



British Embassy  
Dublin



NUI Galway  
OÉ Gaillimh



Enterprise Research Centre

## Executive Summary

This report sets out possibilities for greater economic exchange between the west of Ireland, focussing in particular on counties Galway and Mayo, and regions of the United Kingdom. Mayo is relatively strong in pharmaceuticals and life sciences while Galway has particular strengths in medtech with smaller cluster in IT and the creative industries. A review of recent research on industrial clusters in the UK reveals sixteen regions of the UK with similar or overlapping industry sector profiles to Galway and Mayo in the west of Ireland.

This demonstrates that there are possible opportunities for deeper economic relationships across the UK, including outside Greater London and the south-east of England. These relationships could extend much wider than trade alone, and could include exchange of information and experience of industry cluster or ecosystem management, collaboration and syndication in specialist growth finance such as venture capital, and collaboration in packaging technology commercialisation opportunities by researchers in universities and private sector firms.

Within the south-east of England, Cambridge, Oxford and Brighton have some similar characteristics to Galway (a core vibrant university city, around 100,000 population and in the case of Brighton a coastal location) and Hertfordshire has some similar characteristics to Mayo (no central large city, strength in pharma and life sciences), though clearly it is in a more strategically advantageous position, being commutable to London and close to both Oxford and Cambridge.

Outside the south-east of England, lying in the 'Northern Powerhouse', Leeds City Region has strengths in medtech and in digital and creative industries (including games) and is striving to create a coherent industry cluster from some 250 medtech and 200 digital health enterprises. Galway and Mayo have deep historical links to this area through emigration. Other city regions with similar cluster overlaps include Manchester, Birmingham, and Bristol.

In relation to the information economy/creative sector crossover, there are several smaller cities, closer in size to greater Galway, such as Belfast, Brighton and Bournemouth which are worth exploring with a view to exchange of experiences, while Cardiff, Glasgow and Edinburgh are possibilities in the performing arts sector.

To capitalise on these sectoral overlaps, the British Embassy in Ireland should approach City regions suggested by this research to sound out whether they would be interested in a fact-finding economic mission to the west of Ireland. The Embassy could consider first approaching regions that have a distinct medtech/digital health focus, then explore other possibilities, for example in the crossover between digital and creative sectors, for example games or other subsectors such as the performing arts.

The British Embassy in Ireland should contact the Director of the Irish Medtech Association, Dr Sinéad Keogh to sound it out in relation to a possible fact-finding mission by members in the west of Ireland to one or several UK regions. It would be advisable to liaise with Kenneth Deery, CEO of Galway Chamber of Commerce and Mary Rodgers, CEO Galway City Innovation District, and to make contact with the office of the president in NUI Galway.

The British Embassy could consider stimulating exchange of information as well as trade between the west of Ireland and UK regions. For example, the embassy could sponsor a number of sector-specific seminars (which could be virtual) on regional cluster emergence and management, and/or

collaborative learning and innovation in the era of COVID-19. For example, City Region managers from the UK and regional innovation ecosystem leaders in Galway and Mayo could meet (virtually) to compare approaches, and valuable lessons could be drawn from comparing collaboration in vaccine development at pace in England and ventilator innovation in Galway. These collaborative innovations included a wide range of public and private sector actors. Adapting the creative arts to COVID restrictions could be another interesting exchange, particularly in the light of Galway's experience as European Capital of Culture in 2020. Finally, pivoting business models for digital businesses, and encouraging inter sector crossovers such as between medtech and IT, or IT and the creative sector, could be another interesting and valuable theme.

## Foreword

At the end of a momentous year and as we open a new chapter in the UK-Irish relationship, this is a good moment to launch this excellent report, written by experts at NUI Galway and the Enterprise Research Centre, with new ideas and practical recommendations to 'join the dots' between the West of Ireland and the UK.

Since it launched two years ago with Minister Coveney in Cork, the 'Joining the Dots' programme has delivered new UK-Ireland partnerships, working with Cork, Kerry and Limerick in Ireland, and Coventry, Birmingham and Wales in the UK. This includes new links between civic leaders, businesses and academics in fields from advanced manufacturing to agri-tech and cyber.

I am delighted to be bringing Joining the Dots virtually to Galway and Mayo and only sad that Covid prevents us, for the moment, from coming together in person.

I am grateful to Professor Jonathan Levie and his team for producing this report, which highlights the leading clusters in the West of Ireland and where there are synergies with cities and regions in the UK.

It shows that Galway/Mayo has world-class medtech, pharma and healthcare clusters, as well as being a significant hub for the creative industries. Eight of the top ten med tech companies worldwide have a presence in Galway, and at the outset of Covid-19, half of the world's stock of ventilators were manufactured from this region. This is, by any standards, an extraordinary concentration of expertise.

In my view, there is much that we in the UK can learn from the development of these clusters, and, I hope, vice versa. I'm delighted that the report also profiles the strengths in these sectors within Scotland, Wales, and Northern Ireland as well as England. We hope and intend that the report and the supporting Joining the Dots activity the Embassy aims to take forward with partners will kick start new UK-Ireland civic, business and research partnerships in these important fields.

Ireland is also investing in the future relationship with the regions and nations of the UK. Just last month, the Irish Government announced it was opening a Consulate General in Manchester, covering the whole of the North of England, a region with a population of 15.5 million, over one million businesses and an annual GDP of £412 billion. I am delighted this report also underlines the specific potential of developing West of Ireland links with the Leeds City Region, home to NHS Digital and a quarter of all UK jobs in digital health.

The Embassy has forged a close relationship with Galway and Mayo over recent years, not least through the visit to Galway of the Their Royal Highnesses The Duke and Duchess of Cambridge in March 2020.

I am confident the launch of this excellent report will inspire and enhance the development of UK connections with the amazing counties of Galway and Mayo.



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Paul Johnston  
British Ambassador to Ireland

# Joining the Dots: Business Clusters in Galway/Mayo and the UK

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# Business Clusters in Galway and the UK

## 1. Introduction

The British Embassy in Ireland commissioned Professor Jonathan Levie and Dr Majella Giblin of the J.E. Cairnes School of Business & Economics at National University of Ireland Galway to conduct the following study:

1. An analysis of sectoral strengths in Galway (city and wider region) and of existing business, research and civic connections to the UK broken down by UK region and sector.
2. An assessment, based on the research above, of UK cities or regions that have complementary strengths to Galway (city and region) and where there is scope for greater trade and investment, research and civic cooperation.
3. Recommendations for a programme of work to deliver the increased economic connections between Galway and the selected UK regions.

This report describes three business clusters in counties Galway and Mayo and identifies cities and regions of the UK, especially those outside of London, that might have complementary business profiles to counties Galway and Mayo.

### Current Links between Galway and Mayo and the UK

Galway and Mayo lie on the western edge of Europe. The nearest parish to the west is Boston, Massachusetts<sup>1</sup>, and the civic and economic ties of these counties reflect their close ties with the United States, first through emigration and more recently through foreign direct investment. Reflecting this, Galway is twinned with 9 cities, six of which are in the United States, and only one in the UK (Bradford). It has a friendship agreement with Stirling in Scotland. This pattern is repeated among towns in the region; there are very few civic links with the UK, apart from a link between Mayo county council and Calderdale Council and between Ballina and Craigavon in Northern Ireland.

Ireland is the most UK trade-dependent country in the EU<sup>2</sup>. In 2017, 14% of Irish exports were to the UK, while the UK as an export destination represented 11% of sales of enterprises that exported to the UK (this statistic is known as “export intensity”). However, the west region of Ireland (comprising counties Galway, Mayo and Roscommon) has the second lowest UK export intensity of any Irish region (7.6% in 2017), with the southwest region being the lowest at 5.6%. In 2017, a total of 444 exporting enterprises in the west region exported €793 million to the UK, the second lowest volume of any region in Ireland (the midland region being the lowest). This compares with 8,685 exporting enterprises from the whole of Ireland exporting €46,226 million to the UK, or 11.3% of their turnover. Thus the west region exported only 1.7% of total Irish exports to the UK. For comparison, the Southwest region exported 23% of Irish exports to the UK, and exported €137million on average to the UK per exporting enterprise, almost six times higher than the average for the west region (€24 million) and almost four times higher than the regional average<sup>3</sup>. This means that exporting to the UK is more concentrated in a few large firms in the southwest than in the west.

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<sup>1</sup> Geographically, the nearest parish is St Johns, Newfoundland, but arguably the nearest parish in spirit is Boston.

<sup>2</sup> Ali-Yrkkö, J., & Kuusi, T. (2020). Brexit and impact routes through global value chains. *National Institute Economic Review*, 252, R33-R44. doi:10.1017/nie.2020.15

<sup>3</sup> Source: Central Statistics Office, Dublin. Note: transfer pricing and differences in the location of head offices and plants can distort regional production and export volumes, typically in favour of the Dublin region.



## Industry clusters in Galway and Mayo

Clusters are geographic concentrations of firms within the same industry. Research shows that businesses within clusters benefit from agglomeration effects such as facilitating knowledge exchange, increased access to relevant skills and reduced supply chain costs. Galway and Mayo contain an internationally significant Med tech, pharma and healthcare cluster as well as smaller clusters in the ICT and Creative Industries. These industries are formally defined as follows; note the overlap between ICT and Creative industries<sup>4</sup>:

- **MedTech (core):** based on NACE codes this includes Manufacture of medical and dental instruments and supplies; Engineering activities and related technical consultancy; other research and experimental development on natural sciences and engineering.
- **ICT:** the Information Economy based on NESTA's definitions – Computers and computer peripherals, communications, software and computer services.
- **Creative Industries:** based on NESTA's definitions - Advertising and marketing; Architecture; Design: product, graphic and fashion design; Film, TV, video, radio, and photography; IT, software and computer services; Music, performing and visual arts; and Publishing.

The overview of the evidence on clusters in Galway and Mayo is based on academic research conducted by the second author, insights from seminars on the medtech industry at NUI Galway, a recent detailed report on the economy of Mayo<sup>5</sup>, and visual representations of the locations of businesses in the three clusters in the west of Ireland specially commissioned for this project from the Insight Centre for Data Analytics, using public data.

The overview of the available evidence on business clusters in the UK is compiled from a range of sources and include the following studies:

1. Analysis by the Enterprise Research Centre (ERC) on Local Enterprise Partnership (LEP) Clusters across England (ERC Research Paper No. 14, January 2014).
2. Analysis of Clusters in the Design Industries (ERC Research Report for the Design Council, May 2018)
3. Analysis by statisticians in the UK Department for Business, Energy and Industrial Strategy (BEIS) on identifying industrial clusters in the UK (BEIS (2017) Density-based spatial clustering: identifying industrial clusters in the UK - methodology report, <https://www.gov.uk/government/publications/spatial-clustering-identifying-industrial-clusters-in-the-uk>).
4. Industrial Clusters in England by NIESR, City-REDI and SpazioDati for BEIS (BEIS Research Report No. 4, September 2017)

Supplementary information was also provided by the Scottish and Welsh Governments and Invest Northern Ireland. New bespoke analysis was commenced by the researchers in the ERC to bring all the above analyses up to date for the three industries of interest in order to see which cities/regions have

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<sup>4</sup> Note: NACE codes are not typically used in the UK, and were converted to SIC codes for this project. See Appendix 1 for a complete list of codes used for all three clusters.

<sup>5</sup> Bradley, J. (2019) The Economy of the Atlantic Economic Corridor: A study of County Mayo. AEC Business Forum. Available at <https://www.westportchamber.ie/post/the-economy-of-the-atlantic-economic-corridor-a-study-of-county-mayo-by-dr-john-bradley>

complementary strengths which would present opportunities for economic collaboration with the Galway region. However, due to the COVID-19 it was not possible to progress this work since access to the ONS data through the secure lab access in the research team's offices was no longer possible.

Despite this difficulty in accessing the most recent data, it is unlikely that cluster patterns have changed substantially in the last few years in the UK. In fact, it is more likely that given the COVID-19 and Brexit shocks, the industrial landscape in both Ireland and the UK will change more in the future five years than they have done in the past 5 years. For example, before the COVID-19 crisis, half of the world's ventilators were manufactured in Ireland, with most of this activity centred in Galway<sup>6</sup>. While manufacturers such as Medtronic in Galway have doubled production, sudden global shortages of ventilators have prompted many entrants to this mature industry, and it remains to be seen if these new entrants will remain or indeed disrupt incumbents with innovative and/or low cost designs. COVID-19 has caused huge problems for the creative sector, with significant investment for activities related to Galway 2020 European Capital of Culture having to be written off.

In this document, we first profile the three main clusters in counties Galway and Mayo: the "supercluster" of Medtech, pharma and healthcare industries which are dominated by well-established multinational businesses, some employing thousands of people, as well as smaller clusters in the Creative Industries and ICT.

Next, we review data and research on localisation of industry in the UK, and attempt to identify areas outside of London with substantial clusters of Medtech/pharma, Creative industries and ICT that might be worth exploring further, with a view to encouraging further regional level links.

Finally, we make recommendations on what next steps could be taken to develop such links between industry in Galway and Mayo and specific regions of the UK, based on their industrial profiles.

## Introduction to Galway and Mayo

Galway and Mayo are similar sized rural counties halfway up the western seaboard of Ireland, directly west of Dublin. Galway has twice as many people as Mayo and contains the only city in the region. Administratively, Galway is divided into Galway City and Galway County, while Mayo is a County. Galway and Mayo, together with Roscommon, make up the west region. Galway city contained around 80,000 people in the 2016 census, up from 72,000 in 2006 (+10%). Galway county (excluding Galway city) contained 179,000, up from 159,000 (+13%). County Mayo contained around 130,000, up from 124,000 (+5%). The largest town in Mayo is Castlebar with a population of 12,000. Figure 1 shows the distribution of population across county Mayo and Galway county and city. The population of Galway county is concentrated in an arc around Galway city, and much of the county is sparsely populated, particularly in west Connemara and south Galway (with the exception of the town of Loughrea)<sup>7</sup>. The population of county Mayo is more dispersed among small towns, but the north west and south west are very underpopulated. The most recent population estimate for the west region suggests a 5% growth in population over the 5 year period to 2019, compared with 6% for Ireland.

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<sup>6</sup> <https://globalambition.ie/ireland-races-to-produce-ventilators-nebulisers-and-more/>

<sup>7</sup> It is worth noting that in the 1841 census, Galway city and county had a population of 440,000 and Mayo had 389,000. In comparison, Dublin, with a population in the most recent (2016) census of 1.35 million, had 373,000 people in 1841, less than either Galway or Mayo. After 180 years, the region's population has still not recovered from the effect of the great famine.



At the last census in 2016, 45% of people in Galway who had finished their education had third level qualifications, compared with 35% in Mayo. Almost half (47%) of adults aged 25 to 64 in the west region of Ireland had third level education in 2019, the same proportion as in Ireland as a whole.<sup>8</sup> The region has one university, National University of Ireland Galway (NUI Galway), and one Institute of Technology, Galway-Mayo Institute of Technology (GMIT). These third level institutions, with a combined third level student population in their Galway campuses of around 25,000, have a significant impact on the nature of Galway city, giving it a young vibrant character. A second important feature is the place of the Irish language. In the 2016 census, 49% of people in Galway city and county were recorded as Irish speakers, the highest of any county in the State; Mayo was the fourth highest at 44%.

Statistics on sector employment and output at the county or region level should be treated with caution. This is because employment and output are linked to where enterprises are headquartered, not the county which produced the employment and output. Administrative changes in head office location of large employers can therefore distort official data, and this may have happened in this region in the last 10 years. In addition, transfer and tax-based pricing can distort values of some commodities.

With this caveat in mind, in 2017, 18% of employment in the west region was recorded as in industry, and 47% of employment and 77% of gross industrial output was foreign owned. These are the highest proportions of any region in Ireland (the equivalent percentages for Ireland were 13%, 40% and 79% respectively)<sup>9</sup>. The west's contribution to the Irish total was 10% of employment in industry, 12% of employment in foreign owned plants and 6% of the value of total and foreign-owned industrial output. 56% of this output and 44% of industrial employment was provided by large enterprises (employing 250 or more).

While Galway and Mayo have similar proportions of people employed in industry and construction (21%), Galway has more people employed in services and less in agriculture, reflecting the impact of Galway city on Galway's economy. The most recent business demography statistics show that employment in industry in Galway grew by 36% between 2015 and 2017, with double digit growth in many other sectors. Employment growth in Mayo was less spectacular.

In both 2008 and 2017, private household disposable income in the Northern and Western NUTS2 region of Ireland was close to that of the West Midlands of the UK<sup>10</sup>. Between 2008 and 2017, disposable income per capita in Ireland declined and then rose again, recovering to 2008 levels only in 2017. However, some regions recovered faster than others, and since 2008, relative disposable income in both Galway and Mayo declined relative to the State average. In 2008, disposable income per person in Galway stood at 99.1% of the State average, with 88.6% for Mayo. By 2017, disposable income per person had declined to 91.7% of the average for Ireland for Galway and 84.2% of the Irish average for Mayo. One reason for this may be the relative growth of information technology and professional, scientific and technical activities in the Dublin area, which has pulled up incomes relative to the rest of the country. In contrast, the economy of Galway and Mayo has remained more based on manufacturing.

