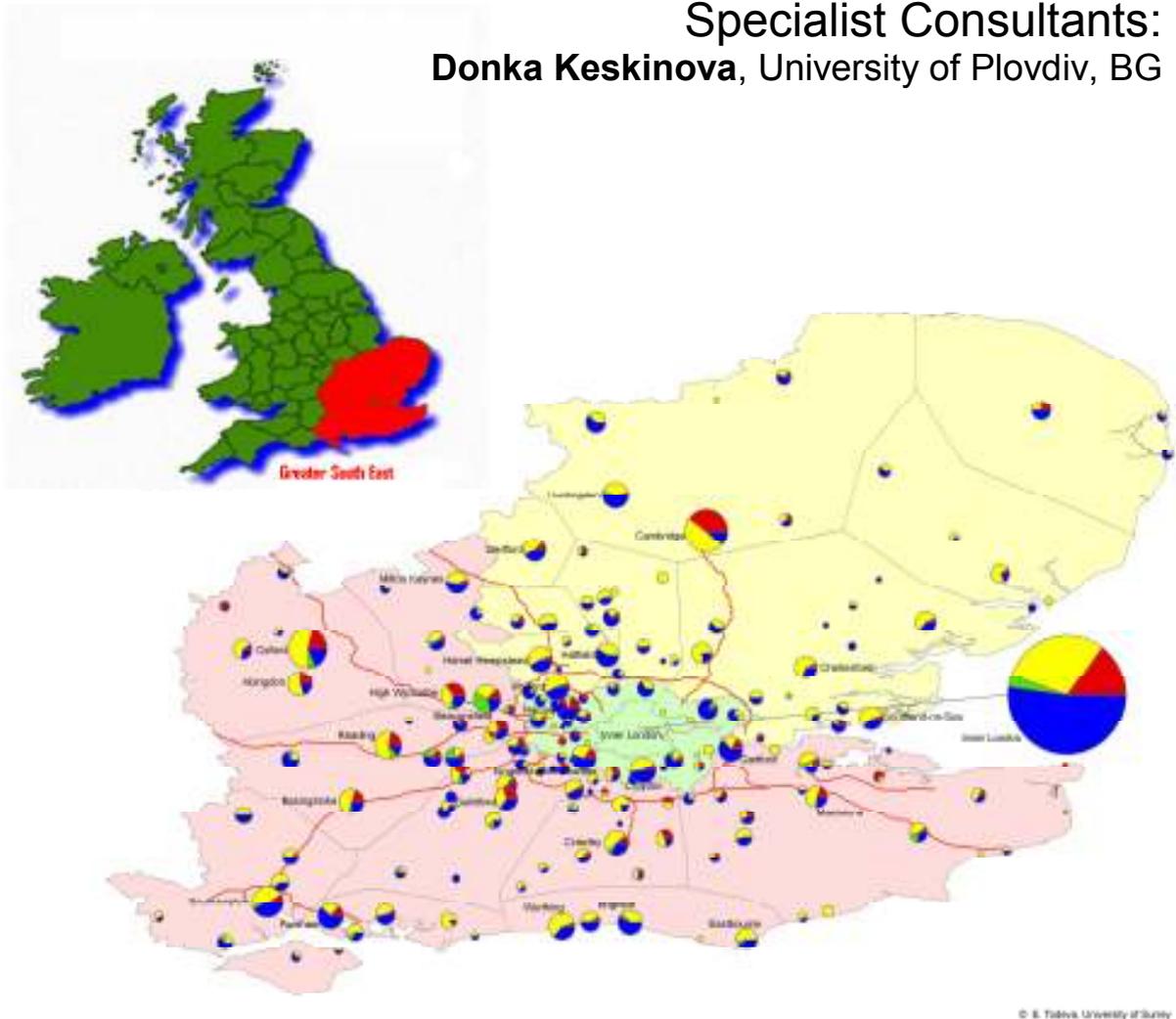# HEALTH TECHNOLOGY CLUSTER
in the
GREATER SOUTH EAST[1]

Authors and Contributors:
Dr. Emanuela Todeva, School of Management, University of Surrey, UK

Specialist Consultants:
Donka Keskinova, University of Plovdiv, BG

Foreword

I am very pleased that the South East Health Technologies Alliance (SEHTA) has been able to coordinate the activity leading to this report. I would like to thank my colleagues in SEEDA, EEDA and the LDA for their support and Dr Emanuela Todeva and her team at the University of Surrey for carrying out the work.

The report follows on from an earlier project sponsored by the EU which compared clusters of health technology companies in the SEEDA region with those in the Emilia Romagna region in Italy. As a consequence of our experience in the first project, we refined our methodology and approach in defining the sector, analysing the data and its presentation. However, as practitioners in this sphere of activity will recognise, this is not perfect art and we would value comments and suggestions so that we can continue to improve our knowledge and understanding of this highly significant sector, not just to the Greater South East, but to the whole of the UK. We also recognise that we have produced a 'snapshot' of a very dynamic sector; more value would be added by annual up-dates of the work.

This report highlights both strengths and challenges for the sector in the region.

Strengths

- The GSE has a huge cluster of over 4700 core companies generating revenues of almost £100 billion p.a. and around 11400 supply and delivery companies generating c. £32 billion.

- All the world's top pharmaceutical companies are represented in the GSE; 115 companies, with over 200,000 employees generating revenues in excess of £51 billion.

- The GSE has a superb research base with over 60 research active universities, including 4 out of the worlds top 10 universities, which attracted a total of over £4 Billion in public sector and charity funding from 2000 – 2007.

- There is evidence of complementarity between the regions in the GSE; The LDA region is especially strong in trade companies (supply, wholesale, retail and marketing), SEEDA in medical device companies and integrated pharma-bio companies, and all three regions have an excellent bio-pharma research and development base.

- The GSE has an excellent well diversified health technologies sector with depth and very good supply chain opportunities - from basic research and development through to customers.

Challenges

- public sector and charity funding of the research base could be spread more evenly through the knowledge base.

- reliance on big pharma as an economic base may be risky as many large multinationals re-evaluate their business models.

- there is no evidence that the geographic proximity of companies leads to commercial interactions between them.

The report should be seen as the basis of a new invigorated campaign to sell the GSE regions strengths overseas.

Although we have not bench-marked the GSE against other regions world-wide, it is difficult to envision any other comparable geographical region in the world with such a breadth and depth of research and business in the health sector. However, with that knowledge comes a degree of responsibility. In challenging financial times we have a joint responsibility to enable the sector to realise its full potential. More innovation, commercialisation, and collaboration with more 'open innovation' must be the way forward for our sector in order to keep ahead of the global competition.

Dr David Parry
Chief Executive Officer SEHTA

REPORT CONTENT

LIST OF TABLES, GRAPHS AND MAPS

1. The Health Technology Sector in the Greater South East: Key Findings

- The Health Technology Sector is defined as the amalgamation of **bio-technology, diagnostics, surgical / medical instruments and devices, pharmaceuticals and medical research**. As a key sector of the economy, it is responsible for the human health and wellbeing, and comprises a dense mesh of private and publicly funded establishments that contribute to its dynamics.
- The health technology sector is represented by a complex set of interconnected value-chains that integrate specific strategic industry groups, or clusters of firms that exhibit similar portfolio of specialisation. The map in Graph 1 describes this complex set of interconnected value chains, where the driving engine for growth are the two R&D cluster groups in the centre – Bio-Pharma R&D and Drug Development and Support[2].

Graph 1. Value Chains in the Health Technology Sector in the Greater South East[3]
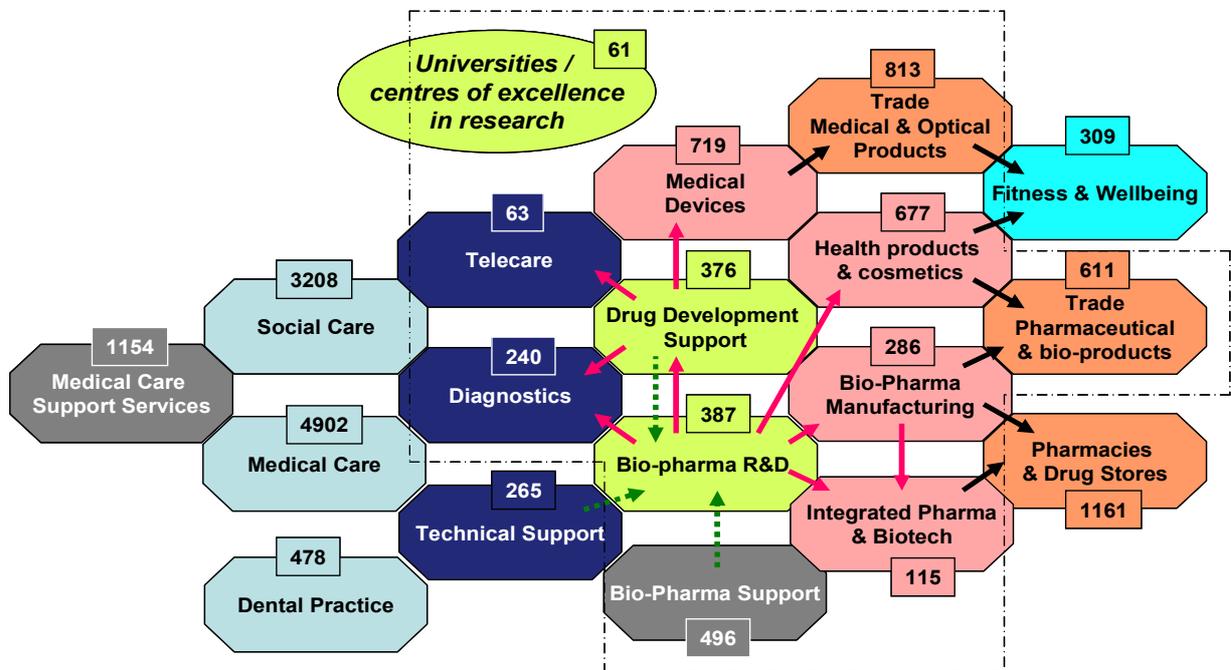
Amadeus 2008   © Todeva (2008)

- The mapping of the health technology sector revealed the existence of 5 interconnected and overlapping value chains that are in a process of integration. The innovation of medicines and bio-products, medical technologies and their test and trial application originate from the two R&D clusters, which are critical to the future development of the sector. The interconnected value chains that expand from these two R&D clusters are the following:

---

[2] The description of individual cluster groups is presented in Table 10. at the end of this report.
[3] Names of strategic cluster groups indicate the main business activities shared by groups of firms. Numbers indicate number of firms that operate in each cluster group. Colours indicate the position of each cluster group in the global value chain of the sector: LIGHT GREEN – R&D; PINK – manufacturing sector; ORANGE – trade, wholesale & retail sector; NAVY BLUE - emerging cluster groups with technology intensive operations; GREY – business and management consulting & support services; LIGHT BLUE – health services sector; EMERALD – other activities and services relevant to the application of health technologies; RED arrows – direction of value added; GREEN arrows – service/supply relationships; BLACK arrows – market/sales relationships.

4

1) Bio-Pharma R&D[4] ►Bio-Pharma Manufacturing ► Integrated Pharma-Bio Manufacturing ► Bio-Pharma Support and Consulting ► Trade Pharma ► Pharmacies & Drug Stores ► Medical Care;

2) Bio-Pharma R&D ►Diagnostics ► Medical Care;

3) Drug Development Support ►Medical Devices Manufacturing ► Trade Medical & Optical Instruments & Equipment ► Medical Care ► Dental Care ► Fitness & Wellbeing;

4) Drug Development Support ►Tele-care ► Social Care;

5) Bio-Pharma R&D ► Health Products & Cosmetics ► Trade Pharma ► Fitness & Wellbeing.

