SOUTH EAST HEALTH TECHNOLOGY CLUSTER*

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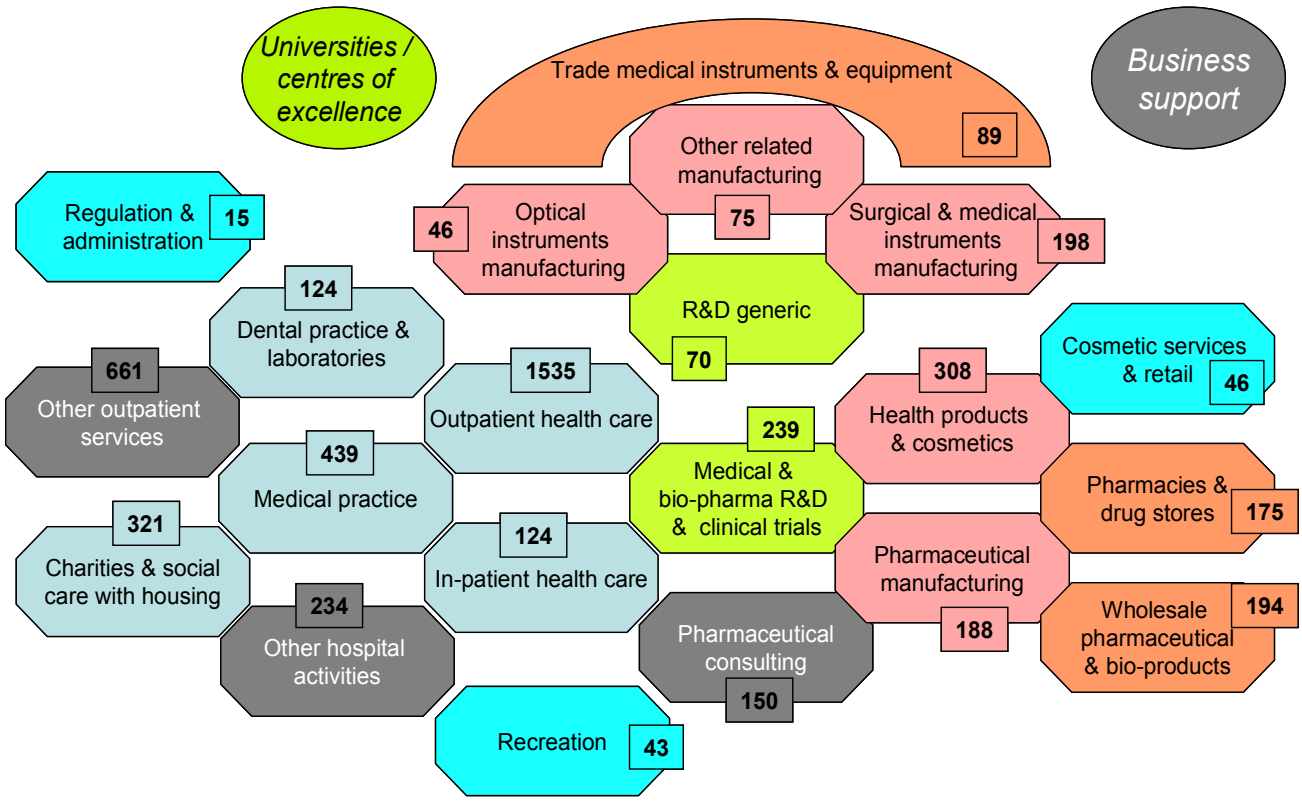
1. The Health Technology Sector in the South East: Key Findings

- 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.
- One of the currently recognised strong trends in the economic development literature is that firms align and collaborate in value-added activities, seeking efficiency from specialisation and from capturing synergies and complementarities based on sharing resources, knowledge and technology. The health technology sector comprises a complex set of interconnected value-chains that integrate specific strategic industry groups, or clusters of firms that exhibit similar portfolio of specialisation and diversification. Our map in Graph 1 describes this complex set of interconnected value chains, where the driving engine is represented by the two R&D cluster groups in the centre – R&D generic, and Medical & Bio-pharma R&D.