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<sup>8</sup> CSO table EDQ03

<sup>9</sup> Source: <https://www.cso.ie/en/releasesandpublications/er/ciprcd/censusofindustrialproduction-localunitsregionalandcountydata2017/>

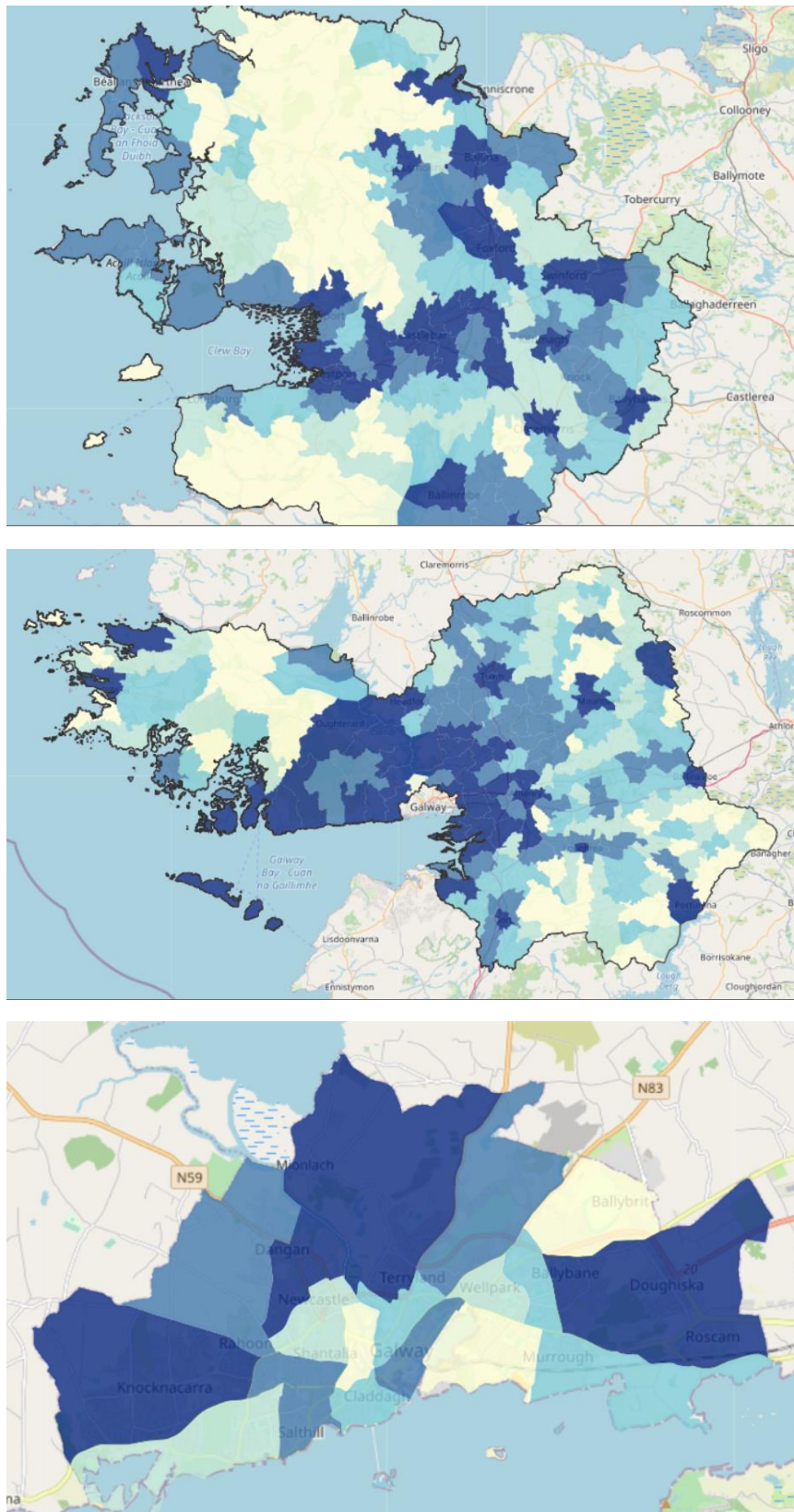
<sup>10</sup> €13,600 purchasing power standard, per inhabitant net disposable income. Source: Eurostat online data code:TGS00026

**Table 1. Galway and Mayo key statistics**

	Galway	Mayo
Population (2016)	258,552	130,507
Population Density (2016) persons per sq. km	42.04	23.35
Employed (2016)	110,067	51,439
Employment Change (2011-2016)	9.20%	4.80%
Labour Force Participation Rate (2016)	61.20%	57.70%
Disposable Household Income relative to State average (2017)	91.7%	84.2%
Numbers Employed by Sector (2016)		
Total	110,067	51,439
Agriculture, Forestry & Fishing	5,668 (5.1%)	4,395 (8.5%)
Industry & Construction	22,975 (20.9%)	10,547 (20.5%)
Services	76,510 (69.5%)	34,359 (66.8%)

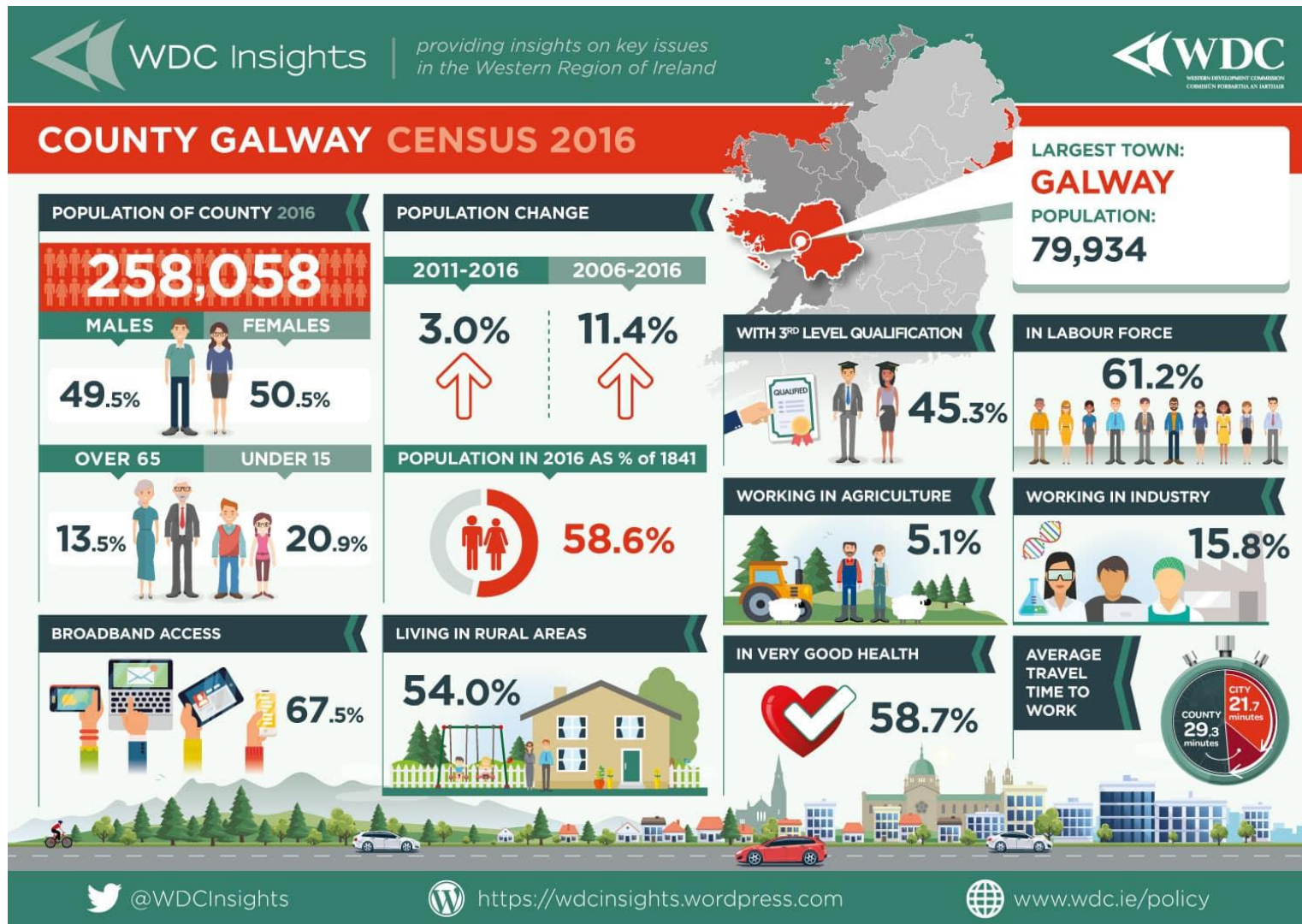
Source: Central Statistics Office

**Figure 1 Population distribution across county Mayo, county Galway and Galway city**



Source: 2016 census and All-Island Research Observatory

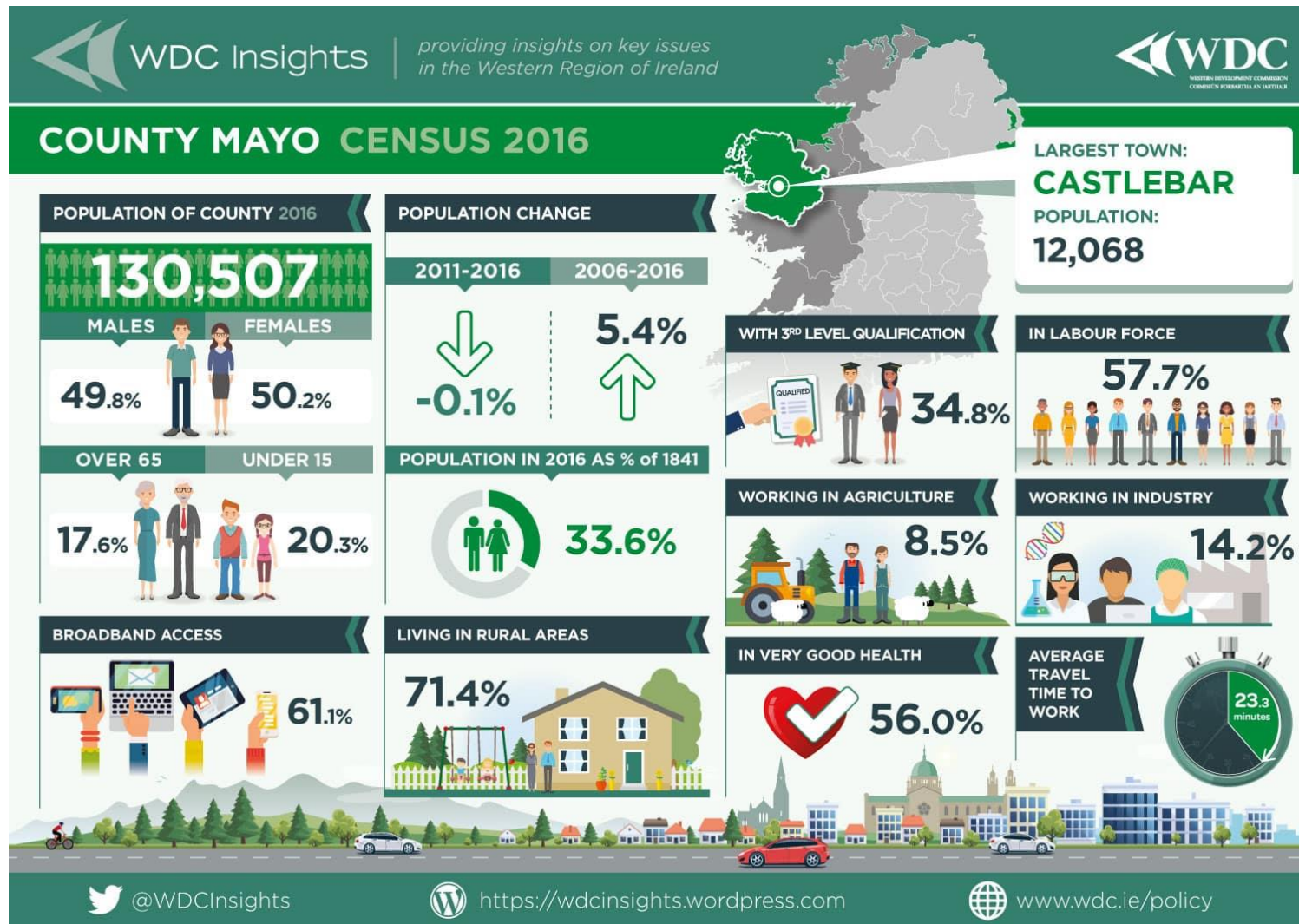
Figure 2 Infographic of Galway city and county



Source: Western Development Commission



Figure 3 Infographic of county Mayo



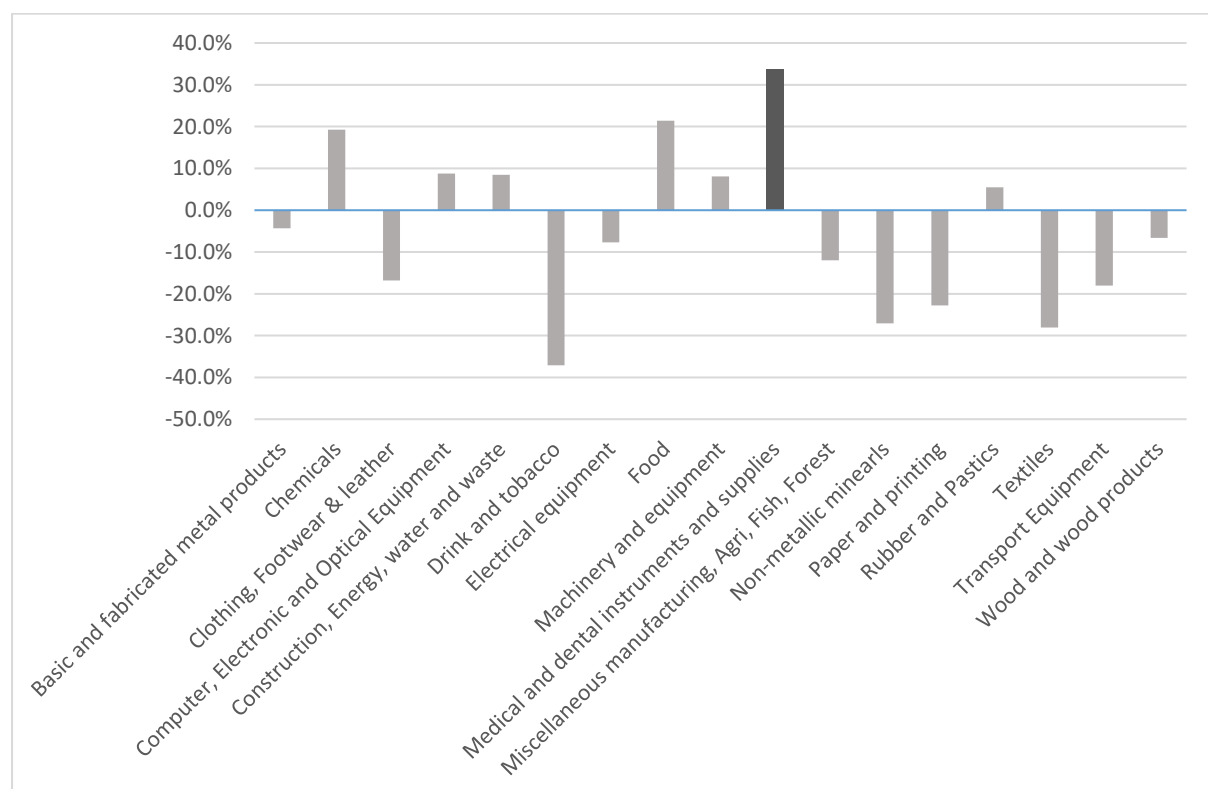
Source: Western Development Commission

## 2. Industry clusters in Galway and Mayo: what do we know?

### The Medtech cluster

The medtech industry comprised 56% of industrial employment in Galway city, 40% in Galway county and 21% in Mayo in 2016, or 4% of the total labour force in Galway and Mayo: over 9,300 people<sup>11</sup>. Figure 4 below, taken from Cunningham et al. (forthcoming), demonstrates the growth in employment in medtech in Ireland's manufacturing industries since the onset of the great recession. In Ireland, medtech was one of only six out of 17 sectors to buck the downward trend in manufacturing employment over this period, and recorded the highest rate of growth over this period. Activity in this sector is concentrated quite heavily in the West of Ireland with Galway as the economic centre<sup>12</sup>.

**Figure 4: Employment Percentage Change, Manufacturing Sectors, Ireland, 2008-2017**



Data source: Department of Business, Enterprise and Innovation (2018). Figure taken from Cunningham et al. (forthcoming)<sup>13</sup>

The Galway-centred medical technology cluster emerged as a consequence of Foreign Direct Investment policies including offering regional grant incentives, a low corporation tax rate and a young, educated and English-speaking workforce. The first foreign-owned medical technology company in Ireland, Beckman Coulter, was established in Galway in 1973. At the time, Galway, like the rest of Ireland, did not have any expertise or knowledge capacity in the field of medical

<sup>11</sup> Western Development Commission Insights series on Labour markets in the Western region, October 2017

<sup>12</sup> Giblin, M. and Ryan, P. (2012) Tight Clusters or Loose Networks? The Critical Role of Inward Foreign Direct Investment in Cluster Creation, *Regional Studies*, 46:2, 245-258.

<sup>13</sup> Cunningham, J.A., Collins, P. and Giblin, M. (forthcoming). The Evolution of Irish Industrial, Science and Technology Policy. *Annals of Science and Technology Policy*, Now Publishers Inc.



technology. Later arrivals including CR Bard (later to become Medtronic) in 1982 and Boston Scientific in 1994 helped to generate further activity in this sector. Medtronic and Boston Scientific in Galway are both involved in the production of drug-eluting stents for cardiology. These subsidiaries started as mainly low-value added manufacturing and assembly line operations. Over time local project managers and teams built reputations and trust within their respective corporations for successfully and efficiently completing projects. This was rewarded by increased responsibility bestowed on the subsidiary from head-office. Coupled with the availability of skilled labour supplied by the local university, the subsidiaries moved up the value chain from solely manufacture and assembly to also engaging in product design and development. They expanded their product portfolios, and both subsidiaries in the region are now actively involved in R&D. Boston Scientific announced a €91 million investment in R&D for the Galway facility in 2009 to allow for early stage innovative activity to take place and in 2019 the site officially opened a new facility - the Equipment Technology Centre, following an investment by the corporation of €60 million. In 2013, Medtronic opened a €7.7 million Customer Innovation Centre in Galway that brings together physicians and engineers to develop innovative therapies. In short, multinational subsidiaries started as 'implementers' (executors of HQ mandates) and transitioned to 'contributors' (generating new knowledge that adds value to the corporation), and much of this was led by local managers.

The increased activity in R&D had a spill-over effect in the local economy. Other foreign-owned medical technology corporations were enticed to invest in the region as the labour pool grew and local specialised suppliers became available. Employees of local subsidiaries identified entrepreneurial opportunities that involved designing and developing their own medical devices or components to devices, and as these were pursued a new wave of born-global indigenous firms began to emerge in the early to mid-2000s. NUI Galway not only supplies graduates specialised in biomedical engineering but also has significantly invested in research activity across diverse areas including; cardiovascular devices, immunology, and stem cell biology. GMIT has also played a significant role in generating technical staff for the cluster.

While there have been some significant divestments from the region - for example, the multinational corporation Abbott Vascular closed its Galway-based facility in 2007 – a cluster of medical technology activity has emerged and grown in the region over the past 35 years. Boston Scientific and Medtronic play anchor roles in the cluster, having built international reputations for cardiovascular medical devices, and currently employ over 5000 employees between them.

Figure 4 charts the rise in the number of foreign-owned and indigenous medical technology companies in Galway between 1973 and 2016. It shows that at the end of the 1990s, the growth in the number of indigenous businesses started to accelerate faster than the growth in the number of foreign multinationals, suggesting the emergence of a healthy, self-sustaining cluster. While most of these businesses are small, some are significant global players, such as Aerogen, the world's leading aerosol drug delivery business, producing a critical drug delivery component for many of the world's ventilators<sup>14</sup>, while others have scaled and exited successfully, like Creganna Medical which had global sales of \$250 million in 2015 and sold in 2016 to TE Connectivity. Successes like this are crucial role models and sources of expertise and wealth for recycling back into the cluster.