Table 1. Distributions of Firms in Sub-regions in the GSE[5],[6]

GSE Region	Amadeus Sub-regions	In Core Clusters		In Periphery Clusters		Total in Sub-Region	
		Nb	%	Nb	%	Nb	%
EEDA	Cambridge - Peterborough	317	7%	287	3%	604	4%
	Chelmsford-Colchester-Southend-on-Sea	195	4%	749	7%	944	6%
	Ipswich	45	1%	179	2%	224	1%
	Luton	41	1%	93	1%	134	1%
	Bedford	34	1%	74	1%	108	1%
	Norwich	58	1%	219	2%	277	2%
	St. Albans - Hemel Hempstead	183	4%	279	2%	462	3%
	Stevenage	99	2%	202	2%	301	2%
	Total	*972*	*20%*	*2082*	*18%*	*3054*	*19%*
LDA	Greater London North	262	5%	961	8%	1223	8%
	Greater London South	288	6%	924	8%	1212	7%
	Inner London	1417	30%	3767	33%	5184	32%
	Total	*1967*	*41%*	*5652*	*49%*	*7619*	*47%*
SEEDA	Milton Keynes	157	3%	314	3%	471	3%
	Brighton	149	3%	459	4%	608	4%
	Canterbury - Medway- Tonbridge	271	6%	754	7%	1025	6%
	Guildford	316	7%	628	5%	944	6%
	Oxford	216	5%	210	2%	426	3%
	Portsmouth	113	2%	296	3%	409	3%
	Reading - Slough	341	7%	527	5%	868	5%
	Redhill	156	3%	257	2%	413	3%
	Southampton	125	3%	298	3%	423	3%
	Total	*1844*	*39%*	*3743*	*33%*	*5587*	*34%*
Total		4783	100%	11477	100%	16260	100%

---

[4] The cluster group 'Bio-pharma R&D' is deeply interconnected with 'Drug Development & Support' and relies on intense service-supply relationships with 'Technical Support' and 'Bio-pharma Business Support'.

[5] For definitions of core and periphery cluster groups, please, see table 10 at the end of this report.

[6] The database for the GSE is organised by administrative regions which differ substantially from the counties. The names of GSE sub-regions derive from the names of the largest cities in them and represent individual administrative regions within EEDA, SEEDA and LDA with some exceptions. As both SEEDA and EEDA have sub-region **Milton Keynes**, we have attempted to discriminate between the two by identifying the next major city in the sub-region – **Aylesbury** (for SEEDA) and **Bedford** (for EEDA). We have agglomerated the data for London in the following way: **Inner London** includes London EC, WC, E, W, N, NW, S, SE; **Greater London North** includes Enfield, Ilford, Romford, Harrow-Watford; **Greater London South** includes Bromley, Croydon, Kingston, Twickenham, Sutton, Southall. The allocation of firms in sub-regions has been confirmed at post-code level.

- The total database with firms in the health technology sector comprises of 16 260 establishments, where 4 783 are in the core sector with activities in 'Bio-pharma R&D', 'Diagnostics', 'Manufacturing of Bio-pharma Products', 'Medical Instruments Manufacturing', 'Telecare', and 'Bio-pharma Business Support'. The cluster group 'Health Products and Cosmetics' is included in the cluster core as it comprises of manufacturing and trading activities based on bio-technologies, and as such directly connects to Bio-pharma R&D'. The regional distribution of firms in core cluster groups is the following: 41% are located in LDA, 39% in SEEDA and 20% in EEDA (Table 1). <u>All subsequent data analysis is based on the core cluster groups only.</u>

- In general, the core cluster groups represent the supply of new products and new technologies, while the periphery cluster groups – identified as 'medical care', 'social care', 'dental practice', fitness and well-being', as well as 'pharmacies and drug stores' – represent the demand-side of the sector. Although the core and the periphery are deeply intertwined in innovation, development, manufacturing and service delivery, for the purpose of this analysis we selected only the core cluster groups.

- The core health technology cluster is well diversified and includes: knowledge intensive and technology intensive activities, manufacturing and trading activities, as well as good underpinning with business support and technical services.

- Geographically the location of commercial enterprises in the core cluster groups is very dispersed. Companies are registered in 406 residential areas throughout the GSE. In addition to London (with 30% of all registered firms in the core cluster), business activities take place in suburbs of London (6%), 8 large cities (10%), and another 100 small towns (16%). The rest of commercial establishments (38%) give registration details in 247 villages, very small residential areas and designated commercial sites outside of the main urban locations.

- The high concentration of bio-pharma companies in all three sub-regions of the GSE (Table 2) is supported with high number of bio-tech R&D and other R&D activities providing drug development support, such as *research supplies, contract research, platform technology, medical-related research, nano-biotech, clinical trials, supportive research foundations, other related engineering R&D* (detailed cluster descriptions are provided in Table 10).

- There is a significant concentration of universities and public sector research institutions, as well as private sector research establishments throughout the GSE region - 61 grant-holder institutions recipients of research funds and over 700 commercial R&D enterprises.

- The mapping of the Centres of Excellence in Research in the GSE identified a vary large pool of research active institutions (61 institutional grant holders with 6938 names of individual grant holders on 8862 research projects for the period 2000-2007). This illustrates a vast innovation potential in the region.

- The distribution of research grants shows a very steep curve, where the top 4 research institutions (University of Oxford, University of Cambridge, University College London and Imperial College) have received 61% of the research grants and 69% of the total regional funding for the period 2000-2007. Beyond that lead, there is another set of large grant holders, where the top 17 research institutions control 86% of the grants and 97% of the total amount of funding for the same period, which is 8862 grants for £ 4,3 bln GBP.

- The leading research institutions in the region are highly concentrated in London (8 in LDA, 5 in SEEDA and 3 in EEDA – excluding MRC as a recipient of research funds). We observe that 47% of the grants are awarded to LDA institutions, 29% - to EEDA institutions, and 29% to SEEDA institutions. This high concentration of research funding in London could explain also the high concentration of commercial R&D activities in London.

- The performance of the cluster groups is calculated on the basis of the last reported year for tax returns. For 90% of the population of firms in the database this is 2006 and 2007. The remaining 10% include firms reporting for 2005 (8%), 2004 (1.5%), or with no Amadeus record (0.5%). Although all efforts have been made to include in the database all firms

indicated by SEEDA, EEDA, and LDA, 80 of these firms had no Amadeus record, and another 15 firms had a record indicating that they are no longer active, or in receivership.

- The comparative performance analysis reveals that most of the cluster groups exhibit specific trend of risk-adjusted performance (Graph 8 in Appendix). The two cluster groups that are exposed to the highest risk are 'Bio-pharma R&D', and 'Bio-pharma Support'. However, the rewards for the R&D firms for the risk they are taking appear negative (i.e. below the fit-line), while the rewards for the bio-pharma consultants are the highest in the sector, and rising over time.

- The two R&D clusters (Map 2 in Appendix) are very distinct from one another, where the Bio-pharma R&D is exposed to much higher risk then the 'Drug-development & Support' group, and the latter exhibits much higher rewards for the risks they are taking.

- With the exception of 'Bio-pharma Support', all other cluster groups in the Bio-pharma manufacturing value chain (Map 3 in Appendix) exhibit very similar risk/reward position (Graph 8 in Appendix), which we can expect in terms of the nature of their activities. In the technology and engineering group (Map 4 in Appendix), telecare firms stand as exposed to relatively high risk, and very low reward for that risk (similar to the 'Bio-pharma R&D'). The 'Diagnostics' group has improved dramatically its position for the last two reported years, by increasing the risk position, but simultaneously increasing the reward position for that risk (Graph 8 in Appendix).

- In addition to the cluster groups investigated in this report, the GSE has a number of other R&D capabilities related to the bio-pharma and medical technology sector. Among such excluded groups with intensive bio-technology inputs and outputs are: health food and food research, agro-bio, environmental and industrial bio-technology, or other applied technology fields. Our selection criteria were drawn to correspond more closely to the medical and health related areas of applications of bio-medical research, and did not include applications of bio-technology outside of these boundaries.

2. Overview of Methodology

The methodology employed for this project is an adaptation from the '*Multi-stage methodology for cluster mapping*' (Todeva, 2006)[7]. The fundamental principles of this methodology are: 1) to build a database with the entire population of firms in a selected region and selected economic sector; 2) to identify the strategic industry groups (or **cluster groups**) in this sector and to demarcate clear cluster boundaries between them; 3) to allocate all firms in cluster groups according to their portfolio of activities and 'best fit'; 4) to label each cluster group according to the core activities of firms in it, and to evaluate the performance of each cluster group[8]; 5) to establish the value chains that interconnect firms in the sector and the region, as well as to map the location of individual firms in these value chains; 6) to complete comparative cluster performance.

Database for Cluster Mapping
We established specific selection criteria that describe the leading technologies and product fields in order to demarcate the boundaries of the health technology sector[9]. The regional boundaries include 20 administrative sub-regions within SEEDA, EEDA and LDA (Table 1.). The database contains the entire population of firms that correspond with our geographic and sectoral definitions, and are registered in Amadeus (or have submitted tax returns for the period 2005-March 2008). The population of firms in the database was enlarged with additional 95 firms that have no Amadeus record for the UK, but have been identified by experts from the three regional development agencies (SEEDA, EEDA and LDA). The complete Amadeus records for individual firms in the database contain registration details, description of activities, firm annual turnover, employment, and performance indicators, provided in the last available year of tax returns by these firms (2005-2007). The database contains two parts, where the first part includes firms from the core cluster groups (see Table 2. and cluster definitions in Table 10.), and the second part includes the extension of the medical sector, or related periphery cluster group.

Multi-stage Methodology for Cluster Mapping and Cluster Analysis
Our multi-stage methodology for cluster mapping is based on the systematic application of statistical methods and analytical procedures for statistical cluster analysis and classification of objects. For the statistical clustering we used K-means, which is applicable to large data sets with large number of variables. All cluster groups were reviewed by looking at the text description of activities, and priority was given to industry text, compared with industry codes. We applied different performance metrics for the performance evaluation, i.e. market performance metrics (return on equity and return on capital), economic development performance metrics (employment and revenue growth), and accounting performance metrics (profit margins, cash flow, and operating revenue).

Methodology for Mapping and Assessment of the Centres of Excellence in Research
We have mapped the innovation potential in the sector with a database of all Centres of Excellence in Research in the GSE region. This database contains the publicly available records for the main recipients of research grants in the region or conducted research for the development of new bio-, health and medical technologies. The database contains comprehensive records for universities and research centres in SEEDA, EEDA, and LDA, all receiving research funds between 2000-2007 from *MRC, BBSRC, EPSRC, Wellcome Trust*, British Heart Foundation, AMR, DoH, AICR, BMA, Diabietes UK, and Arthritis Research Campaign. Individual entries include comprehensive records for research grants, names of grant-holder institutions and individual experts, partners on the project, titles and abstracts describing the innovation, and publicly available financial data on grants.

---

[7] Todeva, E. (2006) '*Clusters in the South East of England'*, University of Surrey.
[8] Cluster groups and strategic industry groups are used as synonyms in this report as both refer to groups of firms co-located in the same industry field and with similar portfolio of activities.
[9] The selection criteria refers to 236 key words and selected industry codes from UK SIC, US SIC, NACE, NAICS, CSO - that represent: biotechnology, diagnostics, surgical / medical instruments and devices, pharmaceuticals, and medical research. A firm is included in the database if it satisfies at least one of our selection criteria.

3. Analysis of Data

Data analysis has been conducted only on the core cluster groups in the database.

Table 2. Distributions of Firms in Clusters in the GSE

Distribution of Firms in Clusters in GSE Sub-regions		EEDA	LDA	SEEDA	Total
Core Clusters	1.Bio-Pharma R&D	115	132	140	**387**
	2.Drug Development & Support	82	140	154	**376**
	3.Bio-Pharma Manufacturing	70	105	111	**286**
	4.Integrated Pharma & Biotech	17	36	62	**115**
	5.Trade Pharma & Bio Products	87	352	172	**611**
	6.Bio Pharma Support	92	212	192	**496**
	7.Diagnostics	44	91	105	**240**
	8.Medical Devices	192	188	339	**719**
	9.Telecare	3	17	43	**63**
	10.Trade Medical & Optical Products	174	338	301	**813**
	16.Health Products & Cosmetics	96	356	225	**677**
	Total	*972*	*1 967*	*1 844*	*4 783*
Periphery Clusters	11.Technical Support	49	98	118	**265**
	12.Medical Care	953	2 183	1 766	**4 902**
	13.Dental Practice	92	216	170	**478**
	14.Social Care	629	1 616	963	**3 208**
	15.Medical Care Support Services	154	621	379	**1 154**
	17.Fitness & Wellbeing	47	136	126	**309**
	18.Pharmacies & Drug Stores	158	782	221	**1 161**
	Total	*2 082*	*5 652*	*3 743*	*11 477*
Total		3 054	7 619	5 587	16 260

The data in Table 2 describes the distribution of firms in the core and periphery clusters across the entire GSE region, and their overall concentration in SEEDA, EEDA and LDA. The core cluster groups in the GSE include 4783 firms, of which 41% are located in LDA, 39% are located in SEEDA, and 20% are located in EEDA.