Graph 1. Clusters & Strategic Industry Groups in the Health Technology Sector in the South East of England*

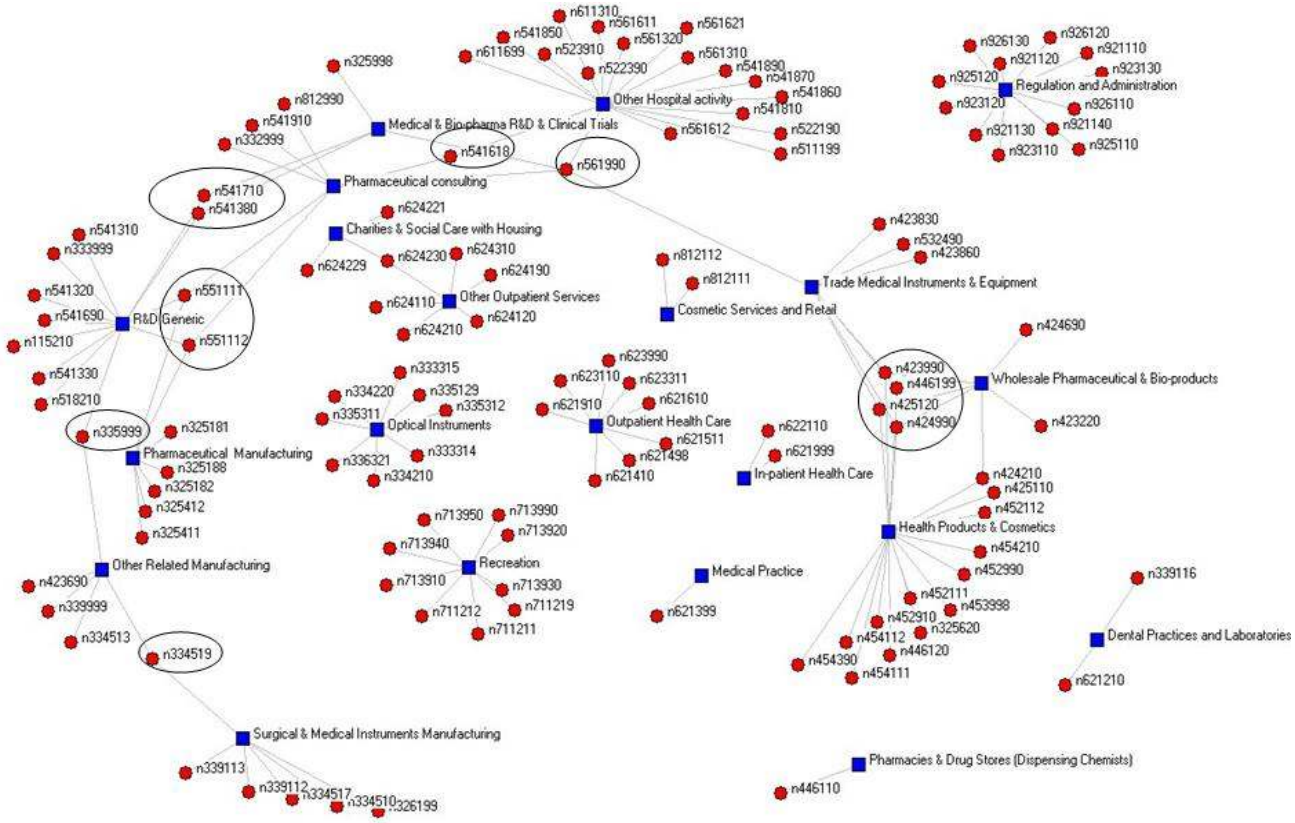


* Names of strategic cluster groups indicate core activities shared by groups of firms. Numbers in boxes indicate number of firms that operate in each cluster group. Colours indicate the position of each cluster group in the global value chain of the sector – GREEN – R&D; BLUE – health service sector; PINK – manufacturing sector; ORANGE – trade, wholesale & retail sector; GREY – business and management consultancy & support services; EMERALD – incomplete cluster groups that have emerged as having relevant activities.