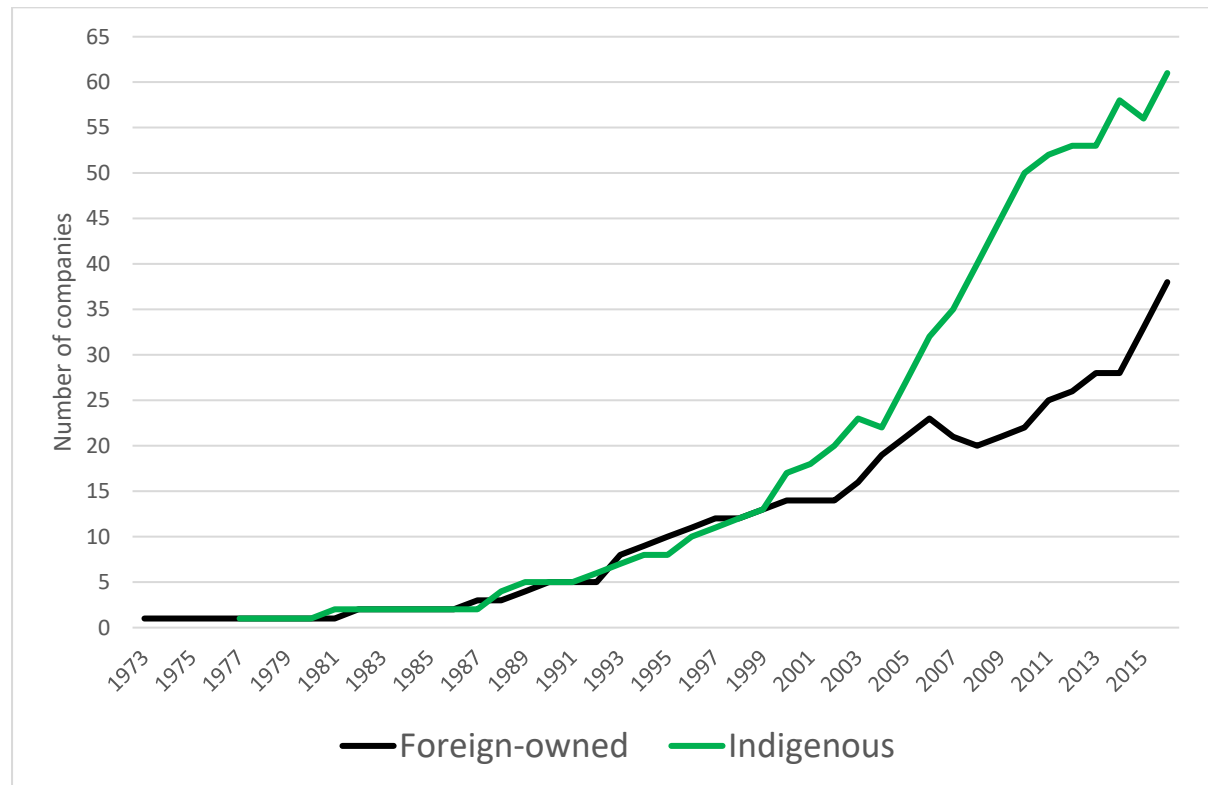
Over this period, the nature of indigenous businesses has changed from being mainly suppliers or subcontractors or service providers to OEMs to being mainly design and development of proprietary devices and/or software or systems related to healthcare. One study found that 35% of the indigenous companies in 2015 that were internationally focused rather than locally-based suppliers

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<sup>14</sup> See [www.aerogen.com](http://www.aerogen.com)

were engaged in medical areas outside of the core cluster specialisation around cardiovascular, including: gastroenterology, urology, pulmonary, gynaecology, respiratory, medical software and intelligent systems<sup>15</sup>. The US is the key market for most medtech applications and with direct flights to the US from Shannon Airport and pre-boarding US border clearance, Galway can feel almost as close to Boston and New York as it does to London, Paris or Berlin.

**Figure 3: Number of foreign-owned and indigenous medical technology companies in Galway, 1973 - 2016**



Source: Updated from Giblin and Ryan (2015)<sup>16</sup>

Another feature of this cluster is the presence of both angel investors who are industry veterans and serial medtech entrepreneurs, some of whom move back and forth between foreign-owned multinationals and indigenous businesses, building international reputations in medtech business management in areas such as customer development, quality standards, and regulation. An example of this is WhiteSwell, a Galway-based company that is building on work by Israeli researchers and targeting the US market for acute decompensated heart failure (ADHF), a primary cause of repeat hospitalization. Several key top team members at WhiteSwell, including the CEO and CFO, were senior managers at Neuravi, a medtech business founded in Galway in 2009, which was sold to Johnson & Johnson in 2017.

<sup>15</sup> Evers, N. and Giblin, M. (2017). Born globals and the medical technology cluster in the west of Ireland. Chapter 7 in I. Mandl and V. Patrini (eds.) European Born Globals: Job creation in young international businesses. London: Routledge

<sup>16</sup> Majella Giblin & Paul Ryan (2015) Anchor, incumbent and late entry MNEs as propellants of technology cluster evolution, *Industry and Innovation*, 22:7, 553-574,

Eight of the world's top ten med-tech companies have a physical presence in Galway. This rapid rise in the density of Galway's medtech cluster (now recognised as one of five global emerging hubs) was assisted and complemented by a deepening of regional cluster services, including relevant education and training programmes and relevant research programmes by the two principal higher education institutions, NUI Galway and GMIT, and services led by industry bodies and government agencies. Tables 2 and 3 show how these services have built up since the late 1990s. One important element, particularly for new entrants, is local venture capital. The Western Development Commission's Western Investment Fund (WIF) has to date invested €21 million in 31 Lifescience/Medtech companies in the Western region as well as supporting another 13 pre-seed companies through the BioExel Accelerator. These companies directly employ 1,100 people which with the multiplier brings total employment to 3,300. WIF investment has leveraged €185m for these portfolio companies and realised acquisition value of over €500 million.

**Table 2: Investment in Programmes and Research Centres related to Medical Technology by Higher Education Institutes in Galway**

<b>Year Established</b>	<b>Programme/Centre</b>	<b>Higher Education Institute</b>	<b>Details</b>
1998	Bachelor of Engineering (Biomedical): Degree Programme	National University of Ireland, Galway	Skills and technical knowledge training and development.
1999	National Centre for Biomedical Engineering Science (NCBES): Research centre	National University of Ireland, Galway	Research activity in the medical technology field, which involves university-industry collaboration
2003	Regenerative Medicine Institute established (REMEDI): Research centre	National University of Ireland, Galway	Research activity focusing on regenerative medicine and involves industry-university collaboration.
2009	Specialist Postgraduate Diploma in Medical Device Science	National University of Ireland, Galway	Graduate skills and training development specific to medical technology
2008	HRB Clinical Research Facility And Translational Medical Device Lab	National University of Ireland, Galway	A joint venture with the local hospital, this facility supports clinical research and clinical trials
2010	Bioinnovate Ireland: training programme for entrepreneurship and intrapreneurship	National University of Ireland, Galway	Training programme aimed at generating new ideas to establish new medical device start-ups or implement the ideas within established companies.
2010	Bachelor of Science (Honours) in Medical Science	Galway-Mayo Institute of Technology	Skills and training development programme in the area of medical technology.
2012	Certificate in medical device technology	Galway-Mayo Institute of Technology	Skills and training development programme in the area of medical technology.
2013	MSc in Biomedical Engineering	National University of Ireland, Galway	Graduate skills and training development specific to medical technology
2014	Irish Centre for Cell Manufacturing Ireland (ICCM)	National University of Ireland, Galway	The only approved centre in Ireland to engage in in stem cell manufacturing
2014	Centre for Research in Medical Devices (CURAM)	National University of Ireland, Galway	Researching and developing implantable 'smart' medical devices.
2016	Medical and Engineering Technology: Research Centre	Galway-Mayo Institute of Technology	Centre that develops technologies for clinical research and medical technology companies. The outputs include new knowledge and the application of knowledge.
2017	BioExel: Accelerator Programme for start-ups	National University of Ireland, Galway	Accelerator Programme for new medical technology start-ups.
2017/2018	Springboard courses in medical technology and quality	Galway-Mayo Institute of Technology	Skills and training development programme in the area of medical technology.
2019	Master in Engineering (Biomedical Engineering)	National University of Ireland, Galway	Graduate skills and training development programme in the area of medical technology.

Source: Cunningham et al. (forthcoming)

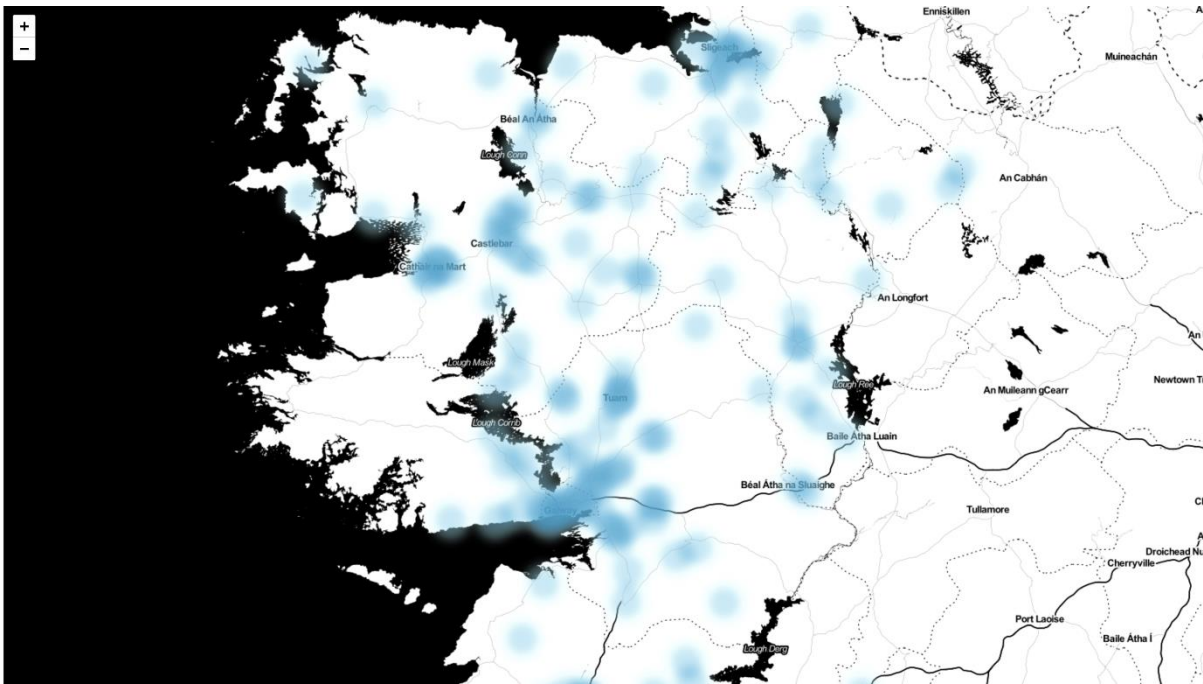
**Table 3: Industry-led initiatives and industrial development agencies supporting the Medical Technology Cluster in Galway**

<b>Industrial Development Agencies – National and Regional</b>	<b>Details</b>
IDA Ireland	Government national industrial development agency focused on foreign-owned investments and has an office in Galway. The agency has a national Medical Technology division.
Enterprise Ireland (and Local Enterprise Offices)	Government national organisation with the remit of supporting indigenous businesses and has an office in Galway. The agency has a national Medical Technology division.
WestBIC	Supports entrepreneurship and innovative SMEs in the region in any sector and is part of the wider Business Innovation Centre network in Europe. This operates as a public-private partnership.
Údarás na Gaeltachta	A Government funded regional authority supporting the economic, social and cultural development of Irish-speaking localities, including areas in Galway.
Irish MedTech Association	A national business association led by the private sector that supports the Medical Technology Sector in Ireland
Western Development Commission	A Government body established to support the development of the Western region of Ireland.
<b>Examples of Current Industry-led Initiatives in Galway</b>	<b>Details</b>
Medtech Brew	Regular networking events held in Galway for people working in the medical technology sector.
Medical Technology Ireland Exhibition and Conference	Tradeshaw and conference – an annual showcasing medical technology products and services in Ireland and is held in Galway.
Med Tech Rising 2019	Medical Technology CEO conference – bringing together business leaders and international experts to discuss topics, such as the applications of new technologies, business models, entrepreneurship, the globalisation of R&D, convergence of technologies and sectors.
Med Tech West Summit 2019	Medical Technology conference on business challenges such as, building a sustainable organisation, supplier-MNC relationships, opportunities and challenges of the medical technology start-up ecosystem, leadership for operational excellence.

Source: Cunningham et al. (forthcoming)

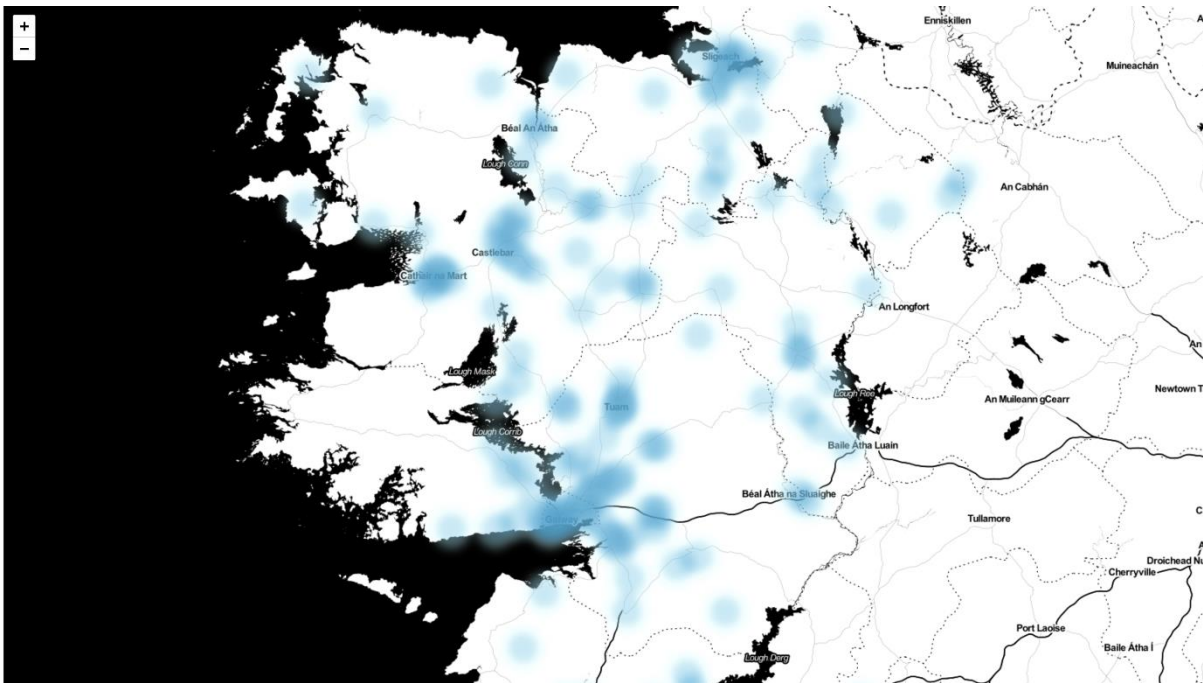
The locations of the main players in the cluster have been mapped by Professor John Breslin of NUI Galway and his map is reproduced in Appendix 2 Figure 2.1. Figures 4 to 7 below, based on public records data on company registration and employment and developed by the Insight Centre for Data Analytics at NUI Galway, show the density of core and peripheral medtech businesses across the West of Ireland in two ways: absolute number of active companies in the area in the sector and the relative number, adjusted for employment size category (ratio of the number of active companies in the sector and the total number of active companies in the area, weighted by their size, from micro companies to large companies). The clustering effect around Galway city is very evident.

**Figure 4 Geographic distribution of core medtech businesses in the West of Ireland, by absolute numbers of businesses at each location**



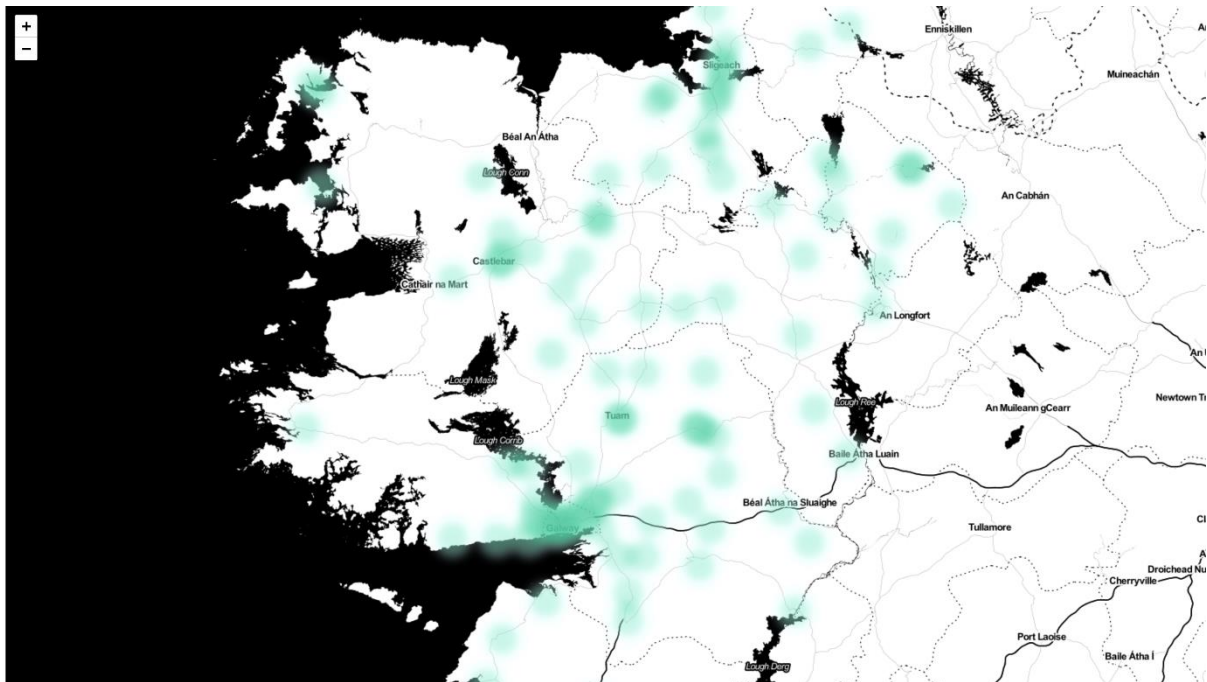
Source: Insight Centre for Data Analytics

**Figure 5 Geographic distribution of core medtech businesses in the West of Ireland, by relative employment size at each location (employment in medtech relative to employment in all businesses)**

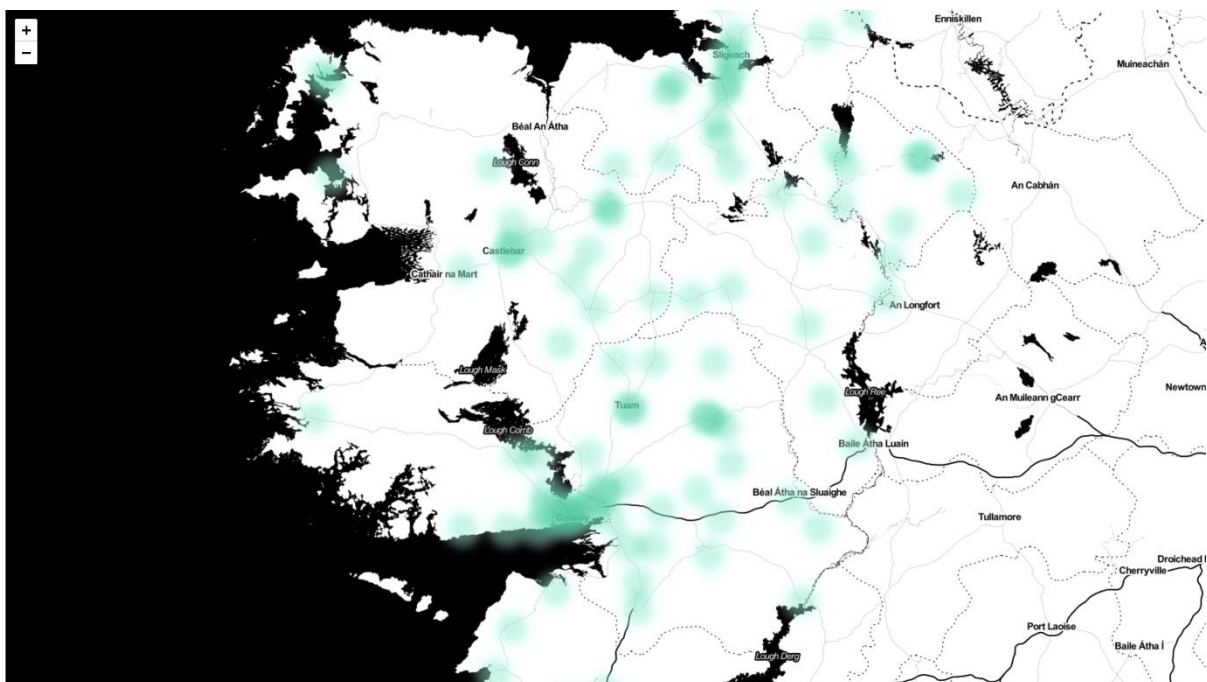




**Figure 6 Geographic distribution of peripheral medtech businesses in the West of Ireland, by absolute numbers of businesses at each location**



**Figure 7 Geographic distribution of peripheral medtech businesses in the West of Ireland, by relative employment size at each location (employment in medtech relative to employment in all businesses)**



Source; Insight Centre for Data Analytics

## The future for Galway's Medtech cluster

There are significant opportunities for Galway's medtech cluster, and its collaborative response to the COVID-19 crisis has revealed strong networks within the cluster. The medtech devices industry has high barriers to entry, and expertise in regulatory processes and customer development is rare and valuable. Breakthroughs in medical device technology continue to be made, and Galway has significant resources and a growing pipeline in this area, including translational research labs, Cúram (a Science Foundation Ireland Research Centre designing the next generation of 'smart' medical devices) and Bioinnovate, a sector-specific medtech needs-driven innovation programme allied to Stanford University's BioDesign program. It is also possible that Galway can attract a significant share of digital health business, if it can out-compete Dublin in expertise such as healthcare regulation, in cost control and standard of living (for example, by providing excellent start-up and remote working hubs at low cost and a lively start-up scene), and reduce the psychic distance between Galway and Dublin's entrepreneurial ecosystems by encouraging more networking between them.