Some cluster groups exhibit higher concentration in particular sub-regions, which can be expected according to the specificities of the region as a whole. For example, medical devices are particularly concentrated in SEEDA (47% of the total number of firms), while the cluster group 'Trade Pharmaceutical and Bio Products' have higher concentration in London (58% of the total number of firms). On average all cluster groups have higher concentration in the LDA area, compared with SEEDA and EEDA.

The data in Table 3 gives an overview of the core cluster groups with the number of firms in each group, and the total employment and revenue for that group of firms. The largest contributor to the employment and the revenue in the region are the 115 firms from 'Integrated Pharma and Biotech' cluster group, which are engaged in R&D, manufacturing, management of clinical trials, and trade of pharma and bio-products. This cluster group attracts 46% of the employment and delivers 51% of the total revenue for the health technology sector in the region. These figures are affected by the presence of leading global corporations such as GSK and others that report also their global revenue figures. Large pharmaceutical companies often report their revenue figures from London offices but

frequently most of their research and development activities are carried out outside London, For example, the European R&D Headquarters for Pfizer is at Sandwich in Kent, and most R&D for GSK is carried out at their Harlow and Stevenage sites.

Table 3. Distributions of firms, revenue and employment data per cluster groups in the GSE region *(core clusters)*[10]

Cluster	Firms	Employees Last Year		Operating Revenue / Turnover Last Year *(in thousands GBP)*	
	Count	Sum	Mean	Sum	Mean
1.Bio-Pharma R&D	387	8 911	61	5 167 390	31 897
2.Drug Development Support	376	29 934	249	2 924 008	15 805
3.Bio-Pharma Manufacturing	286	24 470	275	4 595 224	41 775
4.Integrated Pharma & Biotech	115	215 717	2 876	51 063 865	719 209
5.Trade Pharma & Biol Products	611	18 450	148	10 971 274	54 046
6.Bio-Pharma Support	496	5 439	71	1 034 648	3 749
7.Diagnostics	240	18 239	253	1 851 291	14 132
8.Medical Devices	719	75 704	362	8 750 634	30 490
9.Telecare	63	3 157	105	673 203	19 234
10.Trade Med & Optical Products	813	17 595	139	3 175 035	8 795
16.Health Prod & Cosmetics	677	55 745	680	9 568 695	33 340
Total	**4783**	**473 361**	**411**	**99 775 267**	**47 332**

The second place in terms of contribution to the regional and sectoral employment and revenue is shared by two cluster groups: 'Medical Devices' cluster (contributing 15% of the total number of firms, 16% of the total regional employment in the sector, and 9% of the total regional revenue in the sector), and 'Health Products and Cosmetics' cluster (contributing 14% of the total number of firms, 12% of the total regional employment and 10% of the total regional revenue in the sector). The two R&D cluster groups are similar in size (each with 8% of the total number of firms in the sector). However, they exhibit substantially different characteristics. 'Bio-Pharma R&D' cluster contributes 2% of the total employment in the region and 5% of the total revenue, while 'Drug Development Support' cluster contributes 6% of the total sectoral employment, and only 3% of the total sectoral revenue in the region (Table 3.).

The data in Table 4. shows that the core health technology cluster employs 473 361 specialists, where LDA employs 65% of these experts, EEDA – 10%, and SEEDA 25%. In spite of the distortion for Inner London and Greater London South, due to reporting of some global figures of multinational corporations, this table indicates high concentration of small firms (in Norwich, Southampton, and Cambridge-Peterborough areas) vs. large firms (in Reading-Slough, Milton Keynes, Portsmouth, Ipswich and Luton areas).

The real value of the activities in the health technology sector is shown by the operating revenue data in Table 6 (in Appendix). Although London holds the supreme position as the main contributor of 65% (≈ £65 billion Pounds) of the total regional sectoral revenue (≈ £100 billion Pounds), there are other significant contributors to this revenue. These are: Reading-Slough (13%), and Canterbury-Medway (5% of the total regional sectoral operating revenue). The total figure of operating revenue for SEEDA is 26%, or £26 billion Pounds, and for EEDA is 9%, or £8.6 billion Pounds.

---

[10] **All data is provided by firms in their tax return forms.**

Table 4. Distributions of Sectoral Employment in Sub-regions in the GSE

Employment In Amadeus Sub-regions		In Core Clusters		
		Sum	**%**	**Mean**
EEDA	Cambridge - Peterborough	8 242	2	85
	Chelmsford - Colchester - Southend-on-Sea	8 815	2	252
	Ipswich	2 753	1	344
	Luton	4 675	1	334
	Bedford	2 588	1	370
	Norwich	63	0	16
	St. Albans - Hemel Hempstead	12 450	3	271
	Stevenage	5 410	1	235
	Total	*44 996*	*10*	*192*
LDA	Greater London North	2 734	1	91
	Greater London South	132 896	28	1 984
	Inner London	176 671	37	5 295
	Total	*312 301*	*65*	*725*
SEEDA	Milton Keynes	10 321	2	198
	Brighton	4 362	1	257
	Canterbury - Medway- Tonbridge	15,360	3	290
	Guildford	13 453	3	160
	Oxford	9 661	2	144
	Portsmouth	7 169	2	358
	Reading - Slough	49 760	11	377
	Redhill	3 848	1	120
	Southampton	2 130	0	73
	Total	*116 064*	*25*	*239*
Total		**473 361**	**100**	**411**

More detailed figures at sub-regional level and at individual cluster level are presented in Tables 7, 8, and 9 (in Appendix). Apart from the 'Integrated Pharma & Biotech' cluster, which dominates all three regions in the GSE, each region exhibits additional strengths. For EEDA these are the three large telecare firms that have an average employment of 324 specialists and generate on average £36.9 million Pounds in operating revenue, and the 70 specialised bio-pharma manufacturers employing 8869 specialists and generating in total £1.7 billion Pounds in operating revenue. For LDA, among the major contributors are the 352 companies engaged in trade pharma and biotech, employing 9545 specialists, and generating nearly £8 billion Pounds in operating revenue, followed by the 188 large medical devices firms, employing in total over 42 thousand specialists, and generating over £4 billion Pounds in revenue. For SEEDA the extra strength is in 'Health Products and Cosmetics' cluster, where 225 firms employ over 31 thousand specialists, and generate nearly £7 billion Pounds in operating revenue.

The comparative performance analysis indicates that there are some significant differences in performance between SEEDA, EEDA and LDA core clusters. However, this can not be observed at the level of individual cluster groups due to the small numbers. Table 5 compares the differences in performance at the level of individual cluster groups in the GSE. The best performing cluster groups are 'Bio-Pharma Manufacturing' and 'Bio-Pharma Support' with consistently high profit margins and consistently low variability of results – both within cluster and across the period of 6 consecutive years. The cluster with the lowest performance is 'Telecare', which also has the highest variability of

results, which means some very good and some very bad performing organisations with a lot of negative results. The cluster 'BioPharma R&D' also exhibits very high variability of results, which suggests that there is very high competition in it.

Table 5. Comparative Cluster Performance in the GSE[11]

Cluster	Median Profit Margins						Coefficient of Variance of Profit Margins					
	t	t-1	t-2	t-3	t-4	t-5	t	t-1	t-2	t-3	t-4	t-5
1.BioPharmaR&D	4,5%	3,7%	4,8%	0,7%	3,5%	3,1%	23,2	11,0	11,3	20,6	8,7	11,1
2.DrugDevelopmentSupport	5,3%	6,8%	6,6%	6,2%	7,4%	6,7%	4,9	3,5	2,9	3,0	3,1	3,0
3.BioPharmaManufacturing	10,5%	7,7%	7,3%	7,2%	7,2%	6,1%	2,0	4,6	3,6	1,6	3,7	6,0
4.IntegratedPharma&Biotech	7,3%	7,8%	7,3%	7,2%	6,9%	5,3%	5,5	17,6	5,1	3,6	2,5	4,6
5.TradePharmaceuticalProducts	2,9%	2,7%	2,7%	3,0%	3,3%	3,4%	2,7	11,7	4,7	4,3	4,4	3,0
6.BioPharmaSupport	15,6%	15,8%	13,9%	13,5%	13,0%	8,1%	1,5	1,4	1,6	1,9	1,5	2,6
7.Diagnostics	6,5%	6,2%	4,3%	3,4%	5,7%	4,5%	2,8	5,1	10,7	6,0	3,4	2,8
8.MedicalDevices	5,6%	5,4%	4,2%	5,2%	5,1%	4,8%	5,5	4,8	5,0	4,4	4,7	2,8
9.Telecare	1,0%	3,1%	-0,3%	0,8%	2,1%	1,3%	-12,1	11,5	-4,0	15,9	9,4	2,3
10.TradeMed&OpticalProducts	5,8%	5,8%	5,9%	5,8%	4,9%	5,3%	2,9	2,5	2,2	2,8	3,6	2,4
16.HealthProd&Cosmetics	4,0%	5,6%	4,2%	5,65	5,6%	4,8%	37,4	4,9	9,8	5,1	6,2	3,1

The preferential location of some cluster groups is depicted at sub-regional level. Graph 2 represents a network analysis of the relationship between sub-regions in the GSE and cluster groups. The Graph exhibits relatively stronger relationships such as the preferential location of 'Integrated Pharma & Biotech' firms in Greater London South, in Guildford, and in Reading-Slough. Similarly, firms active in 'Trade Pharma and Bio Products' cluster group have higher location concentration in the three London regions and in Milton Keynes. An interesting observation is the similarities in competences between Southampton, Portsmouth, and Chelmsford-Colchester-Southend-on-Sea. The three sub-regions control higher concentration of activities in 'Medical Devices' and 'Trade Medical & Optical Products' cluster groups. Oxford and Cambridge also exhibit significant similarities, whereby they have almost mirrored competences in 'Bio-Pharma R&D', 'Drug Development Support' and 'Diagnostics'. A small diversification between the two is that Cambridge has more influence on 'Bio-Pharma Manufacturing', while Oxford has more influence on 'Medical Devices'.

Another observation from Graph 2 is that some cluster groups attract each other, as their development depends on each other. These are: 'Bio-Pharma Manufacturing' with 'Drug Development Support', and 'Bio-Pharma R&D' with 'Diagnostics'. We can observe also the special case of Telecare, which is the smallest cluster group, but has also some location preferences – for Milton Keynes (Aylesbury) and Reading-Slough.

The geographic location and concentration of cluster activities in the GSE is also depicted on the regional maps (Map 1, 2, 3, and 4.). The first map represents the distribution of cluster activities throughout the 20 GSE sub-regions. The size of the graphics is based on the number of firms in each sub-region, and indicates concentration of activities. Map 2 compares the distribution of firms in the two R&D cluster groups, where we can compare the concentration of activities both at sub-regional level, and the level of individual cities. There are 26 residential locations with 5 or more R&D establishments from the first two cluster groups in each of them. Among the top locations for the two R&D cluster groups are: London (with 233 firms), Cambridge (89), Oxford (30), Abingdon (22), Slough (16), Reading (15), Guildford (13), Southampton, (13), and Saffron Walden (10 firms).

---

[11] For the performance analysis we have used the *median* to counteract the strong asymmetric distribution of data and the presence of extreme cases.

Graph 2. Associations Between Cluster Groups and Sub-regions (*normalised value*)**[12]**

Map 3. in a similar way compares 5 related cluster groups that directly contribute to the Bio-Pharma sector. The map represents 273 residential locations hosting Bio-Pharma manufacturing and trade activities, and 30 of these locations host 15 or more firms in this group of cluster activities. Among the top locations are: London (726 firms), Cambridge (50), Harrow (40), Slough (32), Croydon (30), Reading (26), High Wycombe (23), Little Hampton (23), Basingstoke (21), Milton Keynes (20), Norwich (20), Bedford (18), Huntingdon (18), Oxford (18), Wembley (18), Stanmore (16), Uxbridge (16), Weybridge (16), Ashford (15), Brentford (15), Guildford (15), Horsham (15), Ilford (15), and Watford (15).