- The mapping of the health technology sector revealed the existence of 4 interconnected and overlapping value chains that are in a process of integration, and the innovation of products and technologies and their test and trial are critical to this process. These interconnected value chains are:
  1) Medical & Bio-Pharma R&D ►Pharmaceutical Manufacturing ► Pharmaceutical Consulting ► Pharmacies & Drug Stores ►Wholesale Pharma;
  2) R&D Generic ►Surgical / Medical Instruments Manufacturing ► *Optical Instruments* ►Other Related Manufacturing ► Trade Medical Instruments & Equipment;
  3) Medical & Bio-Pharma R&D ► *Outpatient Health Care* ► *In-patient Health Care* ► *Medical Practice* ► *Dental Practice & Laboratories* ► Charities & Social Care with Housing ► Other Outpatient Services ► Other Hospital Activities;
  4) Health Products & Cosmetics ► Wholesale Pharma ► Trade Medical Instruments & Equipment.*

  In addition, there appear a strong connection and integration between Pharmaceutical Consulting and Other Hospital Activities, between the two R&D cluster groups, and between R&D Generic and Pharmaceutical Manufacturing (see Map 1). These connections indicate areas of convergence and cross-fertilisation between value chains.

Map 1. Interconnected Cluster Groups and Industry Codes *(normalised value $x^2 > 108$)*[**]



[*] Cluster groups in *Italic* are only loosely connected to their value chain and exhibit fairly independent specialisation.

[**] BLUE squares represent strategic cluster groups; RED dots represent individual industrial codes (in NAICS - North Atlantic Industry Classification System); TIES between industry codes and strategic cluster groups represent significant specialisation of firms from the strategic group into core industry areas. The selection of the strongest ties to core industries for the representation in Map 1. is based on a normalised value *($x^2 > 108$)*. Circled industry codes can be interpreted as 'bridge industries' that contribute to the value-added activities of different strategic cluster groups, and industries where conversion of technologies and competences may be expected.

- All cluster groups in the sector exhibit substantial volume and scope of activities. Outpatient Health Care has the largest number of establishments (1535), while the Pharmaceutical Manufacturing cluster group has the largest number of employment (41%) and revenue (55%) from the total employment and revenue for the sector (see Table 1). However, the performance results show that the establishments in the Health Care groups exhibit consistently the largest profit margins in the sector for the last three years and the lowest variation between firms (i.e. lowest coefficient of variance) (Table 2. - results highlighted in green). The two R&D clusters show significantly different performance, where we observe rapid deterioration of profits for the Generic R&D firms, while the profits for the Medical & Bio-pharma R&D firms increase. The cluster groups with the lowest performance are the Optical Instruments and the Other Related Manufacturing (Table 2. - results highlighted in red).

Table 1. Distributions of firms, revenue and employment data per cluster groups in the region.*

CLUSTER	Number of firms per cluster	% from total population	Total revenue per cluster*	% from total population revenue	Total employment per cluster	% from total population employment
Outpatient Health Care	1535	29,1%	1350330	2,3%	19109	5,9%
Medical Practice	439	8,3%	79690	0,1%	1336	0,4%
Dental Practices and Laboratories	124	2,3%	25457	0,0%	448	0,1%
Other Outpatient Services	661	12,5%	95918	0,2%	21142	6,5%
In-patient Health Care	124	2,3%	325966	0,6%	16747	5,1%
Other Hospital activity	234	4,4%	201815	0,3%	692	0,2%
Charities & Social Care with Housing	321	6,1%	54847	0,1%	9415	2,9%
Surgical & Medical Instruments Manufacturing	198	3,7%	2135175	3,7%	16985	5,2%
Optical Instruments	46	0,9%	86444	0,1%	751	0,2%
Other Related Manufacturing	75	1,4%	229028	0,4%	1768	0,5%
R&D Generic	70	1,3%	821900	1,4%	7241	2,2%
Medical & Bio-pharma R&D & Clinical Trials	239	4,5%	3484234	6,0%	17908	5,5%
Pharmaceutical Manufacturing	196	3,7%	32128969	55,4%	133710	41,0%
Pharmaceutical consulting	150	2,8%	3419767	5,9%	26793	8,2%
Pharmacies & Drug Stores (Dispensing Chemists)	175	3,3%	221606	0,4%	1524	0,5%
Wholesale Pharmaceutical & Bio-products	194	3,7%	6859649	11,8%	11618	3,6%
Cosmetic Services and Retail	46	0,9%	7668	0,0%	255	0,1%
Health Products & Cosmetics	308	5,8%	5873843	10,1%	32237	9,9%
Trade Medical Instruments & Equipment	89	1,7%	416433	0,7%	2426	0,7%
Regulation and Administration	15	0,3%	214	0,0%	0	0,0%
Recreation	43	0,8%	177920	0,3%	4227	1,3%
Total	5282	100%	57996873	100%	326332	100%