Galway's medtech cluster also faces several challenges to continued growth. To survive and thrive, the multinational subsidiaries may need to move from being 'contributors' to 'strategic partners' to HQ (a critical player in the corporation where significant decisions are made), or risk being phased out through the consolidation process – and this applies also to key suppliers. COVID-19 has resulted in an influx of new competitors as global demand for many of the key medtech products manufactured in the west of Ireland has temporarily soared. There is a threat that incumbents could be leapfrogged by innovative thinking by new entrants from outside the industry.

A further possible threat is a longer term strategic shift in health care services to digital health, where a merger of technological potential in ICT with stresses in health delivery services could lead to new breed of scalable digital health companies. While Galway has a growing ICT cluster, centred around the Portershed accelerator in the city centre and the Galway Technology Centre (both of which were about to execute major expansion plans immediately before COVID-19 hit) the national centre of gravity for expertise in this area is Dublin.

Arguably, the keys to growing the cluster in the future will be talent with relevant experience in globally scaling medtech companies with new business models such as servitisation. Resources follow talent, but talent is mutually attractive and is in short supply globally.

## Pharma sub-cluster

While Mayo has several long-established foreign-owned medtech plants, including Hollister and Fort Wayne Metals, pharma and life sciences is a more significant sector for the county. Allergan, a leading pharma corporation, is like Medtronic legally headquartered in Dublin but has significant plants in the west of Ireland, in Westport Co Mayo and in Galway. The Westport plant is very complex, and houses a pharmaceutical facility, two biologics plants, and an ocular implant facility. It is the world's only source of Botox. While pharma is distributed throughout Ireland (with significant clustering in Cork), Allergan is regionally significant in Mayo. A number of other leading pharma and life science companies have significant establishments in Mayo, including Baxter Healthcare and Charles River Laboratories and this has led to the emergence of indigenous businesses that specialise in niche services to the industry not just in Ireland but globally, as large multinationals consolidate supply chains. A possible threat to this cluster is the stated US policy to repatriate offshore pharma production.

## ICT cluster

Like the medtech cluster, Galway's ICT cluster has a mix of foreign multinationals with significant R&D as well as sales operations (including Hewlett Packard Enterprise, Avaya, Cisco, SAP, Fidelity, Aspect, Electronic Arts, SmartBear, Applied Systems, MathWorks) but also smaller indigenous businesses, some of which are spinoffs from NUI Galway and GMIT, and contain serial entrepreneurs and "serial scalers": cornerstone functional heads with experience in scaling both multinational and indigenous businesses.

Official estimates suggest around 4,000 people are employed in around 700 ICT businesses in Galway and Mayo, with most employment clustered in Galway<sup>17</sup>. This is almost certainly an underestimate, because of employment is assumed to occur in the county in which the enterprise is registered. Several large employers in Galway are registered elsewhere in the state.

As in the case of medtech, Ireland's close links with the US have been instrumental in growing this cluster. An example would be Altocloud, a software as a service company set up in 2014 by two Irish Cisco executives Barry O'Sullivan and Joe Smyth. Altocloud sold to Genesys in 2018 but continued to grow its Galway operations. Its CFO left Altocloud in 2019 to become CFO at SIREN, a rapidly growing Artificial Intelligence company which spun out of NUI Galway. An example of inward attraction of foreign entrepreneurs would be Romero Games. A recent feature has been the attraction of satellite "spill-over" units of smaller fast growing scaling US-based companies such as Rent The Runway, whose main Europe, Middle East and Africa base is in Dublin. (Dublin is the main European location for many American internet giants, including Google, Facebook, eBay, PayPal and Twitter).

In comparison with the medtech cluster, the ICT "cluster" is not as well integrated, despite predating the medtech cluster. Digital Equipment Corporation started its first European manufacturing base in Galway in 1971, and Nortel was another early FDI anchor firm in Galway. The closing of DEC's manufacturing plant in 1993 spurred several new indigenous tech businesses. HP's Innovation Centre, opened in 2015, made Galway a centre for excellence within HP's global operations, focusing on software R&D, OpenStack cloud technology and business service innovation. A new but key player in developing an ICT ecosystem for new ventures is the Portershed, an accelerator based in Galway city centre.

The locations of the main players in the Galway ICT cluster have been mapped by Professor John Breslin of NUI Galway and his map is reproduced in Appendix 2 Figure 2.2. Figures 7 and 8 below, based on public records data on company registration and employment and developed by the Insight Centre for Data Analytics, show the absolute (by number of businesses) and relative (to employment size) location for ICT businesses across the West of Ireland. Compared with the medtech cluster, which is more concentrated around Galway, ICT businesses are more evenly distributed across business locations in the West of Ireland. They are also widely distributed across many different subsectors. One important and growing sector within ICT is Software-as-a-Service (SaaS) businesses, which in theory can scale quickly and globally using the cloud if they hit on a viable business model. In Galway, such businesses are typically B2B type businesses. This may make it difficult to capitalise on co-location with the medtech cluster to enter consumer digital health markets. On the other hand, gamification could be one key to unlocking the potential of B2C digital health business models, and Galway hosts leading games developers including Electronic Arts and Romero Games.

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<sup>17</sup> Central Statistic Office Business Demography statistics.

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## Creative industries cluster

In 2016, the creative industries in the west of Ireland, comprised 13% of Irish creative industries businesses, 12% of all businesses in the west of Ireland, and 3.6% of all employment in the west of Ireland<sup>18</sup>. A comparison of creative sectors in five different peripheral European regions in 2018 put the west of Ireland in an intermediate position, but leading in population density, population of young people, and level of education<sup>19</sup>. Figure 9 below shows an infographic on the creative industry in the West of Ireland, based on 2016 data.

Galway has a reputation for being a vibrant, almost bohemian city, with resident theatre and street theatre groups, significant higher education investment in both teaching and research for the creative sector, especially in creative arts related to the Irish language, and a series of major festivals throughout the year, such as the Galway International Arts Festival. Anchor companies include Druid, the first theatre company in Ireland outside Dublin, founded in 1975, and Macnas, an innovative street theatre company founded in 1986, but more recently, the games industry has become significant with Electronic Arts and BAFTA award-winning Romero Games, set up by an American couple who moved their business to Galway from the US. Based on this strength in the arts, Galway won its bid for European Capital of Culture 2020, in part based on earlier work in mapping and engaging with the cluster by researchers in NUI Galway<sup>20</sup>. While this should have given a huge boost to Galway's creative cluster, Galway2020 has been dogged by a series of setbacks, including bad weather causing the cancellation of the main opening ceremony, followed by national lockdown caused by COVID-19. An extension of the period of Galway2020 to the end of April 2021 may help the sector to recover somewhat.

A gallery of 126 creative industry businesses in the west of Ireland is available at <https://mycreativeedge.eu/showcase/west-of-ireland/>. As this gallery shows, the creative industries are disparate and multi-dimensional, ranging from fine arts to software, yet there are some issues they have in common<sup>21</sup>. A survey of over 100 creative industries professionals in the West of Ireland in 2017 showed access to co-working infrastructure and finance were mentioned by more than half of respondents as significant issues for them. Since then, a string of co-working spaces has opened up in Gaeltacht (Irish-speaking) regions, and the Portershed in Galway has developed expansion plans. Given the forced move to home working for many professionals in Ireland in March and April 2020, it is very likely that a significant number of creative industry professionals will work from home more often but also seek access to co-working space for one or two days a week, particularly where their home internet connections are poor. This may also nurture cross-sector collaborations within the creative industry space, for example between designers and artists and those working in advertising, marketing and digital media, which is recognised as an unfulfilled opportunity within this disparate cluster.

Public funding was extremely or very important as a source of revenue for 41% of survey respondents, while 45% said it was not important. For a large minority of creative industry

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<sup>18</sup> Collins, P., Murtagh, A., Breen, B. and Commins, V. 2018. Economic and Social Impact Assessment: West of Ireland Creative Sector. Whitaker Institute, National University of Ireland, Galway. In this report, the West of Ireland included coastal counties from Donegal to Clare.

<sup>19</sup> Collins, P. and Murtagh, A. (2018). Creative Economy Index. Whitaker Institute, National University of Ireland, Galway.

<sup>20</sup> See [www.mycreativeedge.eu](https://www.mycreativeedge.eu)

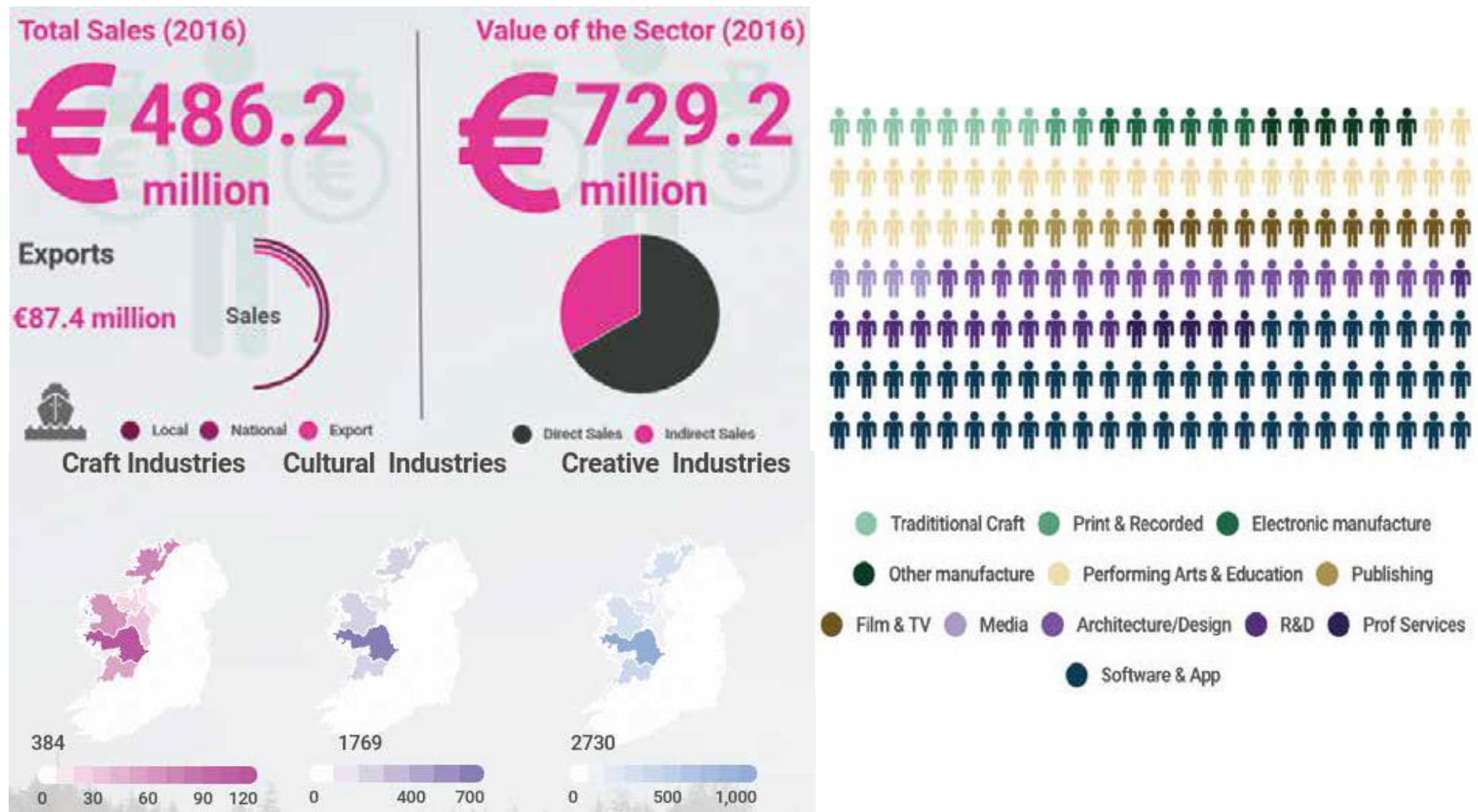
<sup>21</sup> Murtagh, A. and Collins, P. 2018. Creative Sector Supports in the West of Ireland : Entrepreneur Perspectives on Future Needs . Whitaker Institute, National University of Ireland, Galway

professionals, therefore, state agencies are a lifeline. Export skills was identified as an area that was lacking among many creative industry businesses; less than half of respondents in the survey exported. UK was the most significant export region, with 34% of respondents reporting exporting to the UK, followed by the United States and Canada.

Figures 10 and 11 below, based on public records data on company registration and employment and developed by the Insight Centre for Data Analytics, show the absolute (by number of businesses) and relative (to employment size) location for ICT businesses across the West of Ireland. Relative to the other two clusters, Connemara (west of Galway) shows up in these heatmaps as significant locations, but Galway stands out as a core location.



Figure 9 The creative industry in the West of Ireland (2016 data)



Source: Collins, P., Murtagh, A., Breen, B. and Commins, V. 2018. Economic and Social Impact Assessment: West of Ireland Creative Sector. Whitaker Institute, National University of Ireland, Galway.

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### 3. Clusters in the UK: what do we know?

#### Introduction

This section highlights relevant clusters throughout the UK. We draw on Enterprise Research Centre (ERC) analysis of industrial clusters in English Local Enterprise Partnerships (LEPs), and three Density-Based Spatial Clustering of Applications with Noise (DBSCAN) studies which identified design, pharma and creative industry clusters across the UK and Digital Health clusters in England. This is supplemented with additional information supplied by the Scottish Government, the Welsh Government, and Invest Northern Ireland.

#### Localisation of Industrial Activity across England's LEPs: 2008 & 2012

We begin with a summary of research by the Enterprise Research Centre (ERC) which was commissioned by BEIS to undertake an analysis of industrial clusters in the UK and to use the new Local Enterprise Partnerships (LEPs) as the sub-national spatial frame in England<sup>22</sup>. The analysis was designed as an information source for the LEPs as they prepared their new strategic economic plans and concentrates on the UK 11 Industrial Strategy sectors and a detailed 5-digit Standard Industrial Classification (SIC) analysis for each of the 39 LEPs (note: there are now 38 English LEPs following the merger of two LEPs).

The analysis used a very simple Location Quotient (LQ) measure which is designed to show the extent to which a particular activity is over- or under-represented in each LEP relative to the national average, for 2008 and 2012 using the local unit or workplace version of the Office of National Statistics (ONS) Business Structure Database (BSD). The choice of 2008 as the base year relates to the latest 2007 SIC and also to show if there were any major changes throughout the economic downturn in the UK. The data for 2012 was the most recent data available from the ONS.

Two of the three Galway/Mayo cluster industries are key sectors in the UK's Industrial Strategy, albeit with different labels – Life Sciences and the Information Economy. Creative Industries was not one of the 11 key sectors in the UK's Industrial Strategy but has been the subject of a Sector Deal and employs 2 million people in the UK. It is a disparate sector and thus is analysed by subsectors.

#### Life Sciences

The Life Sciences sector covers the manufacture of pharmaceutical products; medical; dental and electro-medical equipment, as well as R&D on biotechnology. Figure 12 illustrates the situation in 2008 and 2012 across England. Employment within the sector in 2008 was most heavily concentrated in the Hertfordshire LEP, with an LQ of 3-4, followed by Cheshire and Warrington with an LQ of 2-3. The Enterprise M3 LEP and Coast to Capital also had concentrations up to twice the GB average. By 2012 this picture had altered radically, the Humber, Oxfordshire, and Swindon and Wiltshire LEPs had joined Hertfordshire as the most concentrated LEPs for Life Sciences, all of which had employment up to 3 times more concentrated than the GB average.

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<sup>22</sup> Anyadike-Danes, M., Bonner, K., Drews, C.-C. & Hart, M. (2013). Localisation of Industrial Activity across England's LEPs: 2008 & 2012, ERC Research Paper No.15.

## Information Economy

The Information Economy sector includes software publishing, telecommunications; computer programming and other information service activities. Employment within the sector was concentrated within a few LEPs, largely in the South of England (Figure 13). In 2008 Thames Valley Berkshire had the highest concentration, around four times the average, followed by the Enterprise M3 LEP. LEPs in the surrounding vicinity of these two also had employment concentrations at or just above the average, whilst Cheshire and Warrington was the only LEP in the North of England with a higher concentration than average. The pattern of employment was almost identical in 2012, with the exception of Cheshire and Warrington, which no longer had a higher than average employment concentration.