Map 4. represents the four 'engineering technology' intensive cluster groups – 'Diagnostics', 'Medical Devices', Telecare', and 'Trade Medical & Optical Products'. There are 293 residential locations in total attracting these activities, and 28 of these host fifteen or more establishments. The leading residential areas attracting firms in these cluster groups are: London (458 firms), Cambridge (45), Huntingdon (23) Reading (23), Oxford (22), Fareham (21), Croydon (20), Abingdon (18), Southampton (18), Basingstoke (17), Guildford (16), Crawley (15), Dartford (15), St Albans (15), and Watford (15).

While the commercial activities in the sector exhibit good geographic dispersion across all sub-regions, the research activities show extremely high concentration. The database with all Centres of Excellence in Research contains 8862 project entries and 61 institutional grant holders in the GSE region. However, 17 of these institutions are recipients of 85.5% of the project grants and 97% of the total funding for the period 2000 – 2007. Among these institutional grant-holders is also the Medical Research Council (MRC), which has 476 projects receiving funds from other institutions, among which is Wellcome Trust, or the MRC itself. This specific funding relationship represents 8% of the awarded funds for the whole period.

---

[12] RED circles represent individual cluster groups; BLUE squares represent sub-regions within GSE; the size of the dots and squares is proportionate to the number of firms in each cluster and sub-region; ties indicate significant relationship of concentration of firms in regions and in clusters.

Graph 3. The Leading Centres of Excellence in Research in the GSE

Institution Grant-holder

Institution	Sum in th GBP (% Total Sum)
University of Oxford	1 020 093 (24%)
University of Cambridge	807 547 (19%)
University College London	658 159 (15%)
Imperial College London	548 896 (13%)
Queen Mary, University of London	342 506 (8%)
King's College London	121 471 (3%)
London School of Hygiene and Tropical Medicine	118 366 (3%)
University of Southampton	106 947 (2%)
Institute of Cancer Research	88 601 (2%)
University of Sussex	84 876 (2%)
University of East Anglia	82 745 (2%)
University of Reading	51 054 (1%)
Medical Research Council	34 524 (1%)
Babraham Institute	34 186 (1%)
St George's, University of London	33 182 (1%)
Birkbeck, University of London	33 156 (1%)
University of Kent	23 380 (1%)

Sum in th GBP (% Total Sum)

NB: The grant of all other institution is 3% and all of them have less then 0,4%
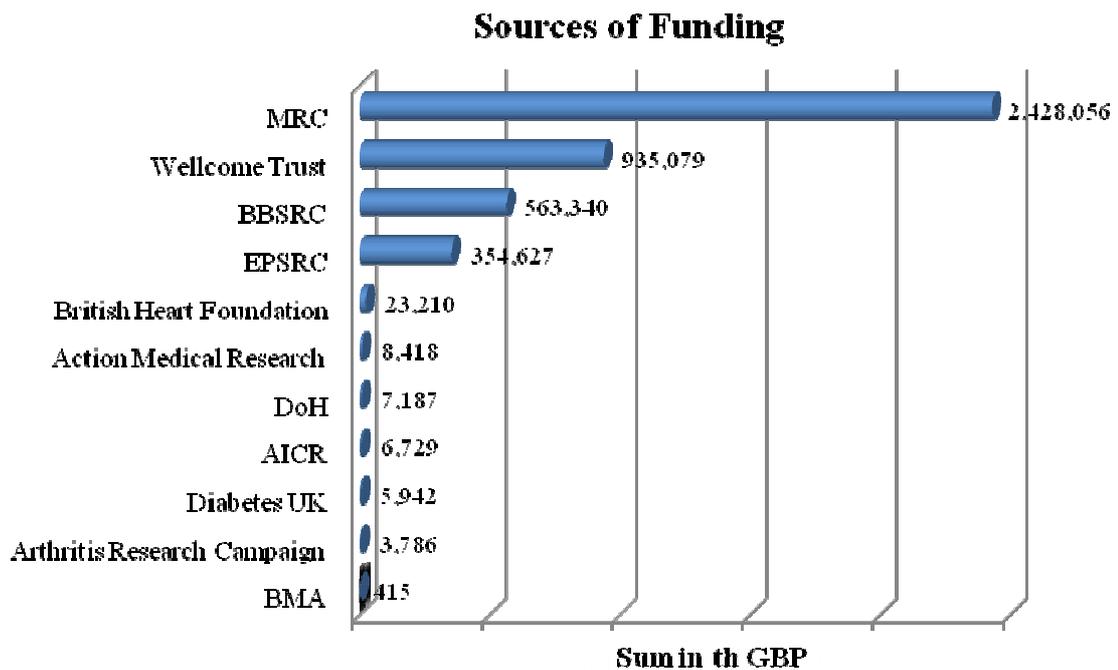
Graph 3. lists the top 17 institutional grant-holders by the funds awarded. This list is lead by the University of Oxford, which has secured 24% of the total funds awarded within the GSE region. This is followed by the University of Cambridge (19%), University College London (14%) and Imperial College (13%). Among the leading non-London based research institutions that have developed research capabilities are: the University of Southampton (2%), University of Sussex (2%), University of East Anglia (2%), University of Reading (1%), Babraham Institute (1%) and University of Kent (1%).

Graph 4 exhibits the sources of funding in the database. The largest funding body is MRC, which has distributed 56% of the awarded funds, followed by Wellcome Trust (22%), BBSRC (13%), EPRSC (8%), and seven other smaller contributors.

Graph 6 (in Appendix) further represents the relationships between the leading funding bodies and institutional grant holders, where we can see that the leading research institutions are receiving their grants mainly from MRC, or from a range of small funding bodies. Although EPSRC, BBSRC, and Wellcome Trust have a lot of cross-funding to a number of institutional grant holders, they also have some satellite preferences. For example, Welcome Trust has funded institutions like University of Luton, or London School of Economics, while BBSRC has funded institutions such as University of Buckingham, Westminster, Hertfordshire and Cranfield University.

Graph 5 exhibits how these funds are allocated to support specific technologies. 64% of the funds have been devoted to the development of biotechnologies. Another 21.5% have been allocated for clinical research; 4% - for regenerative medicine, 3% for diagnostics; 2% for therapeutics; 1.7% for public health; 1.4% for medical devices and equipment; and 1% for integrated health solutions.

Graph 4. Sources of Funding for the Centres of Excellence in Research

Sources of Funding

Source	Sum in th GBP
MRC	2,428,056
Wellcome Trust	935,079
BBSRC	563,340
EPSRC	354,627
British Heart Foundation	23,210
Action Medical Research	8,418
DoH	7,187
AICR	6,729
Diabetes UK	5,942
Arthritis Research Campaign	3,786
BMA	415

Sum in th GBP

Graph 5. Research Funding for Specific Technologies

Allocation of funding by technology

Technology	Sum in th GBP
Biotechnology	2,780,961
Clinical Research	932,388
Regenerative Medicine	176,569
Diagnostics	120,523
Therapeutics/Pharmaceuticals	82,916
Public Health	73,061
Scholarships	66,216
Medical Devices/Equipment	60,590
Integrated Health Solutions	41,516
Industrial Partnership Grants	2,048

Sum in th GBP
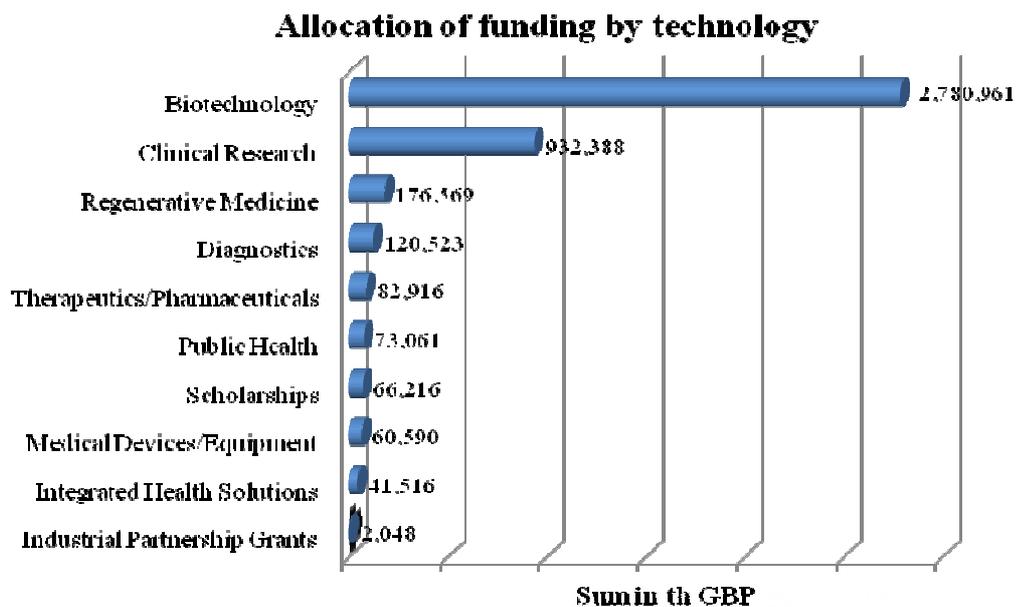
Finally, Graph 7 (in Appendix) exhibits a map of research partnerships in the GSE and worldwide. The institutions that have nurtured the majority of partnership projects are: University College London (with 104 partners within the region and worldwide), University of Oxford (98 partners), University of Cambridge (92 partners), Imperial College London (82 partners), and Kings College London (72 partners). The thickness of the line in this graph represents the consolidation of certain partnerships through multiple projects. We can observe a stronger affinity between University College London and University of Cambridge, and between Imperial College London and University of Oxford.

4. Conclusions and Recommendations

- The distribution of activities within the health technology cluster in the Greater South East shows complementarities between LDA, EEDA, and SEEDA. Different sub-regions have developed specialisation that complements the overall activities in the cluster (Map 1 in Appendix). Although Inner London remains a preferable location for many headquarters, the capabilities in the cluster are well distributed across smaller cities and a variety of locations throughout the GSE.

- All segments of the cluster are well developed, which is an evidence of maturity and self-sustainability. The cluster attracts many international players located throughout the GSE.

- The largest concentration of activities in the two R&D cluster groups (see Map 2 in Appendix) are in Inner London, Cambridge, and Oxford. In addition to these three centres, there are 22 other locations that host 5 or more R&D firms, which is an evidence of geographic spread and expansion throughout the GSE region.

- The geographic expansion of activities is more evident for the Bio-pharma manufacturing and trading activities, where we observe a very high concentration west of London on the intersection of SEEDA, EEDA and LDA. In a small geographic area between Hemel Hempstead, Harrow, Wembley, Kingston upon Themes and Slough there are 11 towns each of which hosts more then 15 firms active in Bio-pharma manufacturing and related activities (see Map 3 in Appendix).

- The spread of activities in medical devices manufacturing, diagnostics and telecare are further evidence of the cluster depth (Map 4 in Appendix). In addition to the three main locations of London, Cambridge and Oxford, there are other 25 residential areas that host a significant concentration of such engineering firms (with more then 15 firms per location), and another set of locations with smaller concentration of firms that spread throughout the entire GSE.

- Although this concentration and dispersion of activities suggest synergies between all core cluster groups, the overall dynamics of the health technology cluster is very much driven by the demand side, or the cluster groups that we labelled as periphery. These are the medical and health care services and associated support activities that represent the market side of the sector. The complexity of core and periphery activities further indicates different engines for the growth and development of the health technology cluster in the GSE.

- The high market performance of the 'Bio-pharma Support' cluster, toppled with low variance (Table 5), indicates that the support activities (finance and management consulting) extract much value added within the value chain, where results are consistent for firms within the cluster group and across multiple years.