- The structure of the value-chain of individual cluster groups reveals interrelated industry codes that contribute to the value-added activities specific to specific product/service/technology market. For example, for the pharma manufacturing cluster group the core codes are: ***325411 Medicinal and Botanical Manufacturing*** (56% of firms)

* Revenue data is in Thousands GBP.

and ***325412 Pharmaceutical Preparation Manufacturing*** (33% of firms) (see Map 17 below and in Appendix). These two codes are responsible for the two main segments of this cluster group, which are interconnected by four small segments, or groups of firms that have different specialisation. One of these segments has operations in both industry codes and is situated in the most central position on the cluster map; the second segment represents holding companies, that in addition provide financing; the third segment include firms that have diversified in support services; and the four segment represents firms that specialise in chemical manufacturing.

Map 17. Cluster "Pharmaceutical Manufacturing (see Appendix)*

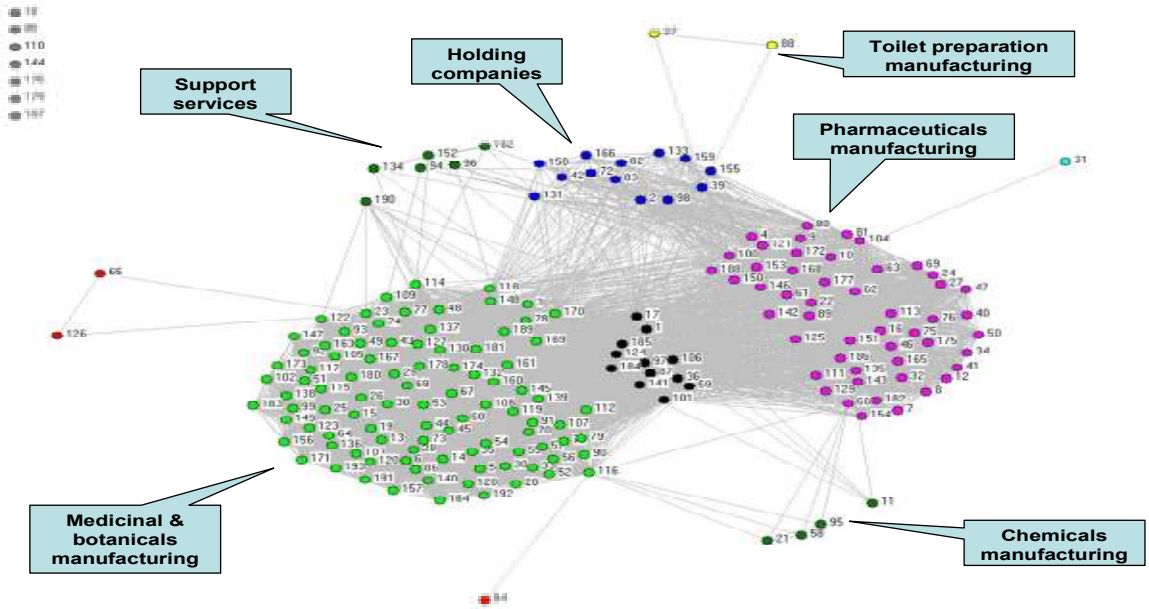


Table 2. Comparative Cluster Performance** (*source: Amadeus, 2005*)