Figure 12: Life Sciences Location Quotients (LQs) – 2008 and 2012

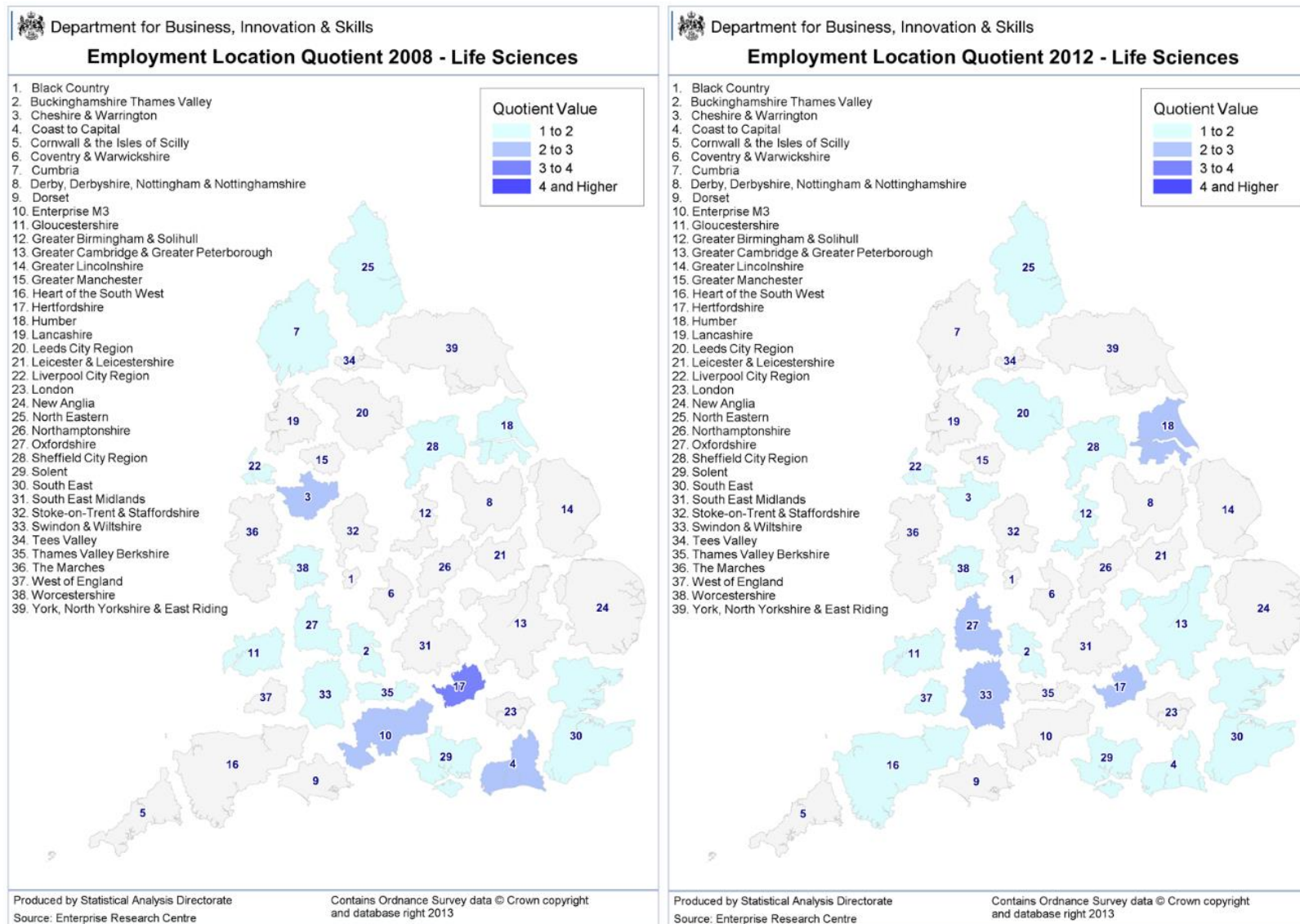
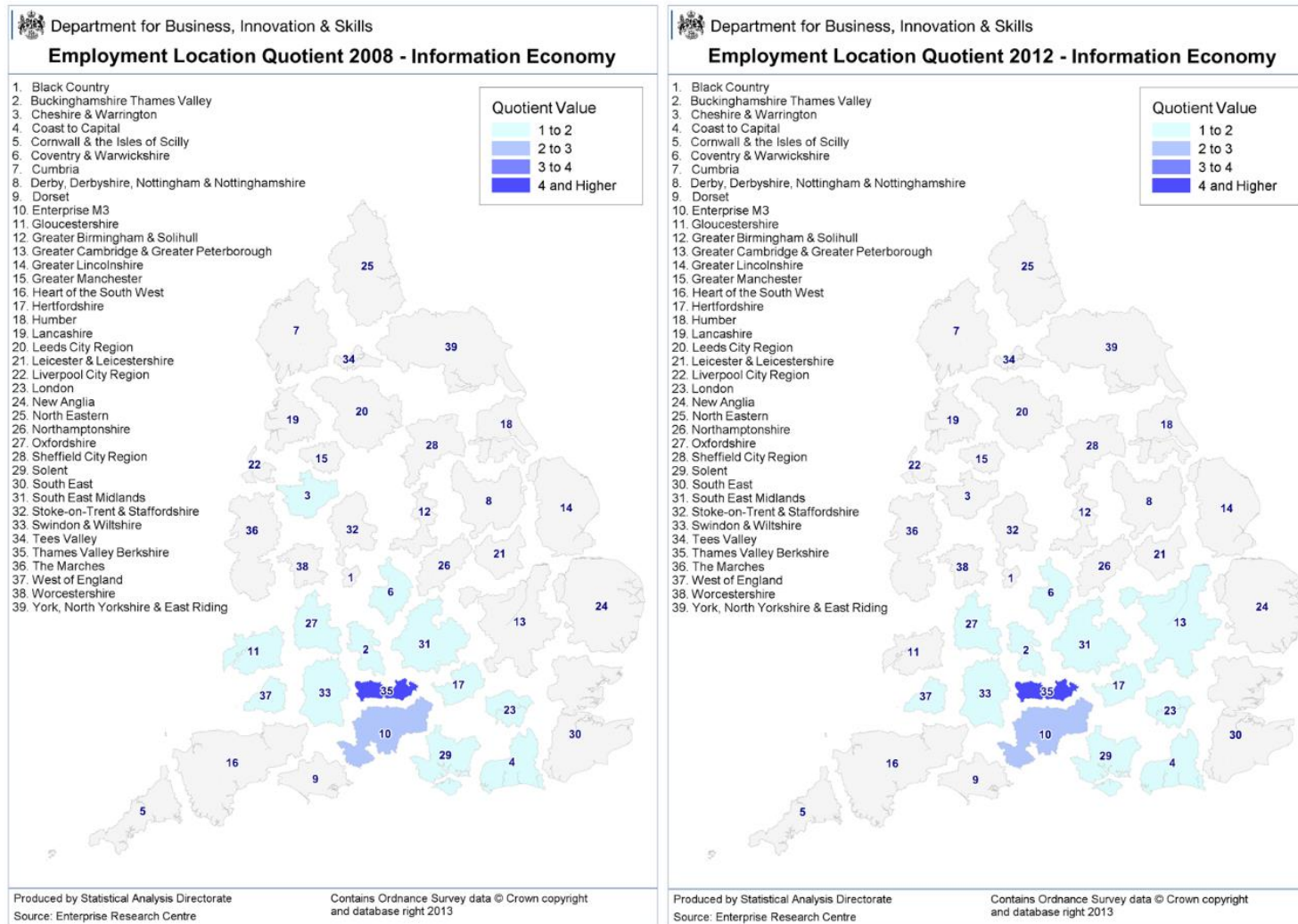


Figure 13: Information Economy Location Quotients (LQs) – 2008 and 2012





## Creative Industries

A review of each of top 20 LQs in each of the 39 English LEPs<sup>23</sup> reveals that the following LEPs had an over-representation of some components of Creative Industries as defined by NESTA<sup>24</sup>. The analysis was undertaken at 5-digit SIC level of disaggregation for 2008 and 2012. We present below only those LEPs with a LQ in excess of one for a sub-sector of Creative Industries and in the top 20 sectors in that local economic area for 2012 only.

**Buckinghamshire:** - motion picture production activities (SIC 59111); motion picture, video and television programme post-production act. (SIC 59120); advertising agencies (SIC 73110); market research and public opinion polling (SIC 73200).

**Cheshire & Warrington:** - film processing (SIC 74203).

**Coventry & Warwickshire:** - market research and public opinion polling (SIC 73200).

**London:** - motion picture production activities (SIC 59111); sound recording and music publishing activities (SIC 59200); television programme production activities (SIC 59113).

**Oxfordshire:** - market research and public opinion polling (SIC 73200); advertising agencies (SIC 73110).

**Thames Valley Berkshire:** - business and domestic software development (SIC 62012); market research and public opinion polling (SIC 73200);

**West of England (i.e., Bristol):** - motion picture, video and television programme post-production act. (SIC 59120); motion picture production activities (SIC 59111).

Overall, the creative industries are only over-represented in 7 of the 39 English LEPs and with the exception of Cheshire & Warrington in the North West and Coventry and Warwickshire in the West Midlands they are located in London and the home counties stretching out along the M4 corridor to Bristol.

It is important to note that a large LQ is by no means sufficient to make the activity indicative of a candidate cluster as is evidenced by their small contribution in many cases to total employment in each LEP. That is certainly the case for SIC 59111 in the West of England and Buckinghamshire.

## Design Industries

New analysis on the clustering of the Design Industries was undertaken for the UK's Design Council in 2018 and adopted the methodologies used in the BEIS and NIESR work summarised above. The work on the identification of design industry clusters was to help to increase the evidence base surrounding the strength of the sector across the UK. The analysis builds clusters using a bottom up approach, using location data for individual business premises from the Inter-Departmental Business Register (ONS).

Density-Based Spatial Clustering of Applications with Noise (DBSCAN) has been used to identify the design industry clusters. This bottom-up approach uses the location of individual businesses to form clusters. As such, results are not restricted to existing administrative boundaries and the clusters fall within and across administrative boundaries. The shape of the clusters are not restricted by convex

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<sup>23</sup> When this analysis was completed for BEIS in 2014 there were 39 LEPs in England but there are now 38 following the merger of two in south east Midlands.

<sup>24</sup> See <https://data-viz.nesta.org.uk/creative-nation/>

boundaries and hence represent the natural growth of clusters. Outliers are defined as 'noise' within the DBSCAN approach if they do not meet the density requirements. The analysis does not require users to specify the number of clusters in advance. Control over clusters is a more flexible approach that is based on two parameters (inputs) - a 'radius' and a 'minimum density threshold'. The radius defines the area of interest (shape, size) around each point, and the minimum density threshold sets the minimum number of points which must fall within the area for it to be considered dense.

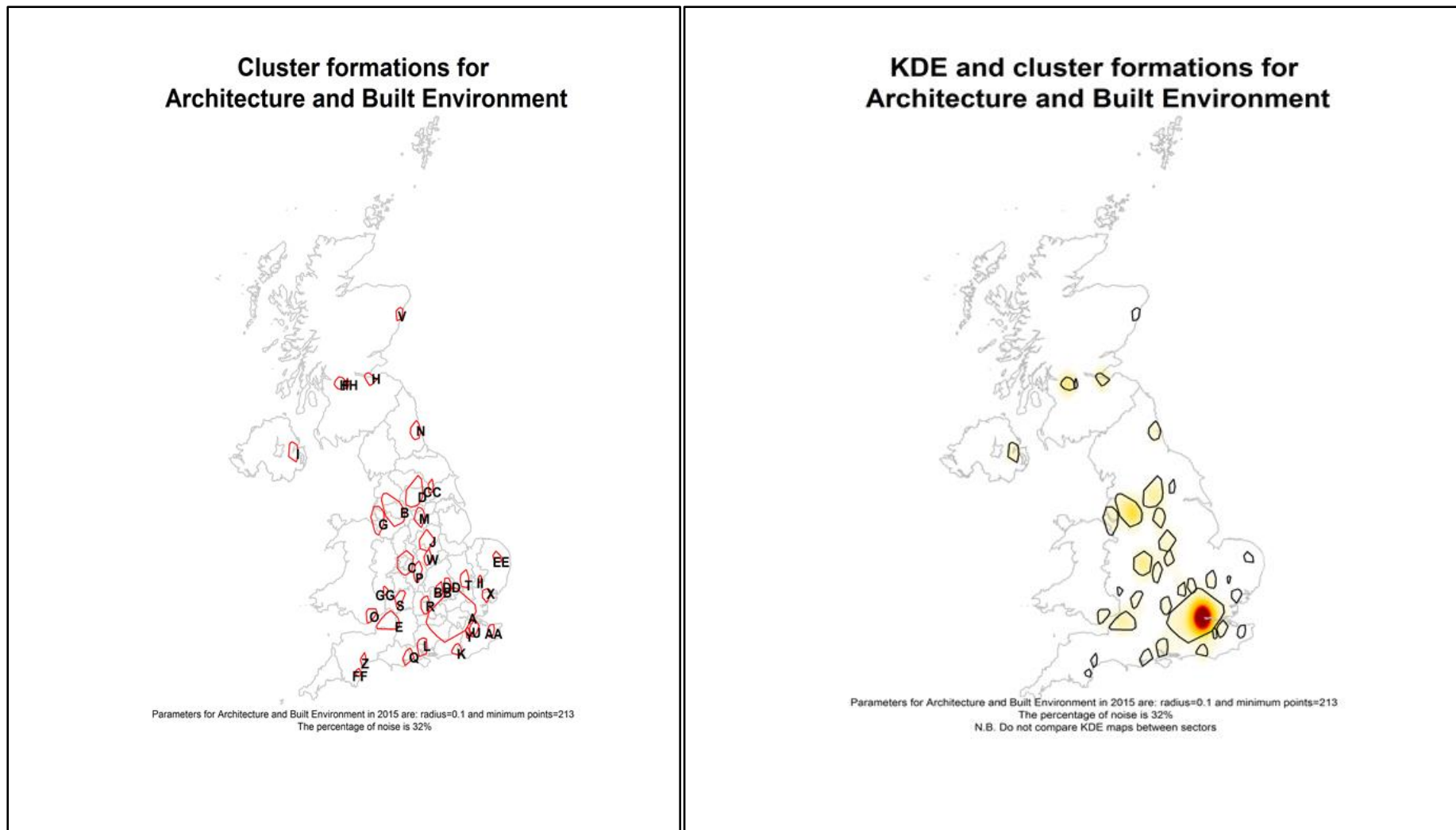
Figure 14 below shows the location of clusters in Architecture and Built Environment, one of the subsectors of the Design industries, which form part of the Creative industries sector. The map on the left is the DBSCAN cluster definition and the one on the right builds upon the DBSCAN map by overlaying the results of the Kernel Density Estimation (KDE). This allows users to better understand the distribution of employment within and outside the clusters. The red 'hotspots' are generally contained within a DBSCAN identified cluster, however where this is not the case, it is because the KDE is picking out areas with high employment, but not sufficient individual businesses to be a cluster. What is clear from these maps is that the main UK cluster here is in London.

The final map for this sub-sector provides additional context to the DBSCAN clusters by illustrating employment growth within the cluster between 2010 and 2015. The map also includes figures for total growth in the sector and the change outside the sector. To find the employment growth, outlines of the 2015 clusters are overlaid onto the 2010 data. The total number of local units and employment in 2010 which fall within the 2015 cluster boundaries are then added together, allowing for a comparison against a baseline.

The main limitation of this approach is the use of convex boundaries. As described above these may include areas which are not part of the original cluster. This does not affect the 2015 figures which are calculated based solely on the businesses identified as being part of a cluster however the 2010 data may contain points from outside these original shapes. There is also the possibility that overlapping clusters are double counting some businesses. Therefore these statistics should be seen as indicative of the scale of growth or decline in an area.

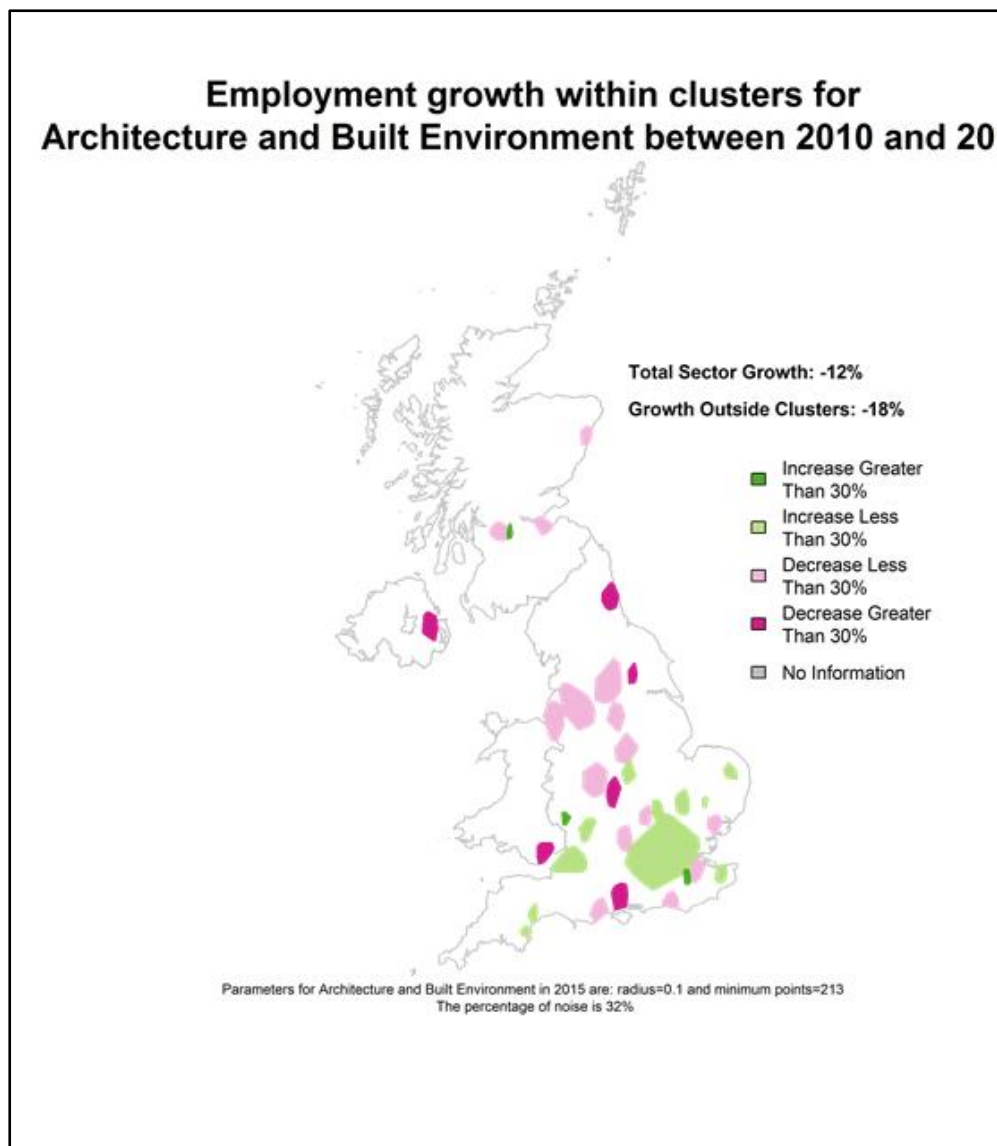
Nevertheless what is clear from Figure 15 is that the performance of the cluster in terms of employment is variable across the UK with the only clusters recording growth being London, Bristol, Worcester, Norwich, Plymouth, Nottingham and part of the central belt in Scotland which exhibits the greatest employment growth between 2010 and 2015. This illustrates the point quite well that the existence of a cluster in physical terms does not automatically convey advantages in terms of performances that the 'clustering' was supposed to deliver in the first place. The UK economy was recovering after the Great Recession in this five-year period but there is a clear north-south divide in terms of cluster performance.