- The high coefficient of variance for the 'Bio-pharma R&D' (Table 5) indicates that there is very high competition affecting this cluster group and some firms are doing well, while others are underperforming. Although this is expected for all innovation industry segments where firms are taking high risk, it is an alarming signal for investors and business analysts. This indicates that this segment of the cluster is still in development stage and firms in it potentially are exposed to forced exits. The negative results for 'Telecare' also indicate the huge discrepancy in performance for this cluster group.

- The comparative performance analysis of cluster groups in the GSE identifies that the best performance is achieved by firms operation in 'Bio-pharma Support, while the lowest performance is achieved by firms in the 'Telecare'. The risk adjusted performance results indicate very similar results between 'Bio-pharma Manufacturing', and 'Integrated Pharma and Biotech'. The 'Bio-Pharma R&D' cluster group exhibits the highest risk and has among the lowest return for that risk, which is consistent with their position in the value chain. The cluster groups that have significantly improved their performance results between 2005 and 2006 are: 'Bio-Pharma Support', 'Diagnostics', and 'Bio-Pharma Manufacturing' (see Graph 8 in Appendix).

- The methods employed for this analysis enable research at all levels in the cluster, where one can zoom in and out into different groups of firms, conduct comparative analysis at firm level, and conduct evaluation at cluster level. We can compare cluster groups at regional and sub-regional level. The firm database unables us to evaluate the position of individual firms and to compare with the best performance in each cluster group.

- All Tables with data presented in the Appendix demonstrate the power of the method, whereby comparative analysis is conducted across regions and sub-regions in the GSE. Table 6 illustrates the aggregate results for individual sub-regions, while Tables 7, 8, and 9 illustrate the unique blend of cluster activities individually for SEEDA, EEDA and the LDA. The data in these tables derives from clear allocation of firm's reported activities according to the address of registration of these firms, where the activities themselves may take place in different operational units and subsidiaries located elsewhere.

- All Maps presented in the Appendix exhibit data from a database. We have developed two comprehensive databases – one with registered firms that are filing information with their tax-return forms, and the other with universities, hospitals and research centres that have received funding for conducting research as a direct contribution to the health technology sector. Both databases are comprehensive for 2007, include the full population of relevant establishments, and are suitable for further in-depth analysis.

- The geographic representation of data in Maps has been accomplished with ArcGis software under academic license, using the National Grid as a geo-positioning background demarcating SEEDA, EEDA and LDA boundaries and location of towns and motorways. In addition, we have developed independently a new layer with administrative boundaries that corresponds with the allocation of individual residential areas in administrative sub-regions. This technology enables us to visualise in a geographic space any data from our two databases.

- We acknowledge that although there are some differences between SEEDA, EEDA and LDA, the pattern of distribution of firm activities is quite similar for the region. The concentration of activities within GSE is evident when looking outside of its geographic boundaries. The administrative boundaries of the GSE demonstrate high intensity of health technology activities within the region, compared with much lower intensity of activities outside the region.

- Although this research does not produce any evidence of integration across commercial health technology activities, whereby firms are directly connected in supply relationships or transactions with each other, it produces evidence of concentration of activities, which suggests a dynamic and vibrant business cluster.

- Table 11, Graph 6 and 7, and Map 5 in Appendix represent the research capabilities and innovation potential within the public sector, including universities, research hospitals and research centres that have developed as Centres of Excellence in Research. Although the concentration of these establishments in London is very high (Map 5), the collaboration pattern between these establishments (Graph 6) explicitly points to the fact that cross-institutional collaborations and partnerships with international research establishments is already a practice. Graph 7 demonstrates that although regional partnerships within the GSE are very strong, the list of national, European and global partners is very large and the innovation potential of the GSE is already embedded in the global bio-technology research. The database on the Centres of Excellence in Research provides a unique opportunity to investigate individual technologies, research active academics, and research establishments, and further research with this database is recommended.

- One of the constraints of the database with firms is that activities are attributed to locations that file tax reports. However, this weakness has to be contrasted with the main strength of this approach – enabling in-depth and comparative analysis of the entire population of firms in the region, where the population of health technology firms is embedded in the rest of the regional economy in the Greater South East.

5. Glossary, Definitions and Abbreviations

Table 10. Definitions of Cluster Groups

	Cluster Name	Definition	Type
1	Bio-Pharma R&D	Research and development resulting in a pharmaceutical or biotechnology product	Core
2	Drug Development Support	Research supplies, contract research, platform technology, medical-related research, nano-biotech, clinical trials, supportive research foundations, other related engineering R&D	Core
3	Bio-Pharma Manufacturing	Companies with primary activity being the manufacture of biopharmaceutical products	Core
4	Integrated Pharma and Biotech	Pharmaceutical R&D Companies which also manufacture and market medicines developed in house	Core
5	Trade Pharmaceutical Products	Companies providing pharmaceutical products, including wholesalers, retailers and marketers	Core
6	Bio-Pharma Business Support Services	Consulting, market research, finance, patents and regulatory for health technology sector, incubators, recruitment, leasing ie. NO products on sale	Core
7	Diagnostics	Diagnostic kits, equipment, reagents, imaging technologies, development, manufacturing, marketing	Core
8	Medical Devices	Development, manufacture, sales of medical devices including laboratory equipment, optical and drug delivery devices	Core
9	Telecare	Companies engaged in assistive technology	Core
10	Trade Medical and Optical Products	Companies selling medical and optical products and equipment, including wholesalers and retailers	Core
11	Technical Support and Equipment	Installation, maintenance of medical equipment, software solutions, specialised IT, sale of equipment, data management	Peripheral
12	Medical Care	Companies providing medical care, including medical clinics and hospitals, ambulance services, eye care, osteopaths, chiropractors	Peripheral
13	Dental Practice	Companies providing dental care and services	Peripheral
14	Social Care	Counselling, care homes, hostels	Peripheral
15	Medical Care Business Support Services	Consultancy, management, external supportive services for primary and secondary care, recruitment, transport	Peripheral
16	Health Products and Cosmetics	Companies developing, manufacturing and providing cosmetics and health products, and cosmetic services.	Core
17	Fitness and Wellbeing	Companies providing fitness, wellness and lifestyle services including Pilates, gym, yoga	Peripheral
18	Pharmacies and Drug Stores	Drugs and Druggists	Peripheral

R&D = research and development
SEEDA = South East of England Development Agency
EEDA = East of England Development Agency
LDA = London Development Agency
MRC = Medical Research Council
UK SIC = UK Standard Industrial Classification System
US SIC = US Standard Industrial Classification System
NACE = Harmonised EEC Economic Activity Codes
NAICS = North-Atlantic Industrial Classification System
CSO = British Central Statistical Office

Table 6. Distributions of Operating Revenue / Turnover (th GBP) in Sub-regions in the GSE

Operating Revenue in Amadeus Sub-regions		In Core Clusters			In Periphery Clusters			Total in Sub-Region		
		Sum	%	Mean	Sum	%	Mean	Sum	%	Mean
EEDA	Cambridge - Peterborough	1 834 888	2	12 398	135 501	0	2 464	1 970 389	1	9 706
	Chelmsford - Colchester - Southend-on-Sea	1 882 728	2	28 100	756 468	2	3 860	2 639 196	2	10 035
	Ipswich	624 617	1	48 047	20 298	0	634	644 915	0	14 331
	Luton	580 840	1	30 571	665 049	2	35 003	1 245 889	1	32 787
	Bedford	433 118	0	30 937	236 198	1	23 620	669 316	1	27 888
	Norwich	117 420	0	5 591	233 592	1	5 562	351 012	0	5 572
	St. Albans - Hemel Hempstead	2 102 315	2	28 031	412 917	1	6 999	2 515 232	2	18 770
	Stevenage	1 057 417	1	25 177	301 647	1	5 586	1 359 064	1	14 157
	Total	*8 633 343*	*9*	*21 637*	*2 761 670*	*8*	*5 914*	*11 395 013*	*9*	*13 158*
LDA	Greater London North	1 093 912	1	12 155	271 558	1	1 229	1 365 470	1	4 391
	Greater London South	37 591 266	38	250 608	3 891 139	12	12 432	41 482 405	31	89 595
	Inner London	26 411 086	26	41 527	21 784 318	67	17 754	48 195 404	36	25 870
	Total	*65 096 264*	*65*	*74 311*	*25 947 015*	*80*	*14 734*	*91 043 279*	*69*	*34 525*
SEEDA	Milton Keynes	1 551 969	2	19 645	363 873	1	3 999	1 915 842	1	11 270
	Brighton	418 220	0	6 337	57 811	0	650	476 031	0	3 071
	Canterbury - Medway- Tonbridge	4 727 727	5	48 242	1 157 237	4	5 701	5 884 964	4	19 551
	Guildford	2 845 252	3	19 897	962 116	3	5 037	3 807 368	3	11 399
	Oxford	1 196 068	1	12 205	350 093	1	6 252	1 546 161	1	10 040
	Portsmouth	960 699	1	24 633	32 568	0	693	993 267	1	11 550
	Reading - Slough	12 895 584	13	70 468	776 470	2	4 152	13 672 054	10	36 951
	Redhill	1 155 366	1	14 442	110 624	0	1 257	1 265 990	1	7 536
	Southampton	294 775	0	6 272	77 968	0	1 772	372 743	0	4 096
	Total	*26 045 660*	*26*	*31 267*	*3 888 760*	*12*	*3 904*	*29 934 420*	*23*	*16 367*
Total		99 775 267	100	47 332	32 597 445	100	10 111	132 372 712	100	24 826

Table 7. Employment and Revenue Figures for the Core Clusters in the EEDA Health Technology Sector[13]

Cluster	Firms		Employees Last Year			Operating Revenue / Turnover th GBP Last Year		
	Count	%	Sum	%	Median	Sum	%	Median
1.BioPharmaR&D	115	11,8	2 409	5,4	30	676 452	7,8	837
2.DrugDevelopmentSupport	82	8,4	2 061	4,6	36	254 661	2,9	1 049
3.BioPharmaManufacturing	70	7,2	8 869	19,7	84	1 739 383	20,1	10 617
4.IntegratedPharma&Biotech	17	1,7	8 996	20,0	624	2 159 378	25,0	113 696
5.TradePharmaceuticalProducts	87	9,0	2 078	4,6	34	710 095	8,2	7 551
6.BioPharmaSupport	92	9,5	966	2,1	28	248 857	2,9	93
7.Diagnostics	44	4,5	1 043	2,3	27	144 895	1,7	1 319
8.MedicalDevices	192	19,8	10 301	22,9	54	1 398 552	16,2	2 473
9.Telecare	3	0,3	647	1,4	324	73 784	0,9	36 892
10.TradeMed&OpticalProducts	174	17,9	7 275	16,2	35	1 143 341	13,2	360
16.HealthProd&Cosmetics	96	9,9	351	0,8	6	83 945	1,0	79
Total	**972**	**100**	**44 996**	**100**	**37**	**8 633 343**	**100**	**1 113**

---

[13] Due to asymmetric distribution, we have used median as average for individual cluster groups.

Table 8. Employment and Revenue Figures for the Core Clusters in the LDA Health Technology Sector[14]

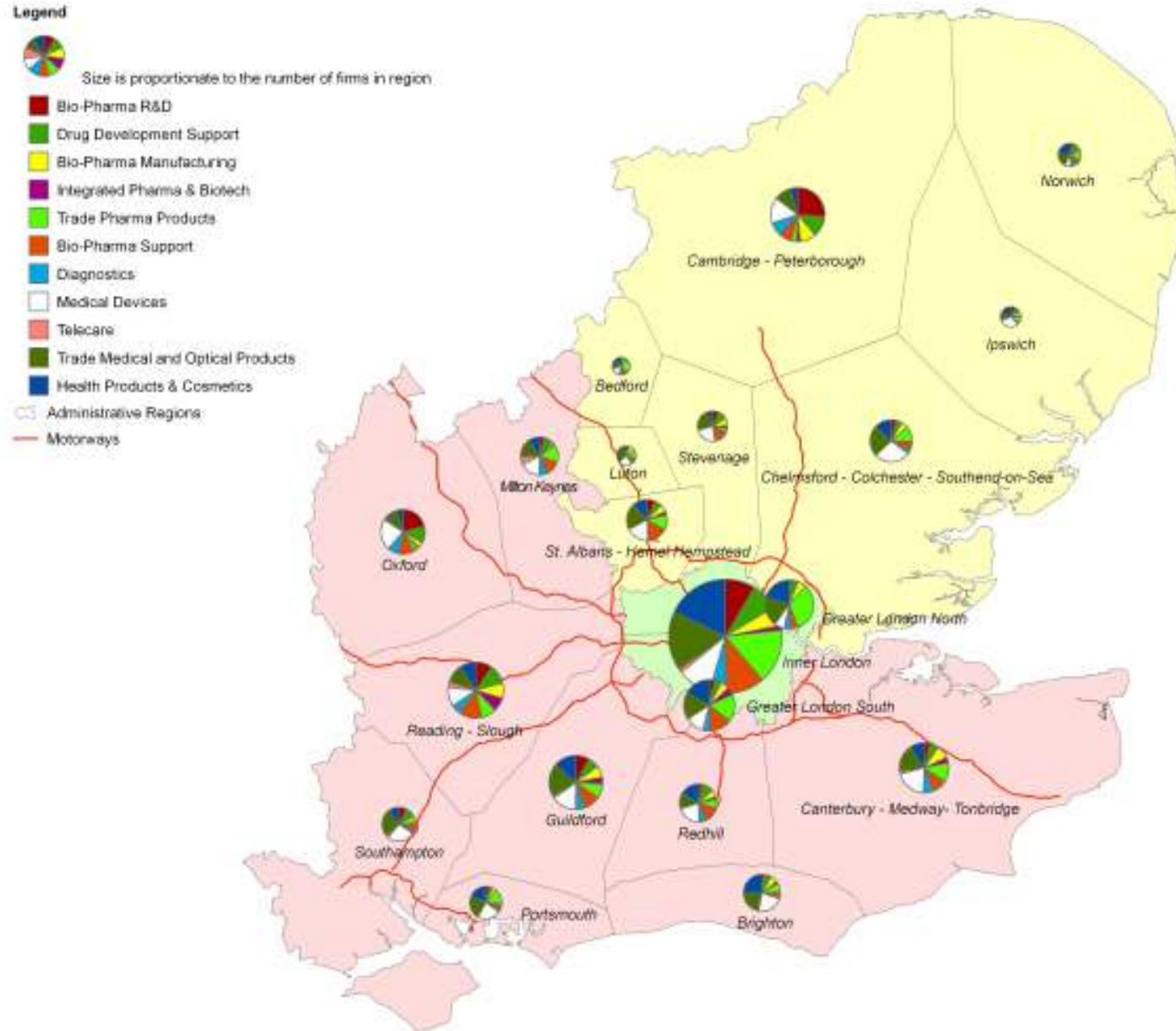| Cluster	Firms		Employees Last Year			Operating Revenue / Turnover th GBP Last Year		
	Count	%	Sum	%	Median	Sum	%	Median
1.BioPharmaR&D	132	6,7	1 914	0,6	24	3 505 438	5,4	626
2.DrugDevelopmentSupport	140	7,1	18 502	5,9	22	1 583 185	2,4	832
3.BioPharmaManufacturing	105	5,3	11 037	3,5	20	1 389 941	2,1	3 924
4.IntegratedPharma&Biotech	36	1,8	184 773	59,2	120	41 427 702	63,6	9 360
5.TradePharmaceuticalProducts	352	17,9	9 545	3,1	31	7 859,362	12,1	2 367
6.BioPharmaSupport	212	10,8	3 222	1,0	28	414 761	0,6	177
7.Diagnostics	91	4,6	10 097	3,2	18	1 028 162	1,6	349
8.MedicalDevices	188	9,6	42 418	13,6	44	4 363 194	6,7	1 232
9.Telecare	17	0,9	479	0,2	33	41 544	0,1	1 031
10.TradeMed&OpticalProducts	338	17,2	5 976	1,9	19	860 188	1,3	191
16.HealthProd&Cosmetics	356	18,1	24 338	7,8	52	2 622 787	4,0	121
Total	**1 967**	**100**	**312 301**	**100**	**30**	**65 096 264**	**100**	**497**

---

[14] Due to asymmetric distribution, we have used median as average for individual cluster groups.

**Table 9. Employment and Revenue Figures for the Core Clusters in the SEEDA Health Technology Sector[15]**

Cluster	Firms		Employees Last Year			Operating Revenue / Turnover th GBP Last Year		
	Count	%	Sum	%	Median	Sum	%	Median
1.BioPharmaR&D	140	7,6	4 588	4,0	40	985 500	3,8	1976
2.DrugDevelopmentSupport	154	8,4	9 371	8,1	53	1 086 162	4,2	973
3.BioPharmaManufacturing	111	6,0	4 564	3,9	66	1 465 900	5,6	4 731
4.IntegratedPharma&Biotech	62	3,4	21 948	18,9	148	7 476 785	28,7	60 757
5.TradePharmaceuticalProducts	172	9,3	6 827	5,9	32,5	2 401 817	9,2	2 370
6.BioPharmaSupport	192	10,4	1 251	1,1	9,5	371 030	1,4	100
7.Diagnostics	105	5,7	7 099	6,1	56,5	678 234	2,6	1 211
8.MedicalDevices	339	18,4	22 985	19,8	83	2 988 888	11,5	3 941
9.Telecare	43	2,3	2 031	1,7	59	557 875	2,1	4 581
10.TradeMed&OpticalProducts	301	16,3	4 344	3,7	28	1 171 506	4,5	521
16.HealthProd&Cosmetics	225	12,2	31 056	26,8	126	6 861 963	26,3	160
Total	**1 844**	**100**	**116 064**	**100**	**55**	**26 045 660**	**100**	**1 053**

---

[15] Due to asymmetric distribution, we have used median as average for individual cluster groups.

Map 1. Distribution of Firms in Sub-regions in the GSE

Legend

Size is proportionate to the number of firms in region

- Bio-Pharma R&D
- Drug Development Support
- Bio-Pharma Manufacturing
- Integrated Pharma & Biotech
- Trade Pharma Products
- Bio-Pharma Support
- Diagnostics
- Medical Devices
- Telecare
- Trade Medical and Optical Products
- Health Products & Cosmetics
- Administrative Regions
- Motorways

© E. Todeva, University of Surrey

Map 2. Distribution of Firms in the Bio-Pharma R&D and Drug Development Support Clusters in the GSE[16],[17]
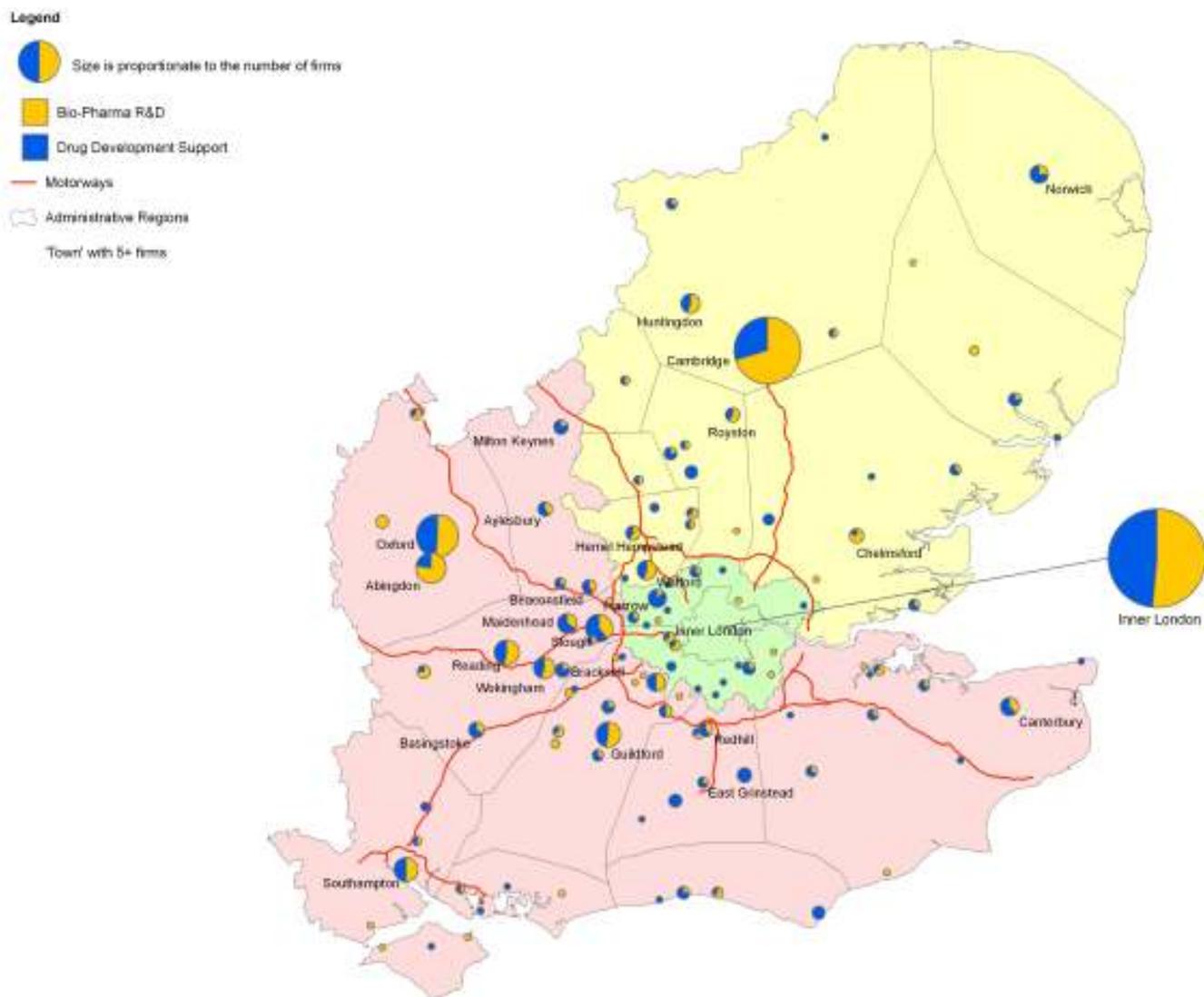
---
[16] Pie-charts without the name of the location represent a location hosting a small number of firms (less then 5 from the compared two cluster groups).

[17] Comprehensive lists of location names, or firms in locations, that correspond with this map are available on request.

24

Map 3. Distribution of Firms in the 'Bio-Pharma Manufacturing', 'Integrated Pharma and Biotech', 'Health Products & Cosmetics', 'Trade Pharma Products' and 'Bio-Pharma Support' Clusters in the GSE[18], [19]
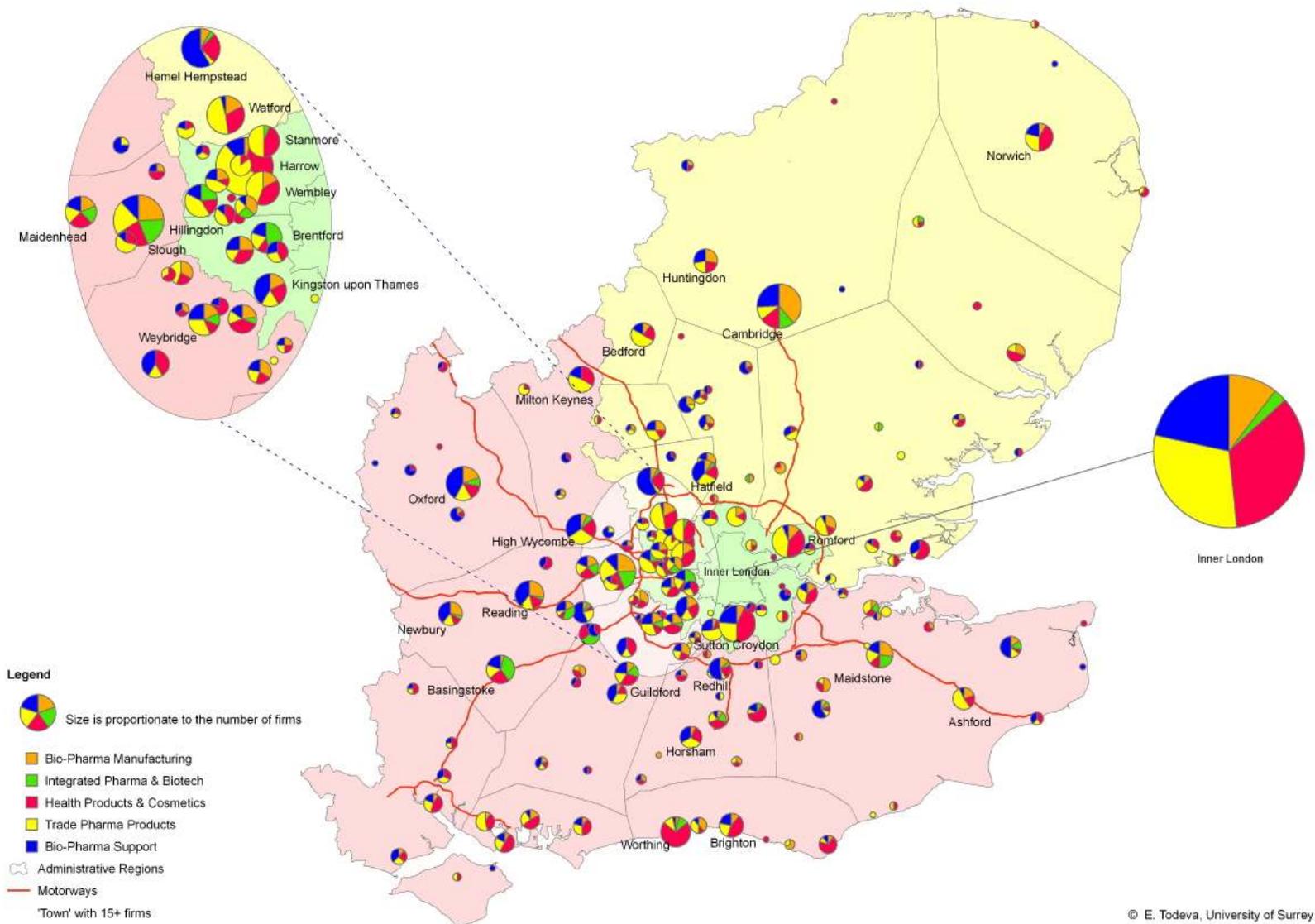