Figure 14: Clusters in Architecture and Built Environment (2015)



Source: ONS BSD and Hart et al (2018)

Figure 15: Employment Growth within Architecture and Built Environment Cluster (2010-2015)



Source: ONS BSD and Hart et al (2018)

## Density-Based Spatial Clustering: Identifying Industrial Clusters in the UK

The first application of density-based spatial clustering was undertaken by the BEIS analysts in 2017 using the ONS IDBR for the period 2010-2015. The methodology is identical to that presented above for a sub-sector of the Design Industries. We only present maps of those sectors which are relevant to the study for the Galway/Mayo region in Ireland. These are Pharma, Performing Arts, Movies and Advertising and Market Research. As with Architecture and the Built Environment, the dominance of London is evident in all these sectors. Other than London, no one region or city stands out as having cluster strength and employment growth across all these industries. This general pattern matches earlier work on the geography of the creative and high-tech industries in the UK by NESTA<sup>25</sup>. The creative industries are concentrated in the southeast, particularly London, with satellite clusters, particularly in Oxfordshire, Berkshire and Buckinghamshire to the west of London, and Brighton and Hove to the south, followed by Cambridgeshire and Hertfordshire to the north east. STEM workers were prevalent in a larger number of cities across the UK. There also appeared to be small clusters in most of these industries in Cardiff, Glasgow, Edinburgh and Belfast.

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<sup>25</sup> [https://media/nesta.org.uk/documents/geography\\_uk\\_creative\\_high-tech\\_economieswv20151.pdf](https://media/nesta.org.uk/documents/geography_uk_creative_high-tech_economieswv20151.pdf)

Figure 16: Clusters in Pharma (2015)

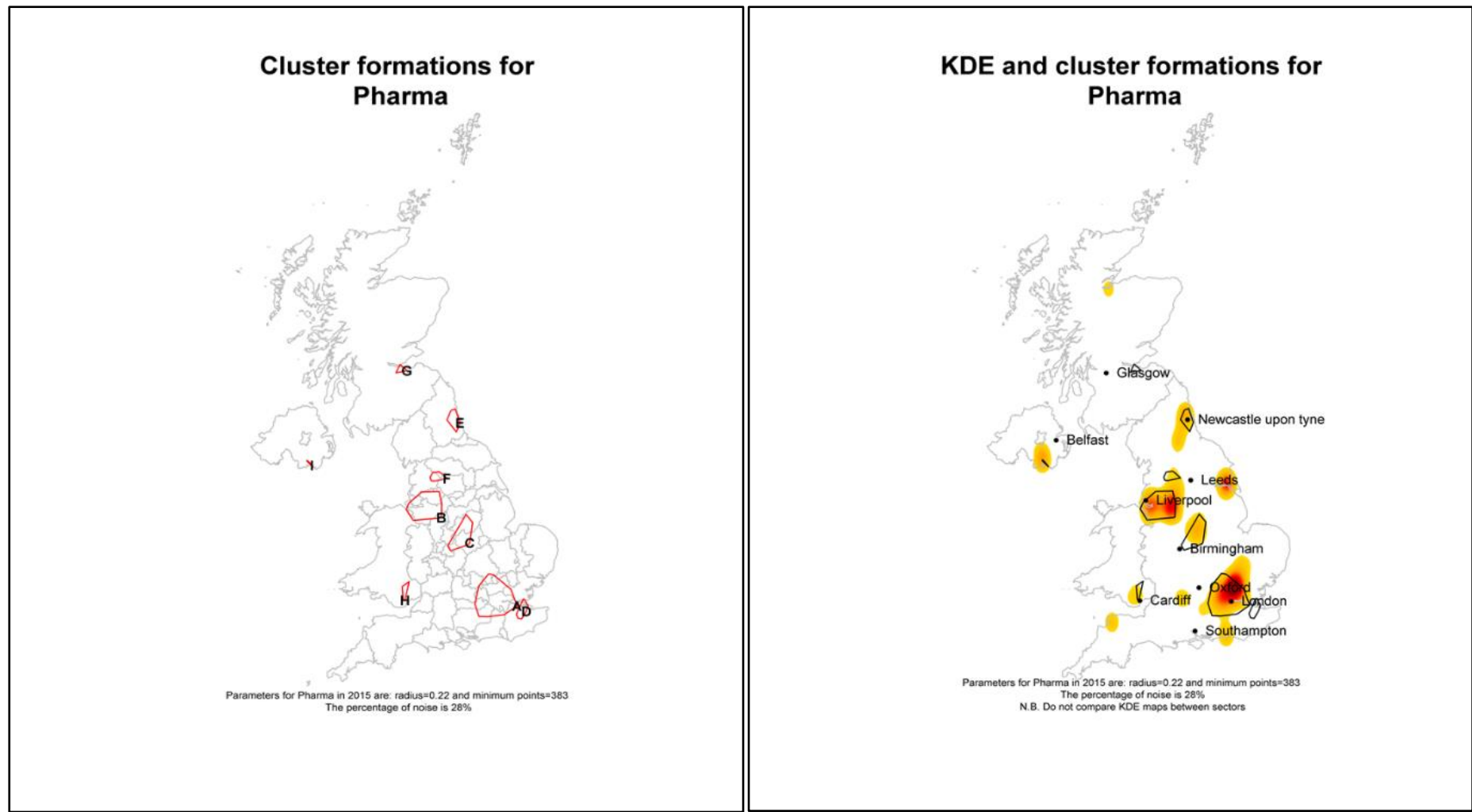




Figure 17: Employment Growth within Pharma (2010-2015)



Figure 18: Clusters in Advertising and Market Research (2015)

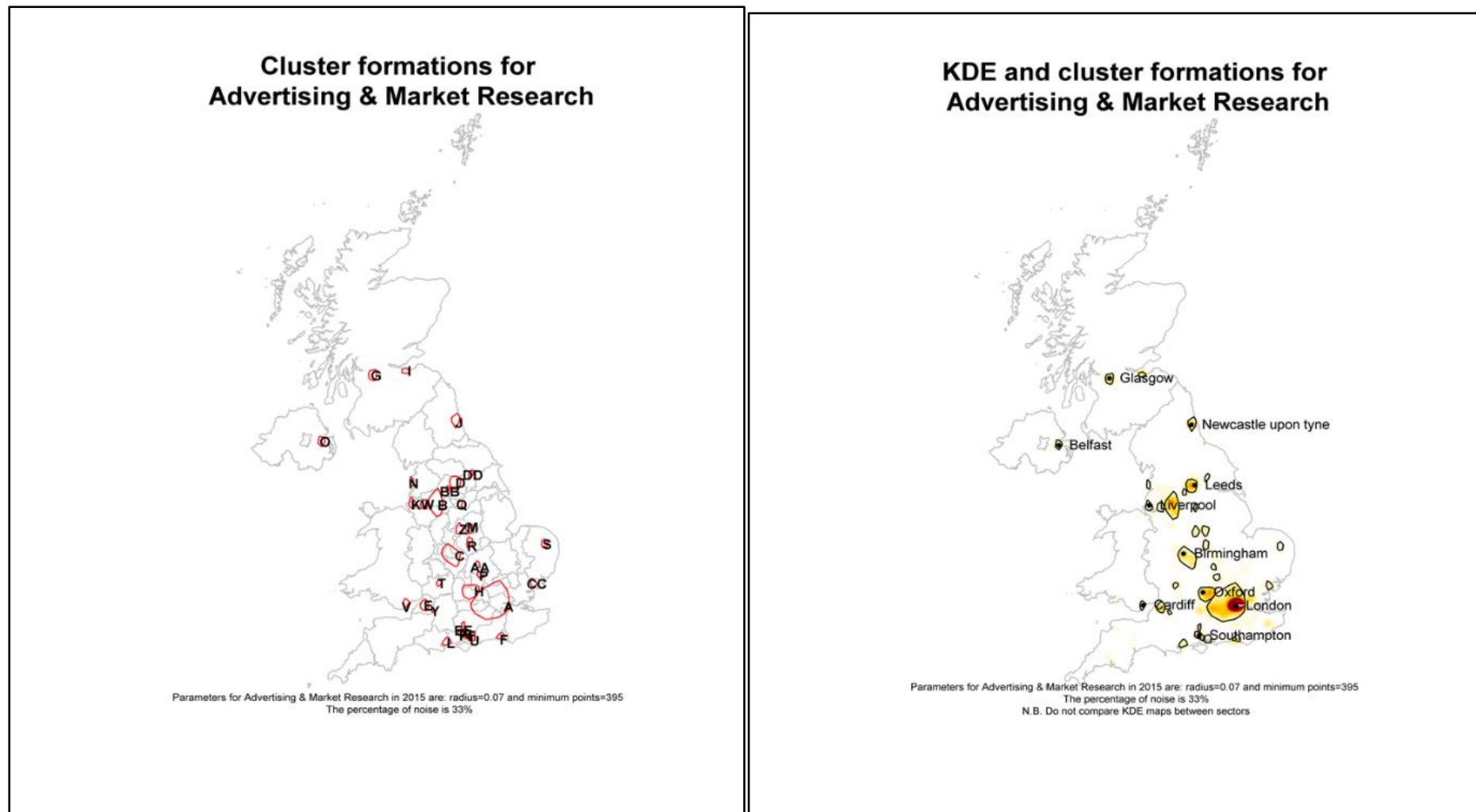


Figure 19: Employment Growth within Advertising and Market Research (2010-2015)

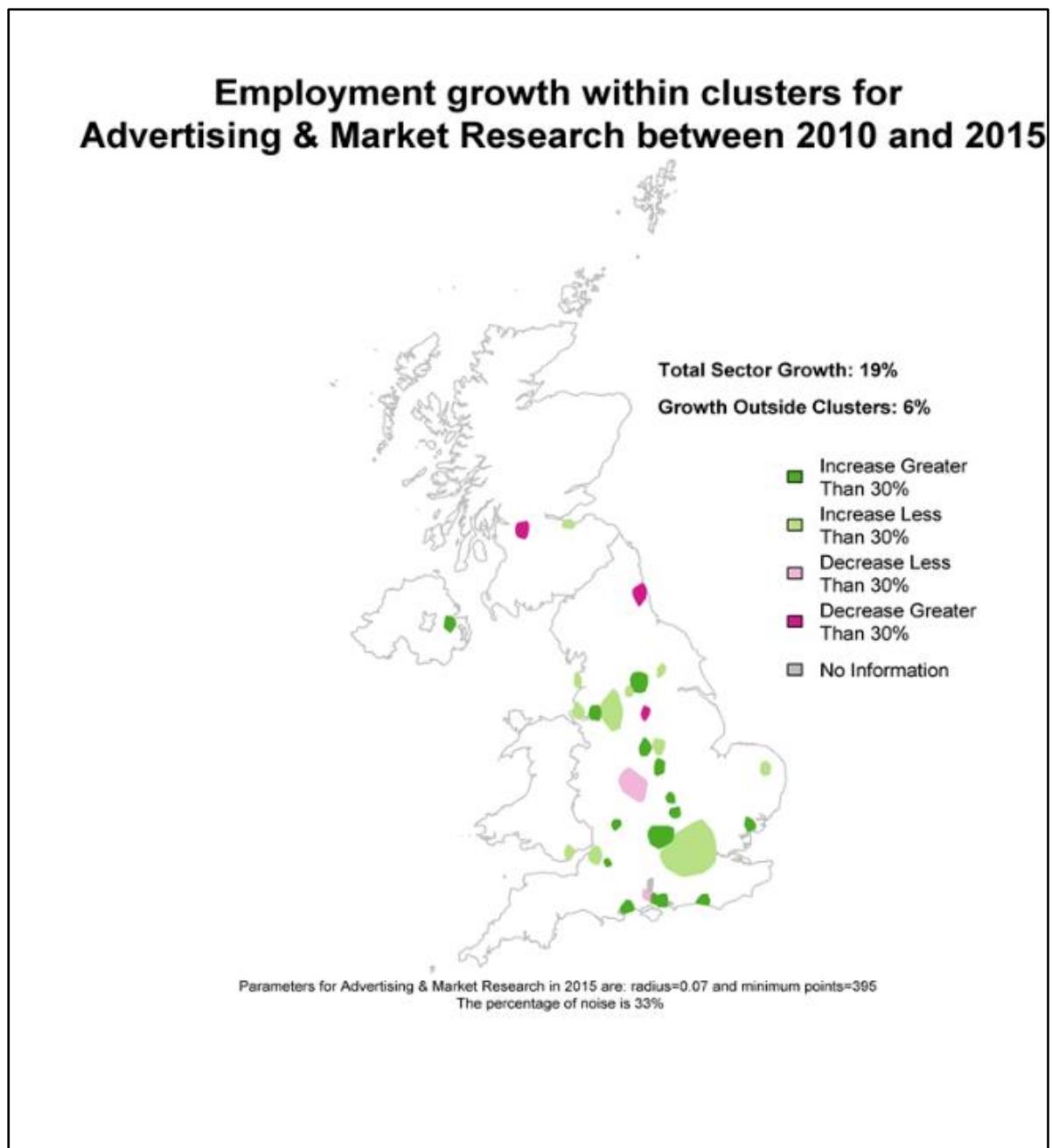


Figure 20: Clusters in Movies (2015)

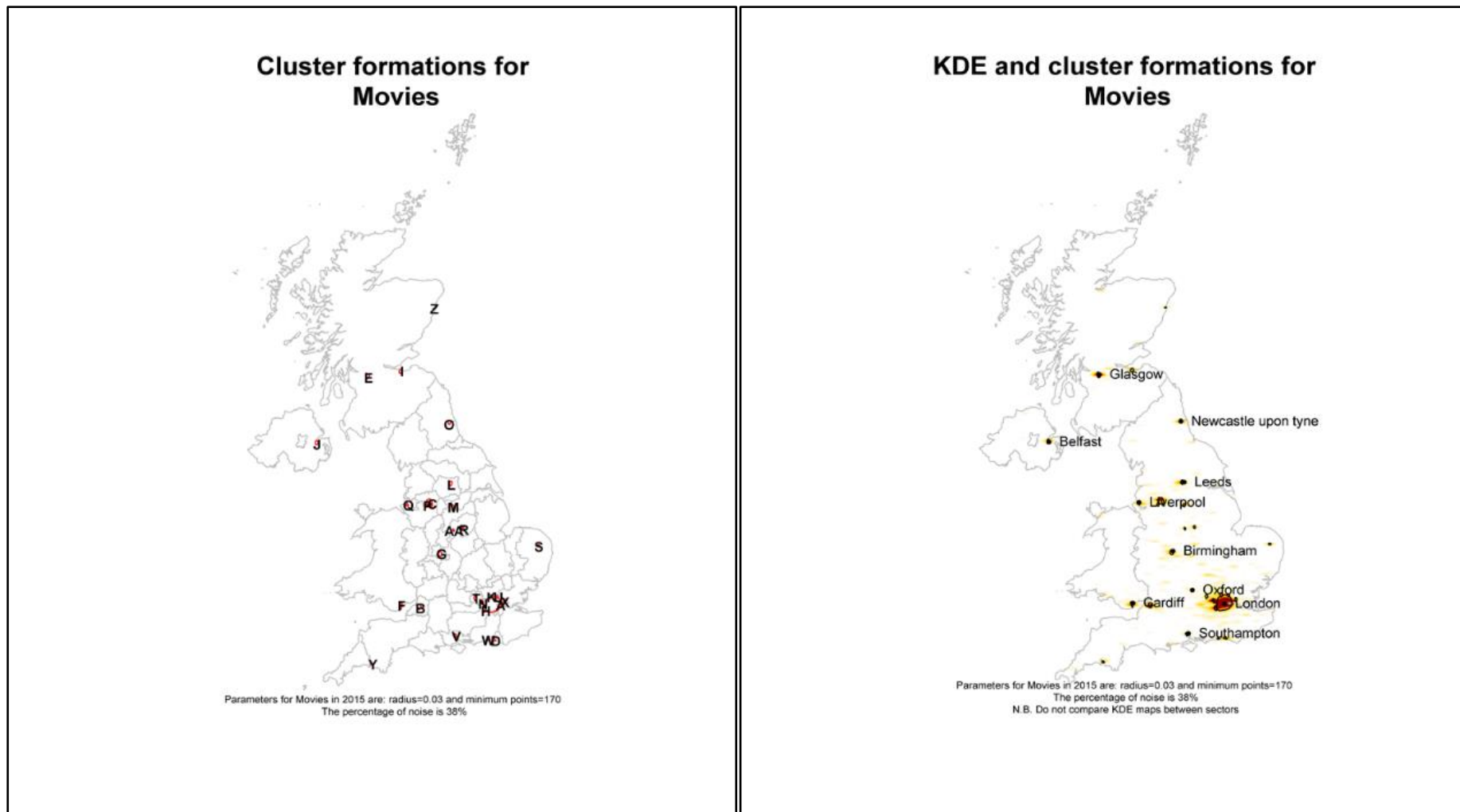


Figure 21: Employment Growth within Movies (2010-2015)

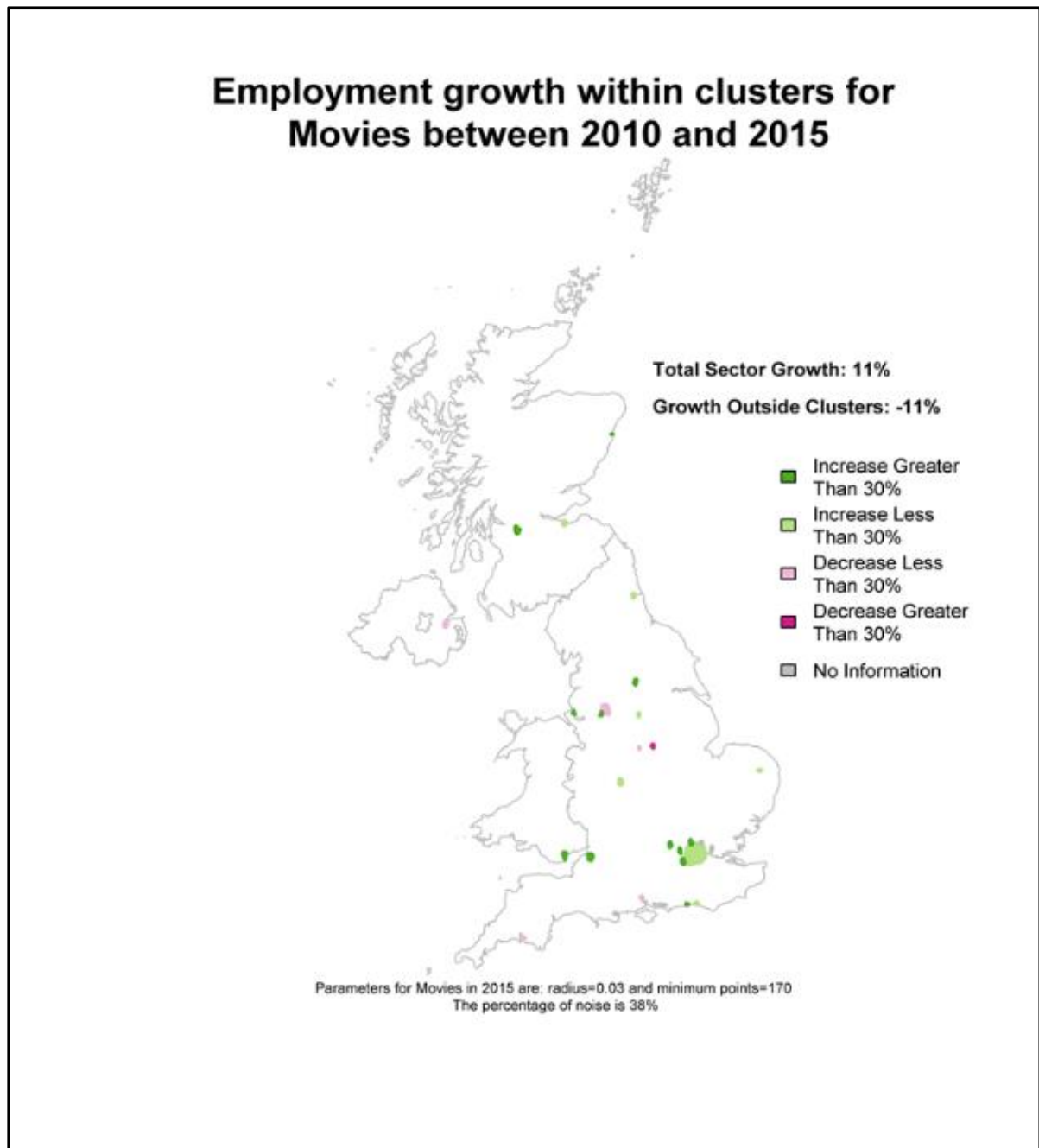




Figure 22: Clusters in Performing Arts (2015)