© E. Todeva, University of Surrey

---

[18] Pie-charts without the name of the location represent a location hosting a small number of firms (less then 15 from the compared five cluster groups).

[19] Comprehensive lists of location names, or firms in locations, that correspond with this map are available on request.

Map 4. Distribution of Firms in the 'Diagnostics', 'Medical Devices', 'Tele-care, and 'Trade Medical and Optical Products' Clusters in the GSE[20], [21]

© E. Todeva. University of Surrey

---

[20] Pie-charts without the name of the location represent a location hosting a small number of firms (less then 15 from the compared five cluster groups).

[21] Comprehensive lists of location names, or firms in locations, that correspond with this map are available on request.
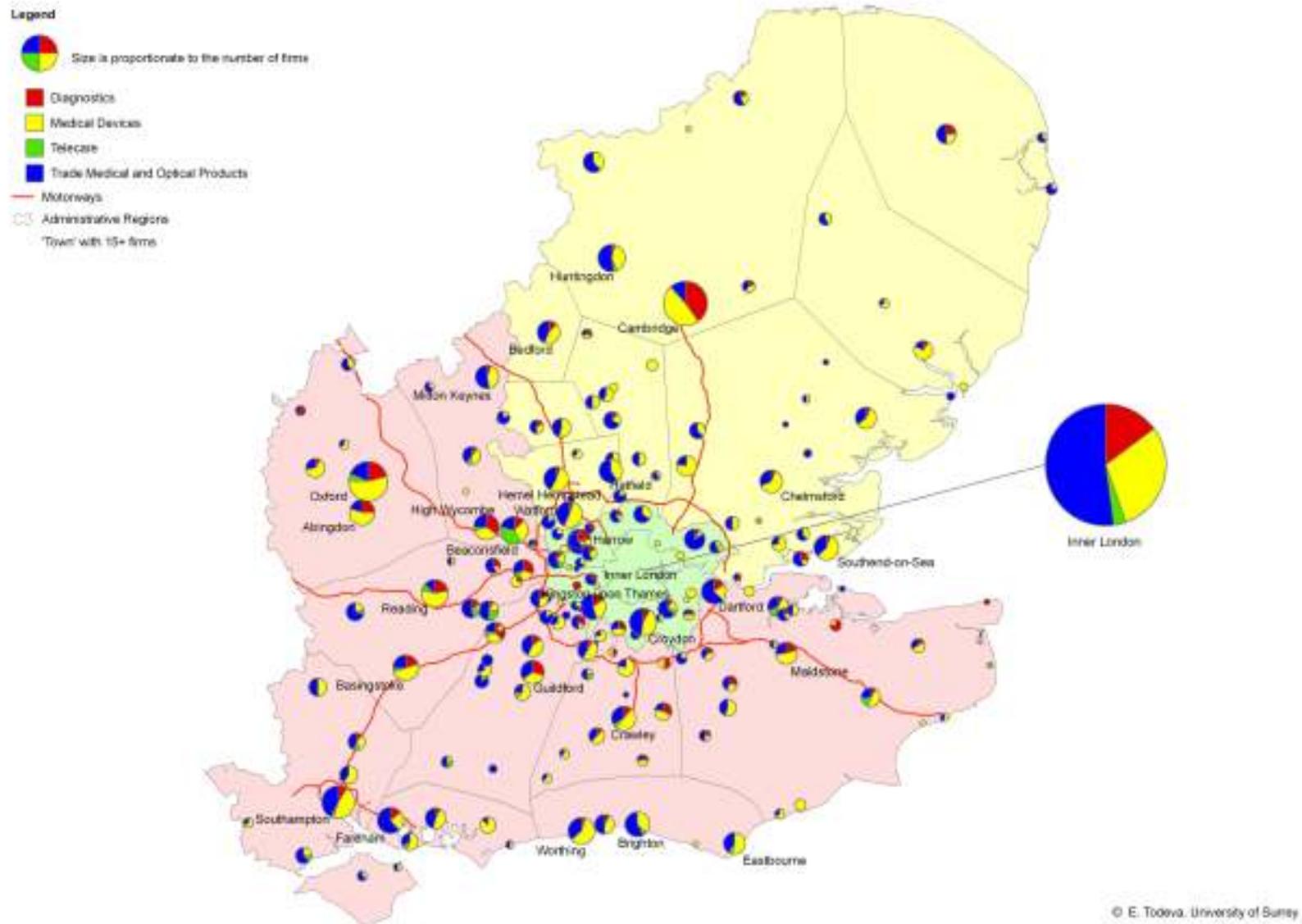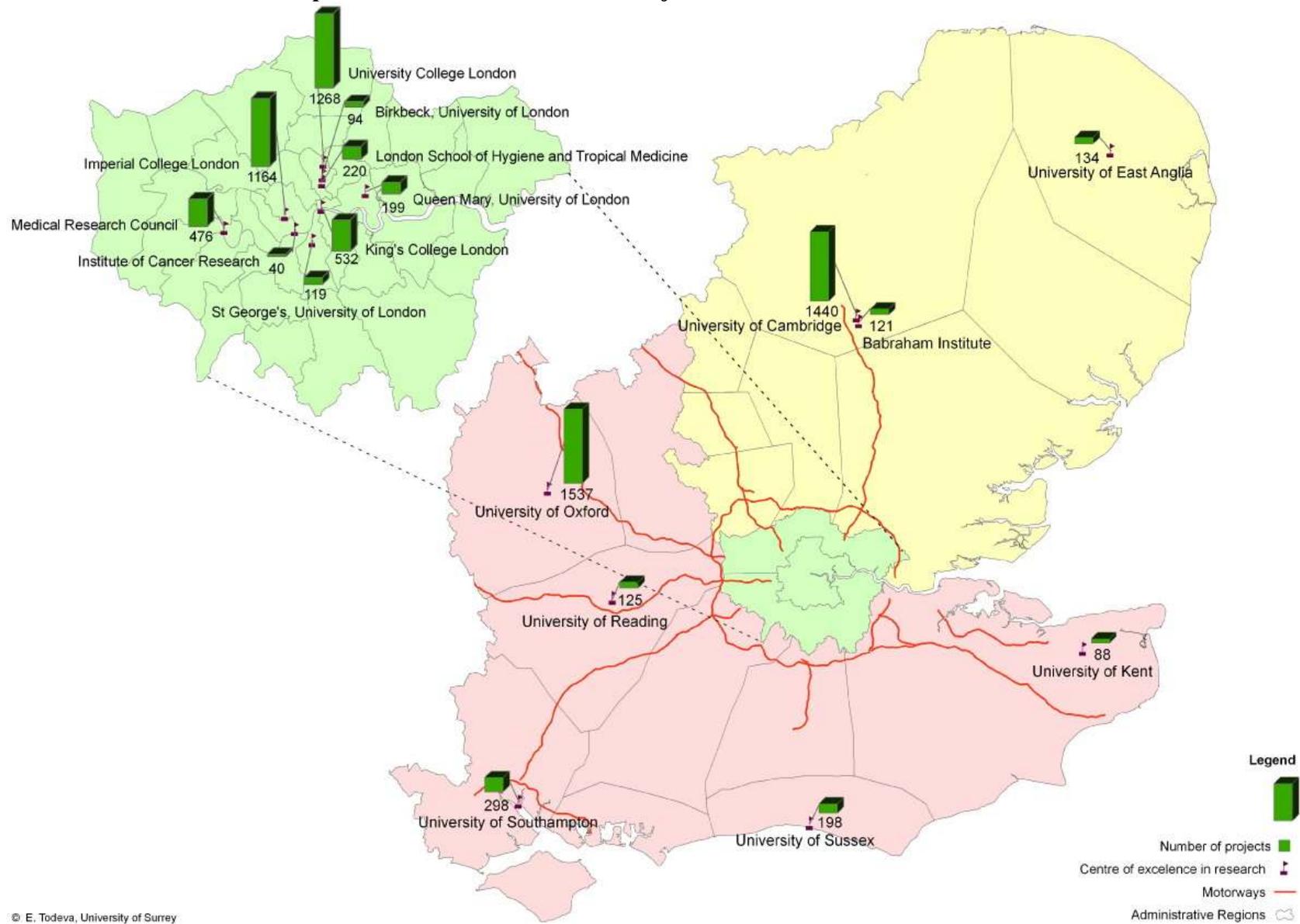
26

Map 5. Distribution of Research Projects in the Centres of Excellence[22]

University College London
1268
94
Birkbeck, University of London
London School of Hygiene and Tropical Medicine
220
Imperial College London
1164
199
Queen Mary, University of London
Medical Research Council
476
532
King's College London
Institute of Cancer Research 40
119
St George's, University of London

134
University of East Anglia

1440
121
University of Cambridge
Babraham Institute

1537
University of Oxford

125
University of Reading

88
University of Kent

298
198
University of Southampton
University of Sussex

Legend

Number of projects
Centre of excelence in research
Motorways
Administrative Regions

© E. Todeva, University of Surrey

Graph 6. Relationship Between Funding Bodies and Recipients of Research Funding *(based on total amount of funding > 200 th GBP)[23]*