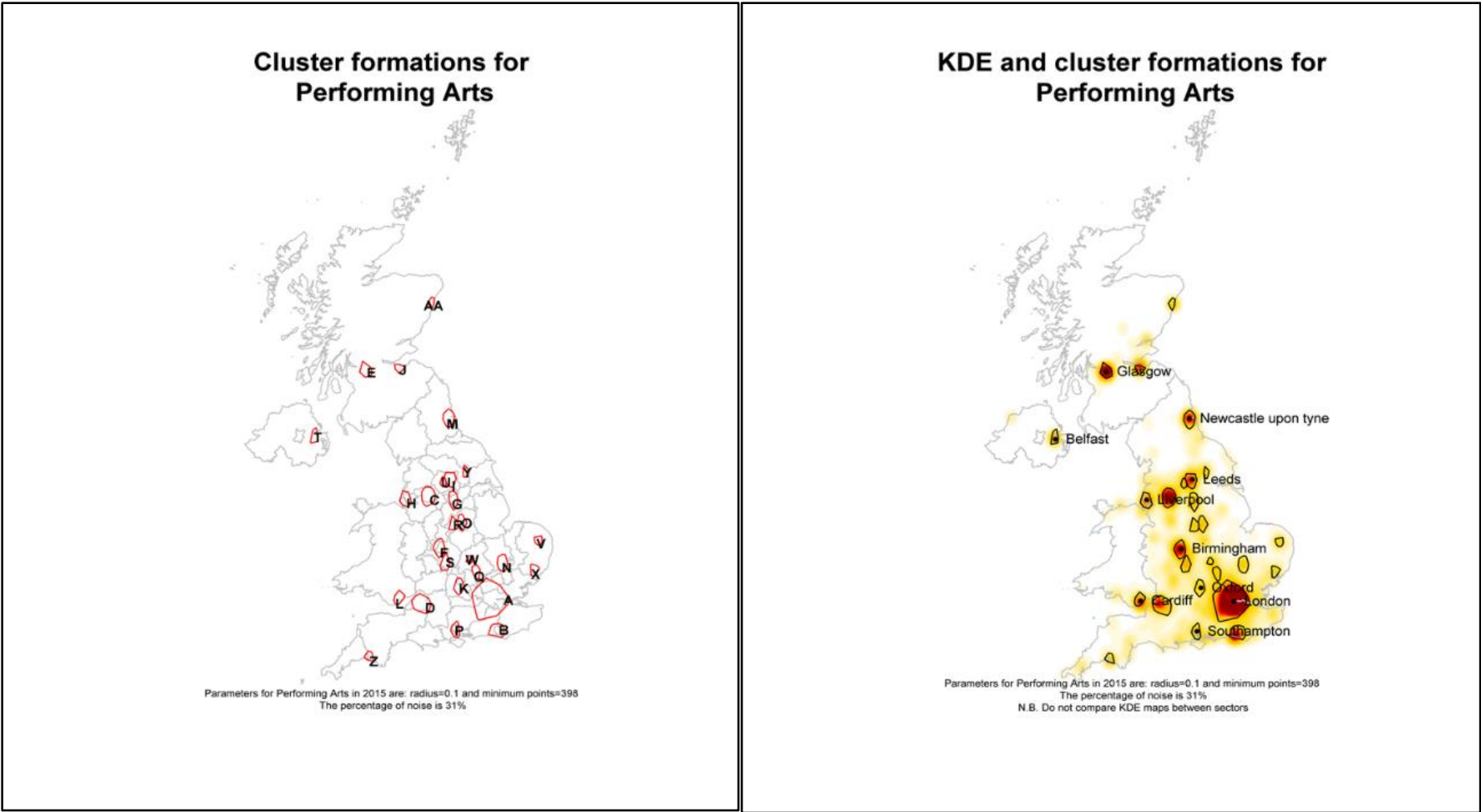
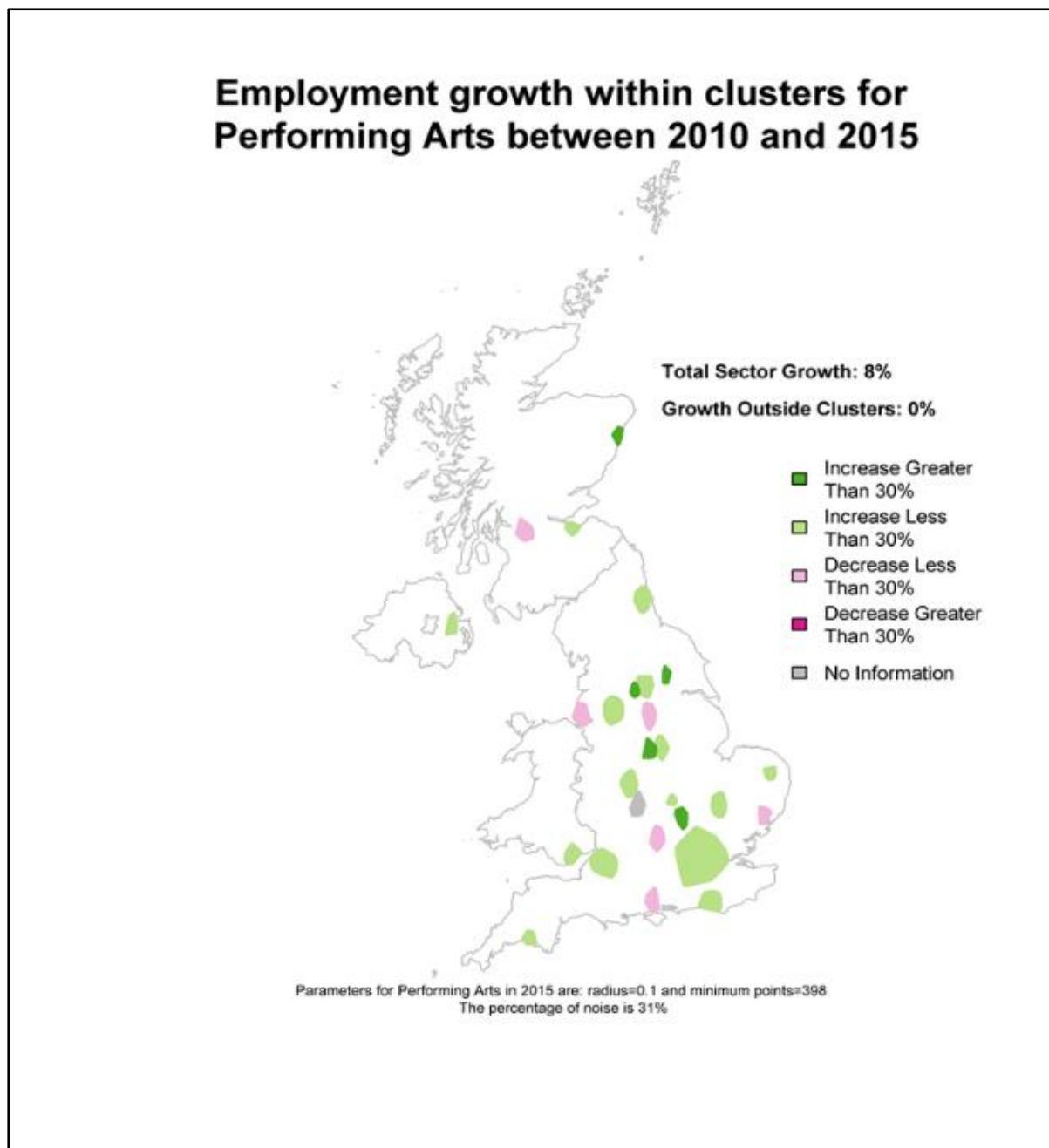


Figure 23: Employment Growth within Performing Arts (2010-2015)



## Digital Health Clusters in the UK

Recently, a research team led by the NIESR sought to test a methodology which ignored artificial administrative and political boundaries. It focused on three sectors in the first instance one of which might be of interest in this study<sup>26</sup>. The Digital-Health sector is seen as an emerging industry at the intersection of healthcare services, information technology and mobile technology and is not easily defined by the standard SIC codes.

Figure 24 shows the geographical location of Digital-Health clusters (Colours) identified by running the BSBCAN algorithm with parameters  $\text{eps}=15\text{kms}$  and  $n=5$ , based on the FAME database for the UK. White circles on the map represent companies that are not assigned to clusters. Most of the clustering of this sector are in main urban areas and are close to London (Southampton; Oxford and Cambridge) or along a corridor from Birmingham to Leeds. Further north Glasgow, Edinburgh and Newcastle are identified as more isolated and smaller clusters.

Figure 25 shows the where the density of the Digital-Health (DH) sector is greater than the national average (LHS) or at least twice as great as the national average (RHS). Most of the clusters we identified above are still shown which suggests there are sector-specific factors attracting DH companies to these areas (LHS). However, only Oxford and Cambridge are identified as DH clusters when we raise the bar to twice the national average. A series of case studies on firms identified as part of a digital health cluster in Birmingham on the basis of information on their websites found that these firms did not in general perceive themselves as part of a functional cluster, and that there were not significant partnerships between them. This is recognised as a UK-wide issue and suggests that a relatively high bar needs to be set in cluster identification.

It is worth noting that this finding matches an assessment of the location of England's innovation activity.<sup>27</sup> This work found the strongest innovation activity in healthcare, biosciences and ICT outside of London were in the Cambridge, Oxford and to a lesser extent Leeds LEP areas.

## Life Science clusters across the UK

The Life Sciences Industrial Strategy 2017, produced by the life sciences sector for the UK government, built on the government report "Strength and Opportunity 2016", and recognised that while medtech businesses were dispersed throughout the UK, as shown in Figure 26 below, there were some regions with greater shares of the industry than others. Yorkshire and the Humber was one of those, with 11% of UK medtech employment and in particular the Leeds area, with around 200 medtech firms.

Leeds City Region, which includes Bradford (with which Galway is twinned), chose medical technologies as strength to focus on in its 2017 Science and Innovation Audit<sup>28</sup>, led by Professor John Fisher from the University of Leeds, in partnership with Leeds Enterprise Partnership (LEP), the region's universities and local businesses. Its Audit report makes the point that the medtech industry in the UK is "highly fragmented" (p.3) and noted a "lack of business-to-business networking and pre-competitive collaboration". Since then, several new initiatives have been announced, including Grow MedTech, a programme providing specialist support for innovation in medical technologies, involving a consortium of six universities across the Leeds and Sheffield City Regions, led by the University of Leeds. The report estimated that Leeds City Region had 2,800 businesses in Health and Life Sciences

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<sup>26</sup> <https://www.gov.uk/government/publications/industrial-clusters-in-england>

<sup>27</sup> [http://smartspecialisationhub.org/wp-content/uploads/2018/02/MEIA\\_updated\\_Nov2017.pdf](http://smartspecialisationhub.org/wp-content/uploads/2018/02/MEIA_updated_Nov2017.pdf)

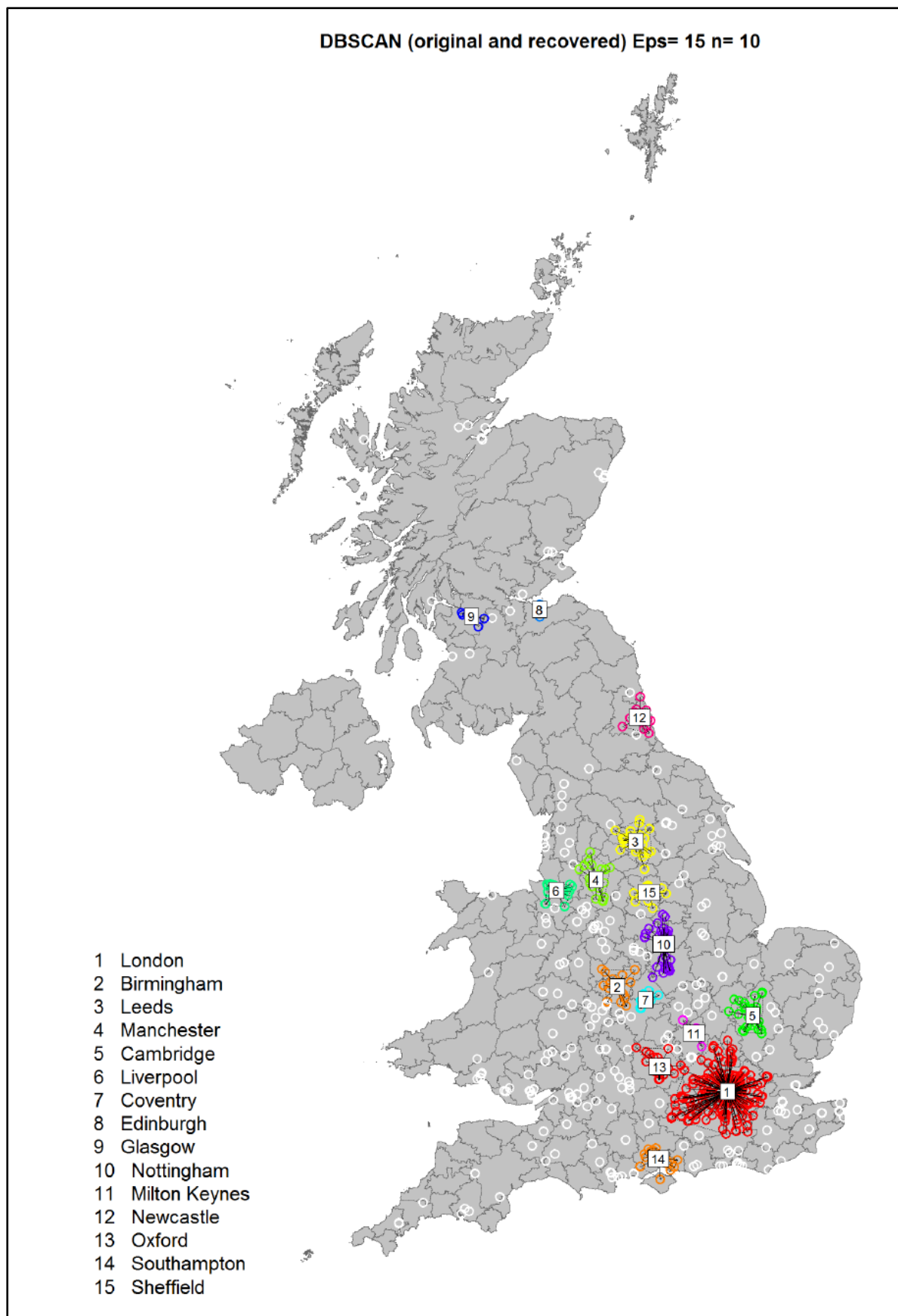
<sup>28</sup> <https://leedscityregionmed.tech/> It should be noted that Health Innovation and Digital Health was also chosen by many other regions as areas of strength, reflecting the dispersed nature of this industry in the UK.

in 2015, of which 250 were medtech companies employing 5,000 people and a further 200 were in digital health. A third of employment was in the niche area of manufacturing of medical instruments. Leeds City Region claims the largest concentration of medical device companies in the UK<sup>29</sup>. Nearly a quarter of the UK's digital health jobs are in the region. NHS Digital is based in Leeds, and medicinal and pharmaceutical products exports from the Leeds City Region totalled £2.5bn in 2015, accounting for 25% of all exports – the region's single largest export commodity. Leeds was also recognised as a global centre for orthopaedic device R&D and manufacturing in the UK Government's Life Sciences Industrial Strategy, released in 2017. A Digital Health Enterprise Zone is led by the University of Bradford.

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<sup>29</sup> <https://www.investleedscityregion.com/key-sectors/healthcare-and-innovation/>

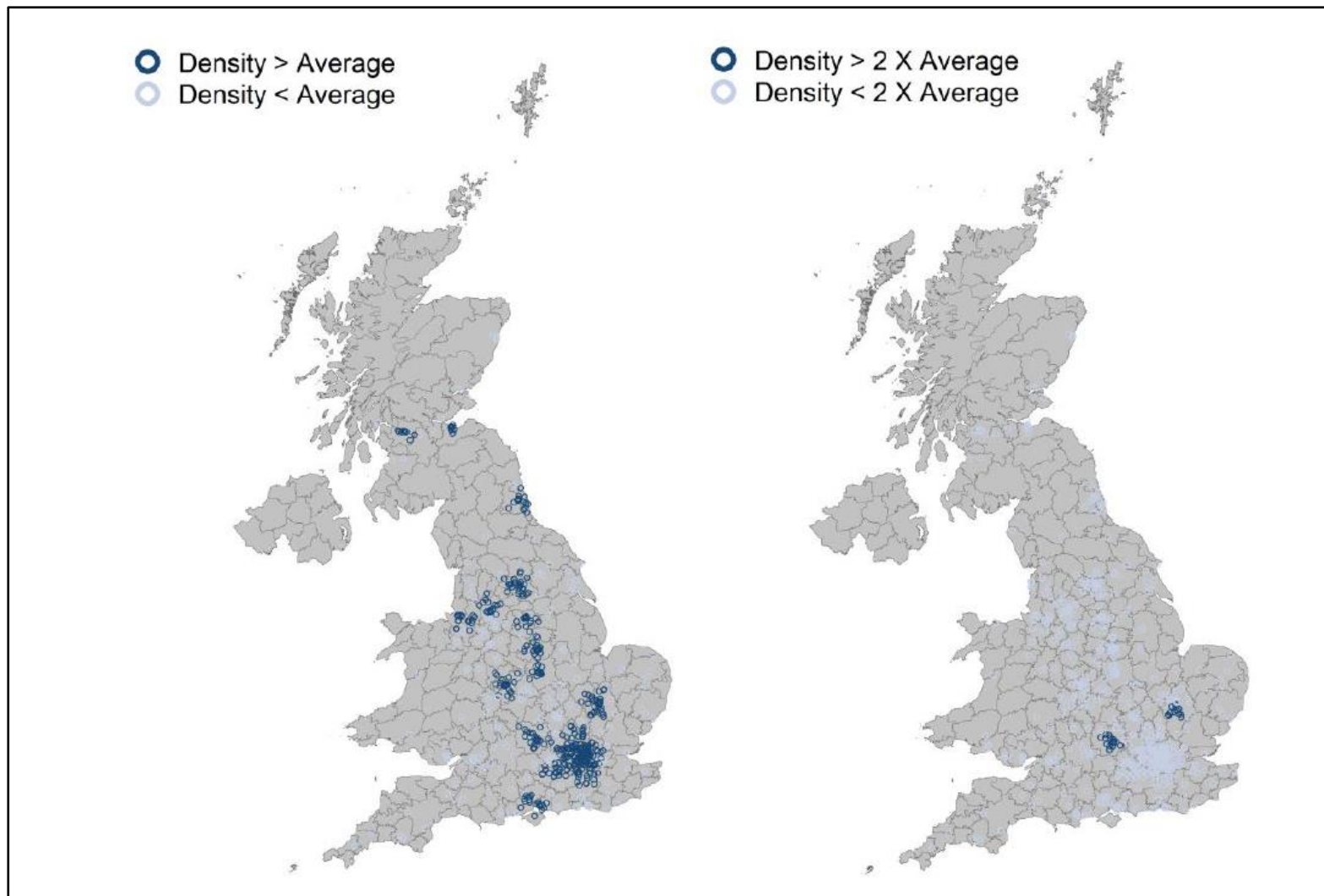
Figure 24: Map of Digital Health Clusters in the UK