---
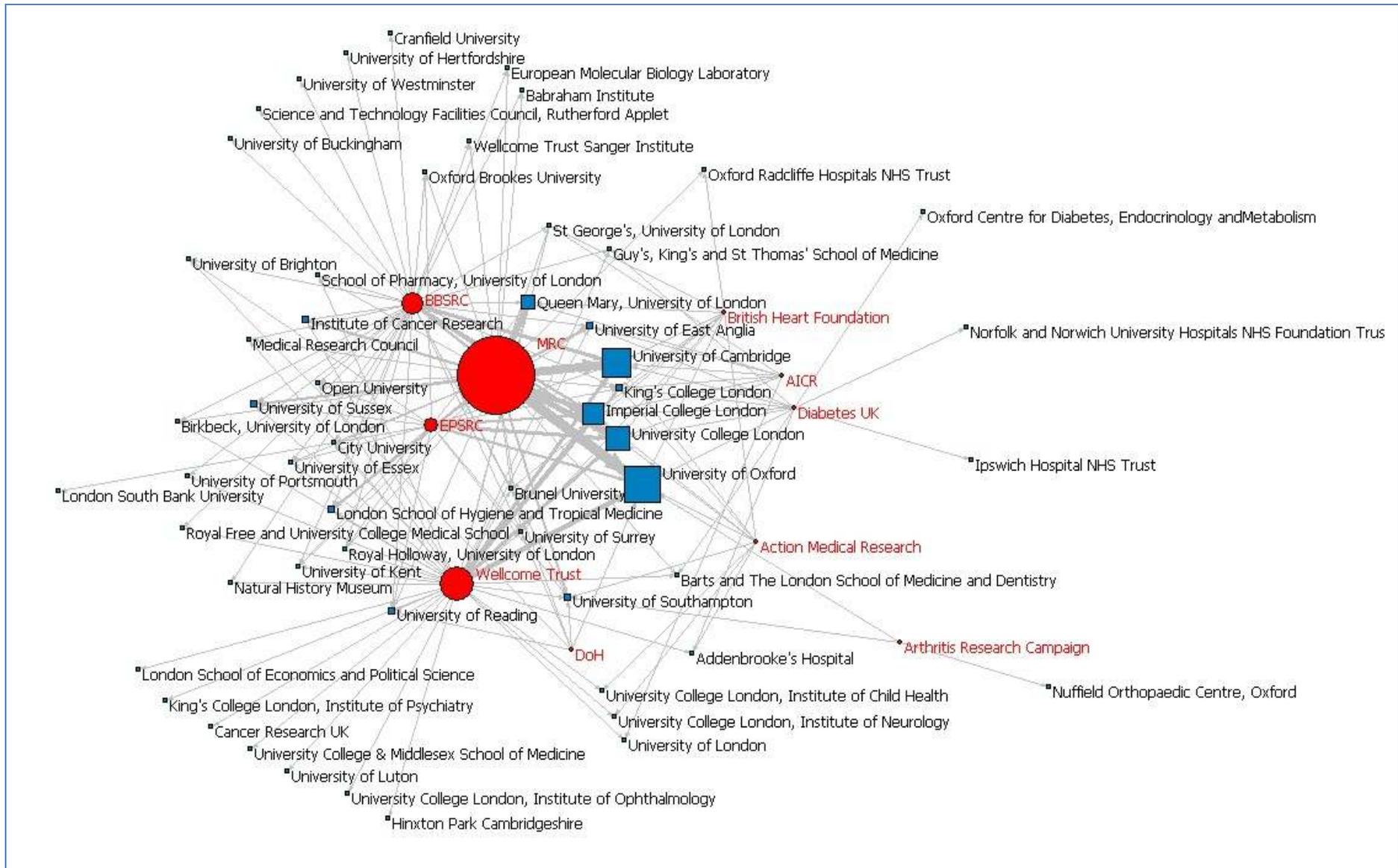
[23] RED circles and names in red represent funding bodies; BLUE squares and names in black represent institutional grant-holders, or recipients of research funding; the size of the dot and the square is proportionate to the amount of funding in GBP for each institution.

Graph 7. Research Partnerships Between Recipients of Research Funding in the GSE[24]


Institute of Cancer Research
King's College London
University of Kent
University of Reading
University of Southampton
Queen Mary, University of London
University College London
Medical Research Council
Imperial College London
Birkbeck, University of London
St George's, University of London
London School of Hygiene and Tropical Medicine
University of East Anglia
University of Cambridge
University of Oxford
Babraham Institute
University of Sussex

---

[24] BLUE circles represent institutional grant-holders that coordinate a research partnership; the size of the dot represents the amount of research funds received by each institution; anonymous institutions represent research partners in the region, in UK, and worldwide; ties represent at least one research partnership.

Graph 8. Risk Adjusted Performance of Cluster Groups in the GSE[25]

Risk-adjusted Performance
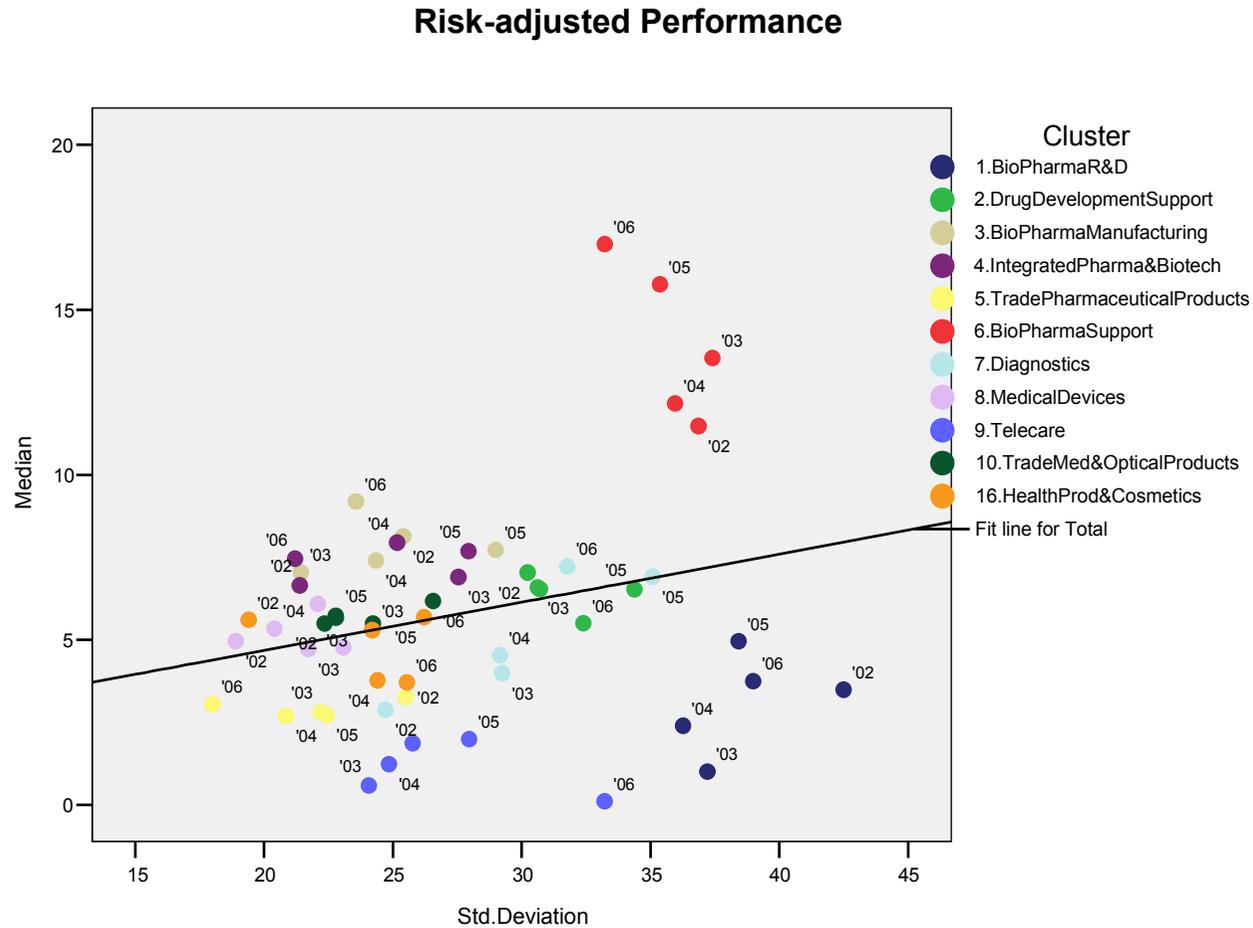
[25] The risk-adjusted performance matrix uses the model of 'sharp ratio' (or mean by the standard deviation). Graph 8 is an adaptation to that model, as it uses the median of profit margins to represent performance and the standard deviation for that indicator to represent the risk that is associated with each cluster group. The fit line represents the theoretical expectation for a balance between risk and reward. Each observation indicates the risk-adjusted performance for an individual cluster group for a specific year (02, 03, 04, 05, 06). The data for 2007 was insignificant for this analysis. Observations below the fit line indicate relatively higher risk related to received reward. Observations above the fit line indicate relatively higher performance for the risk associated with that performance.

Table 11. List of Centres of Excellence in the GSE *(sorted by total value of awards received)*

	Centers of Excellence in Research	Projects 2000-2007		Total value of awards 2000-2007	
		Count	%	Sum th GBP	Sum %
1	University of Oxford	1537	17,3	1 020 093	23,5
2	University of Cambridge	1440	16,2	807 547	18,6
3	University College London	1373	15,5	658 159	15,2
4	Imperial College London	1164	13,1	548 896	12,7
5	Queen Mary, University of London	199	2,2	342 506	7,9
6	King's College London	612	6,9	121 471	2,8
7	London School of Hygiene and Tropical Medicine	220	2,5	118 366	2,7
8	University of Southampton	298	3,4	106 947	2,5
9	Institute of Cancer Research	40	0,5	88 601	2,0
10	University of Sussex	198	2,2	84 876	2,0
11	University of East Anglia	134	1,5	82 745	1,9
12	University of Reading	125	1,4	51 054	1,2
13	Medical Research Council	476	5,4	34 524	0,8
14	Babraham Institute	121	1,4	34 186	0,8
15	St George's, University of London	119	1,3	33 182	0,8
16	Birkbeck, University of London	94	1,1	33 156	0,8
17	University of Kent	88	1,0	23 380	0,5
18	Hinxton Park Cambridgeshire	14	0,2	19 119	0,4
19	University of Surrey	68	0,8	17 210	0,4
20	Guy's, King's and St Thomas' School of Medicine	53	0,6	13 493	0,3
21	City University	22	0,2	11 731	0,3
22	Wellcome Trust Sanger Institute	31	0,3	10 894	0,3
23	Science and Technology Facilities Council, Rutherford Applet	23	0,3	7 453	0,2
24	Royal Holloway, University of London	31	0,3	7 397	0,2
25	University of Essex	39	0,4	6 909	0,2
26	European Molecular Biology Laboratory	29	0,3	6 182	0,1
27	University of Brighton	21	0,2	5 992	0,1
28	Brunel University	27	0,3	5 692	0,1
29	University of Portsmouth	30	0,3	5 175	0,1
30	Open University	22	0,2	4 768	0,1
31	School of Pharmacy, University of London	22	0,2	3 127	0,1
32	Addenbrooke's Hospital	16	0,2	2 803	0,1
33	Oxford Brookes University	14	0,2	2 685	0,1
34	Natural History Museum	17	0,2	2 178	0,1
35	Oxford Radcliffe Hospitals NHS Trust	38	0,4	2 136	0,0
36	Nuffield Orthopaedic Centre, Oxford	7	0,1	1 626	0,0
37	Barts and The London School of Medicine and Dentistry	23	0,3	1 559	0,0
38	Cancer Research UK	1	0,0	1 505	0,0
39	Royal Free and University College Medical School	13	0,1	1 278	0,0
40	University of London	10	0,1	929	0,0
41	University of Hertfordshire	4	0,0	754	0,0
42	Cranfield University	6	0,1	670	0,0
43	London South Bank University	2	0,0	524	0,0
44	University College & Middlesex School of Medicine	4	0,0	504	0,0
45	London School of Economics and Political Science	5	0,1	382	0,0
46	Ipswich Hospital NHS Trust	2	0,0	369	0,0
47	University of Westminster	2	0,0	353	0,0
48	Oxford Centre for Diabetes, Endocrinology and Metabolism	2	0,0	311	0,0
49	Norfolk and Norwich University Hospitals NHS Foundation Trus	1	0,0	257	0,0
50	University of Luton	1	0,0	240	0,0
51	University of Buckingham	1	0,0	237	0,0
52	Health Protection Agency	2	0,0	138	0,0
53	Goldsmiths, University of London	1	0,0	97	0,0
54	South Downs Health NHS Trust	1	0,0	88	0,0
55	University of East London	1	0,0	82	0,0
56	Southampton University Hospitals NHS Trust	10	0,1	77	0,0
57	Anglia Ruskin University	2	0,0	71	0,0
58	Royal Marsden NHS Foundation Trust	1	0,0	53	0,0
59	Brighton and Sussex University Hospitals NHS Trust	1	0,0	39	0,0
60	The National Institute for Biological Standards and Control	1	0,0	10	0,0
61	University of Greenwich	1	0,0	6	0,0
	Total	8862	100	4 336 789	100