Source: NIESR et al (2017)

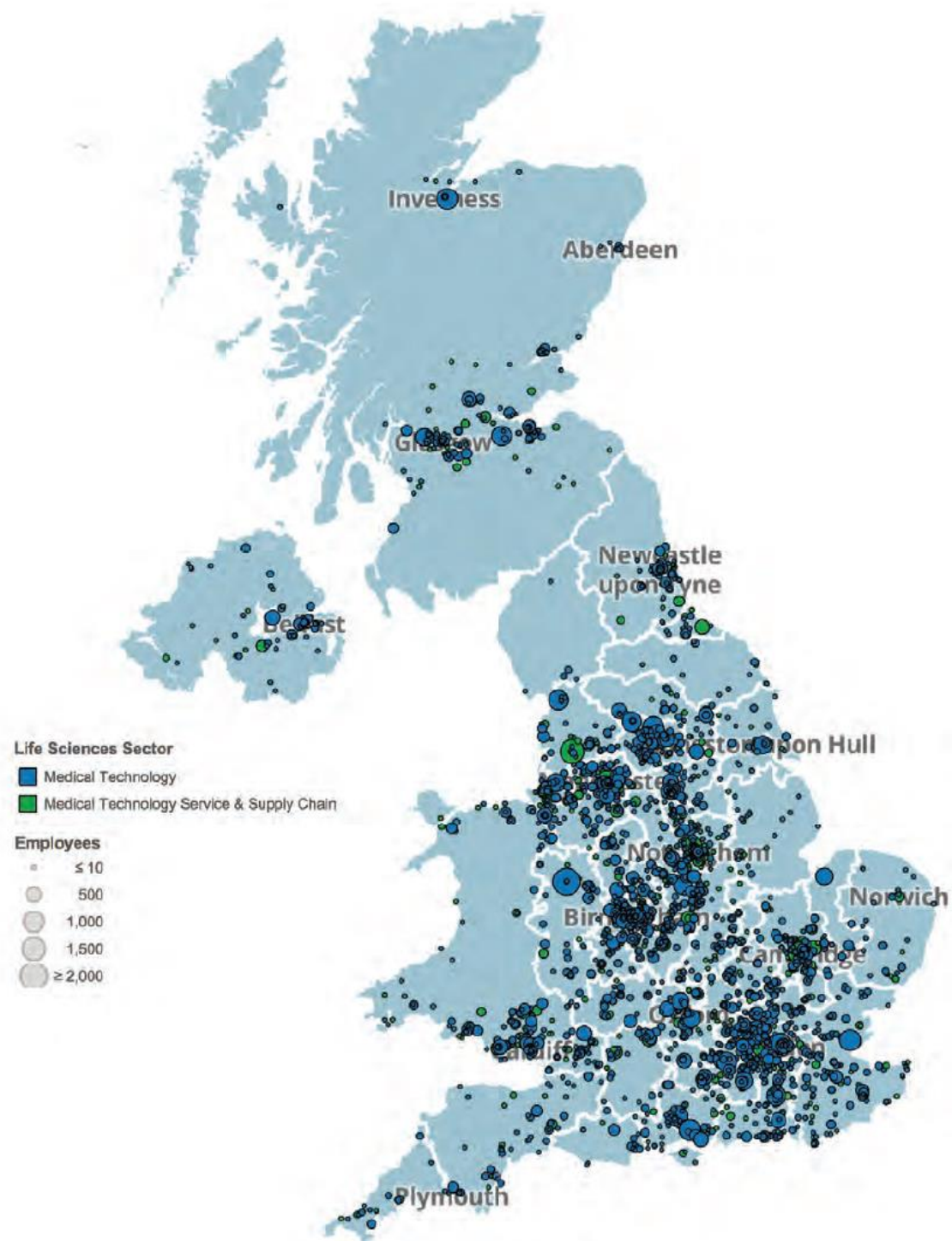


Figure 25: Map of Digital Health Clusters in the UK after controlling for other companies in the clustering areas



Source: NIESR et al (2017)

Figure 26: Medtech industry distribution in the UK



Source: Dept. for Business, Energy and Industrial Strategy (2017). Strength and Opportunity 2016, London: HM Government. p.41

## Scotland, Wales and Northern Ireland

The first study reviewed in this section only considered clusters in English LEPs, and therefore in this section we briefly review clusters in Life Sciences, the Information Economy, and the Creative Industries in Scotland, Wales and Northern Ireland.

Scotland, Wales and Northern Ireland are notable for the strength of their medtech and digital health research infrastructure, including specialist research centres that are recognised within the UK as centres of excellence. The industry distribution maps reproduced in the previous section suggest that this is not quite matched in significance by the size of the medtech industry surrounding these research centres. Scotland reports it has one of the largest Life Sciences clusters in Europe, employing over 41,000 people across some 770 organisations<sup>30</sup>, or 1.5% of the Scottish workforce. Around 250 of these are medtech companies, employing around 9,000 people<sup>31</sup>, or .03% of the workforce. There are 365 Companies in the Life Sciences sector employing over 12,000 across Wales, or less than 1% of the workforce. Of these, 70 businesses are in medtech<sup>32</sup>. A 2015 report on the Life and Health Sciences in Northern Ireland reported approximately 130 mostly indigenous companies employing around 7,500 people in the sector or less than 1% of the workforce<sup>33</sup>.

A 2016 report found 1,200 ICT businesses in Northern Ireland, employing around 13,000 people<sup>34</sup>, or 1.4% of the workforce. There were around 9,500 tech businesses registered in Scotland in 2018<sup>35</sup>, employing 62,500 people, or 2.4% of the workforce. There are 3,600 tech businesses in Wales,<sup>36</sup> employing 45,000 people, or 5% of the workforce. This compares with 12,300 enterprises employing 106,000 people in Ireland in 2016<sup>37</sup>, or 4.5% of the workforce, and 695 enterprises in Galway and Mayo, employing almost 4,000 people, or 1.7% of the workforce.

Over 70,000 people work in the creative industries or in creative occupations in Scotland<sup>38</sup>. This represents around 2.5% per cent of the workforce, somewhat less than the equivalent in Galway/Mayo of 3.6%. Creative industries are one of Wales' fastest growing sectors, with an annual turnover of almost £2bn, employing more than 58,000 people<sup>39</sup>, around 4% of the workforce. Over 25,000 people work in the creative industries or in creative occupations in Northern Ireland<sup>40</sup>. This represents 3.1 per cent of the workforce. In the creative sector, it is worth noting that, in Scotland, Dundee has a historically significant if small video game cluster<sup>41</sup>. One of the world's most successful video games, Grand Theft Auto, was created there by Rockstar.

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<sup>30</sup> <https://www.lifesciencesscotland.com/advantages/vibrant-diverse-growing-company-base>

<sup>31</sup> <https://www.lifesciencesscotland.com/key-subsectors/med-tech>

<sup>32</sup> <https://tradeandinvest.wales/medtech-businesses-wales-0>

<sup>33</sup> <https://matrixni.org/wp-content/uploads/2015/02/MATRIX-life-and-health-sciences-foresight-report-2015.pdf>

<sup>34</sup> <https://matrixni.org/documents/the-2016-digital-ict-report/>

<sup>35</sup> <https://www.scotlandis.com/wp-content/uploads/2019/12/scotlands-digital-technologies-summary-report.pdf>

<sup>36</sup> <https://tradeandinvest.wales/key-industries/tech>

<sup>37</sup> Source: Central Statistics office Business Demography and labour Force Survey

<sup>38</sup> <https://www.gov.scot/policies/creative-industries/>

<sup>39</sup> Source: Welsh Government

<sup>40</sup> <https://www.nibusinessinfo.co.uk/content/creative-industries-overview> accessed 23/11/2020

<sup>41</sup> NESTA <https://gamesmap.uk/#/map> (accessed 23/11/2020) shows 133 games developers and publishers in Scotland, 66 in Wales, 42 in Northern Ireland and 149 in Yorkshire and the Humber.

## 4. Conclusion: Matching clusters in the UK with the west of Ireland

Table 4 summarises the strength of relevant clusters for a set of sixteen city regions and LEPs that display some evidence of clustering in at least one of the three industrial clusters identified for Galway/Mayo. This demonstrates that there are possible opportunities to match clusters in Galway/Mayo with several regions of the UK, including outside Greater London and the south-east of England.

Before highlighting these regions, it is worth reflecting on how the building of exchange relationships between matched regions could extend much wider than trade alone. For example, it could include exchange of information and experience of industry cluster or ecosystem management, collaboration and syndication in specialist growth finance such as sector-specific venture capital, and collaboration in packaging technology commercialisation opportunities by researchers in universities and private sector firms where bundles of complementary technologies may be held by different organisations across regions.

Within the south-east of England, Cambridge, Oxford and Brighton have some similar characteristics to Galway (a core vibrant university city, around 100,000 population and in the case of Brighton a coastal location) and Hertfordshire has some similar characteristics to Mayo (no central large city, strength in pharma and life sciences), though clearly it is in a more strategically advantageous position, being commutable to London and close to both Oxford and Cambridge. All of these are, however, close to London.

Scotland, Wales and Northern Ireland have significant investment in research centres in medtech and digital health, though the size of the industry clusters that surround them are not as large as in certain English regions. Nevertheless, Scotland's medtech industry is the same size as that of Galway/Mayo.

One interesting candidate outside the "golden triangle" or the south-east of the UK is Leeds City Region, which has strengths in medtech and in digital and creative industries (including games) and is striving to create a coherent industry cluster from some 250 medtech and 200 digital health enterprises. Galway has some connections with the area; for example, Galway city is twinned with Bradford, and the president of NUI Galway, Professor Ciarán Ó hÓgartaigh has a PhD from the University of Leeds. Mayo and to a lesser extent Galway have strong diaspora connections with Leeds and Bradford stretching back to before the Great Famine; one estimate puts the size of the Irish community in Leeds alone at 50,000<sup>42</sup>. The Leeds Irish centre sees itself as "the premier Irish Centre in Britain"<sup>43</sup>. Given these strong historic links, the Leeds City Region's identification of medtech as a key industry for the region's future, its relatively strong manufacturing base, and with digital technologies seen as another key sector, this is a possible opportunity for fact-finding missions in both directions.

Given its ambitions and the weaknesses it has recognised in its own medtech industry, such as a lack of connectedness within the sector, Leeds City Region could learn much from the way Ireland's medtech sector has self-organised, and could therefore welcome an approach. The same could be said for Birmingham, where research has suggested that digital health companies in the region are not well networked. In fact, a first step might well be to organise a fact finding mission from Leeds,

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<sup>42</sup> <https://www.untoldstories.co.uk/>

<sup>43</sup> <https://theleedsirishcentre.co.uk/about-us.html>

Manchester, Birmingham, Bristol or other UK city regions to Galway, rather than the other way around. In addition to trade mission activity, themes to explore, could be the management of a regional medtech cluster, stimulating needs-driven innovation (for example, Grow Medtech in Leeds could meet its more mature equivalent in Galway, BioInnovate) and encouraging the emergence of digital health entrepreneurship. The latter is an area where Galway could perhaps learn from Bradford's Digital Health Enterprise Zone. Other themes could include developing an infrastructure for digital entrepreneurship and supporting the creative industries.

In relation to the information economy/creative sector crossover, there are several smaller cities, closer in size to Galway, such as Belfast, Brighton and Bournemouth which are worth exploring with a view to exchange of experience. While these might not lead to much in the way of direct trade links, the exchange of experiences could lead to stronger networks and clusters within the respective regions. Given the risks to trade between the UK and Ireland caused by Brexit, including exchange rate volatilities, widening the exchange to information exchange on issues such as innovation and entrepreneurship ecosystem management could bring short term benefits to both parties while revealing longer term trading opportunities.

### Recommendations

1. The British Embassy in Ireland should approach City regions suggested by this research to sound out whether they would be interested in a fact-finding economic mission to the west of Ireland. The Embassy could consider first approaching regions that have a distinct medtech/digital health focus, such as Leeds City Region, then explore other possibilities, for example in the crossover between digital and creative sectors, for example games. Possible candidates here might include the Business Board (Cambridgeshire and Peterborough's LEP), Oxfordshire LEP, and Coast to Capital LEP (for Brighton) in the South-East, but also Manchester, Birmingham and Cardiff.
2. The British Embassy in Ireland should contact the Director of the Irish Medtech Association, Dr Sinéad Keogh to sound it out in relation to a possible fact-finding mission by members in the west of Ireland to one or several UK regions. It would be advisable to liaise with Kenneth Deery, CEO of Galway Chamber of Commerce and Mary Rodgers, CEO Galway City Innovation District, and to make contact with the office of the president in NUI Galway.
3. The British Embassy in Ireland could consider stimulating exchange of information as well as trade between the west of Ireland and UK regions. One approach could be to sponsor a number of sector-specific seminars (which could be virtual) on regional cluster emergence and management, and/or collaborative learning and innovation in the era of COVID-19. For example, City Region managers from the UK and regional innovation ecosystem leaders in Galway and Mayo could meet (virtually) compare approaches, and valuable lessons could be drawn from comparing collaboration in vaccine development at pace in England and ventilator innovation in Galway. These collaborative innovations included a wide range of public and private sector actors. Adapting the creative arts to COVID restrictions could be another interesting exchange, particularly in the light of Galway's experience as European Capital of Culture in 2020. Finally, pivoting business models for digital businesses, and encouraging inter sector crossovers such as between medtech and IT or IT and the creative sector could be another interesting and valuable theme.



**Table 4 Summary of clusters in major UK cities/LEP areas**

City	Belfast	Birmingham	Bournemouth	Brighton	Bristol
Pharma		x		x	
Life Sciences					
Med-Tech		x			X
Digital Health					
Information Economy	x		X	x	
Creative economy				X	
Design					
Architecture & Built Environment					
Advertising & Market Research					
Movies	x		x	x	X
Performing Arts		X	X	X	X

City	Cambridge	Cardiff	Edinburgh	Glasgow	Hertfordshire
Pharma					X
Life Sciences	X		x	x	X
Med-Tech	X	x	x	x	
Digital Health	X				
Information Economy	x				x
Creative Economy	x		x	x	x
Design					
Architecture & Built Environment					
Advertising & Market Research					
Movies		x		x	x
Performing Arts		x	X	X	

City	Leeds	Manchester	Newcastle	Oxford	Reading	Southampton
Pharma		X	x			
Life Sciences	x			X		
Med-Tech	X	X		X		x
Digital Health	x			X		
Information Economy	x			x	X	x
Creative Economy				X	X	
Design						
Architecture & Built Environment						
Advertising & Market Research	x	X		x		
Movies	x	X				
Performing Arts	X	X	X			

Source: authors' impression based on cited reports

## Appendix 1 Codes for Clusters used in this project

### Core Med Tech

NACE Code      Description

C32.50 Manufacture of medical and dental instruments and supplies

M71.12 Engineering activities and related technical consultancy

M72.19 Other research and experimental development on natural sciences and engineering

### Peripheral/Suppliers to Med Tech

Note: could include many other sectors as well as Med Tech - so potentially higher risk of distorting data on med tech

NACE Code      Description

N82.92 Packaging Activities

C22.29 Manufacture of other plastic products

C31.01 Manufacture of office and shop furniture (includes fitting and furniture for laboratories)

Q86.23 Dental Practice Activities (includes Dental laboratory)

C28.91 Manufacture of metallurgy (includes casting machines)

C28.96 Manufacture of plastics and rubber machinery (includes moulding)

C28.99 Manufacture of other special purpose machinery n.e.c. (includes tubes valve making machinery, robots for industrial use)

J58.29 Other Software Publishing (includes computer software design and can capture medical software)

M71.12 Technical testing and analysis (includes metallurgist (private practice))

M75.00 Veterinary activities (included veterinary laboratory)

N81.22 Other building and industrial cleaning activities (includes sterilisation)

C24.20 Manufacture of tubes, pipes, hollow profiles and related fittings, of steel

C21.20 Manufacture of pharmaceutical preparations (includes diagnostic preparations and medical surgical gut string fr)

### Equivalent SIC codes used in UK comparison

#### MedTech (core)

SIC codes: SIC codes for core medtech manufacturers 3841 to 3851 (Surgical and Medical Instrument Mfg to Ophthalmic Goods Mfg.) Note: this excludes a lot of suppliers, diagnostics and research labs.

**Creative Industries SIC codes** from <https://data-viz.nesta.org.uk/creative-nation/>

8712 Architectural Services;  
8742 Marketing Consulting Services;  
8732 Marketing Research and Public Opinion Polling;  
7812 Motion Picture and Video Production;  
7819 Tele-production and Other Postproduction Services;  
7819 Pre-recorded Compact Disc (Except Software), Tape, and Record Producing;  
7819 Other Motion Picture and Video Industries;  
7389 Sound Recording Studios;  
7389 Other Sound Recording Industries;  
7389 Interior Design Services;  
7389 Packaging and Labelling Services;  
7389 Industrial Design Services;  
7371 Custom Computer Programming Services;  
7372 Software and Other Pre-recorded Compact Disc, Tape, and Record Reproducing;  
7372 Software Publishers;  
7373 Computer Systems Design Services;  
7374 - Computer Processing and Data Preparation and Processing Services;  
7311 Advertising Agencies;  
7312 Outdoor Advertising;  
7313 Media Representatives;  
7319 Media Buying Agencies;  
7331 Direct Mail Advertising;  
7221 Photography Studios, Portrait;  
7999 Promoters of Performing Arts, Sports, and Similar Events with Facilities;  
7941 Promoters of Performing Arts, Sports, and Similar Events without Facilities;  
7929 Bands, Orchestras, Actors and other entertainers and Entertainment groups;  
8412 Museums and Art Galleries;  
7911 - Dance Studios, Schools, and Halls;  
7922 - Theatrical Producers (except Motion Picture) and Miscellaneous Theatrical Service

#### **ICT Sector – Information Economy SIC Codes**

from - <https://www.nesta.org.uk/report/dynamic-mapping-of-the-information-economy-industries/>

3577 Computer Peripheral Equipment, Not Elsewhere Classified;  
3571 Electronic Computers;  
3572 - Computer Storage Devices;  
4812 - Radiotelephone Communications;  
4813 - Telephone Communications, except Radiotelephone;  
7374 Computer Processing and Data Preparation and Processing Services;  
5045 Computers and Computer Peripheral Equipment and Software;  
7371 Custom Computer Programming Services;  
7372 Software and Other Pre-recorded Compact Disc, Tape, and Record Reproducing;  
7372 Software Publishers;  
7373 Computer Systems Design Services;  
7374 - Computer Processing and Data Preparation and Processing Services;  
7629 - Electrical and Electronic Repair Shops, Not Elsewhere Classified

**Figure 2.1 Galway's medtech cluster map**

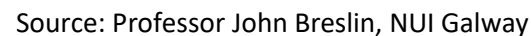




Figure 2.2 Galway ICT cluster map



Source: Professor John Breslin, NUI Galway