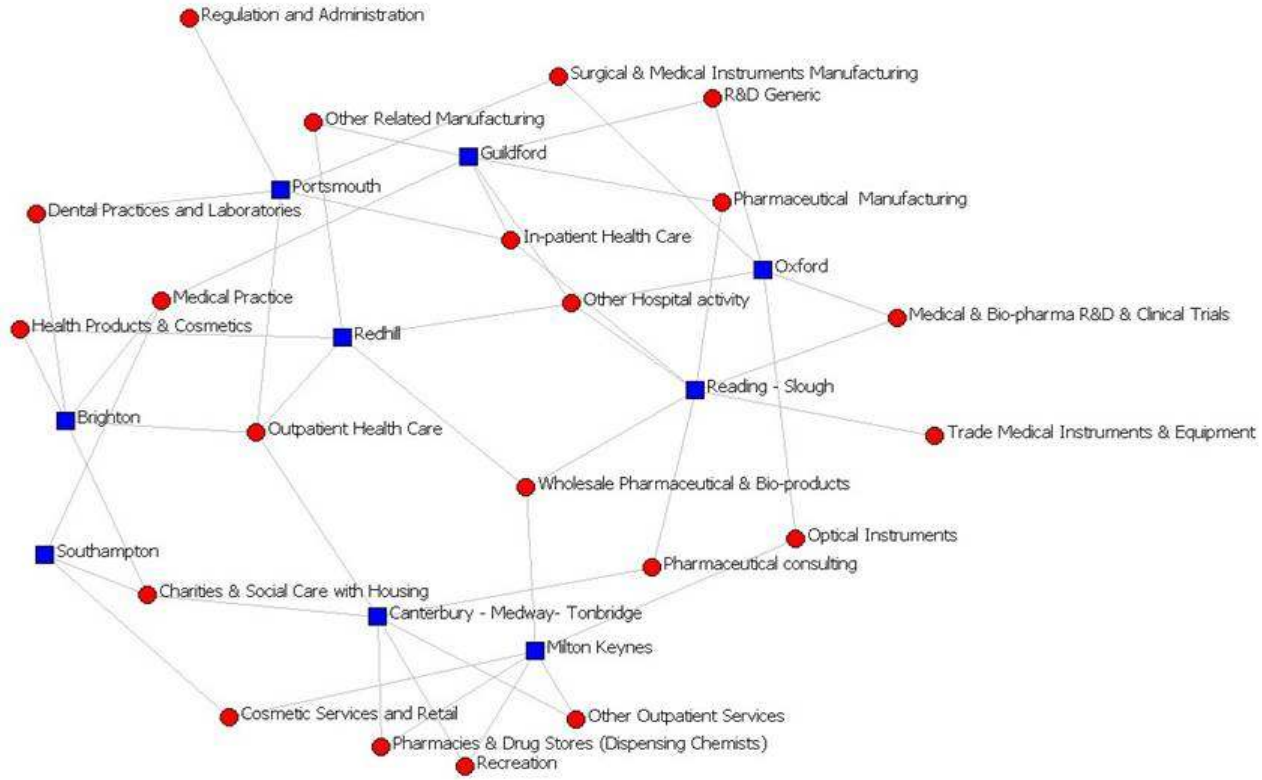
Median Profitability Over the Last 3 Years				Coefficient of Variance			
	Profit Margin (t)	Profit Margin (t-1)	Profit Margin (t-2)		Profit Margin (t)	Profit Margin (t-1)	Profit Margin (t-2)
outpatient health care	13.1%	16.2%	14.8%	outpatient health care	1.6	1.5	1.4
medical practice	23.3%	17.4%	23.9%	medical practice	1.1	1.3	1.2
dental practice & labs	26.9%	32.9%	25.8%	dental practice & labs	1.1	1.1	1.2
in-patient health care	13.3%	12.0%	14.6%	in-patient hlth care	3.8	1.5	1.7
charities & social care	7.0%	6.6%	9.5%	charities & social care	2.3	3.8	1.7
other outpatient services	3.6%	6.8%	5.2%	other outpatient services	2.1	2.0	3.2
other hospital activity	15.2%	15.9%	15.0%	other hospital activity	1.6	1.6	1.7
Optical	1.8%	6.7%	5.0%	Optical	-2.4	3.9	-6.1
Surgical/Medical	7.2%	5.9%	3.7%	Surgical/Medical	2.7	3.8	10.7
Other Related Manufacturing	-0.3%	2.1%	0.5%	Other Related Manufacturing	17.5	284.1	17.1
R&D generic	0.6%	1.0%	5.9%	R&D generic	-4.4	-6.8	2.0
medical & bio-pharma R&D	7.9%	6.1%	5.7%	medical & bio-pharma R&D	5.1	14.0	4.1
pharma manufacturing	9.1%	9.9%	8.1%	pharma manufacturing	2.5	3.5	2.5
health products	7.3%	4.2%	3.7%	health products	2.8	6.3	10.0
pharma consulting	6.3%	9.7%	10.4%	pharma consulting	2.6	1.8	1.6
wholesale pharma	4.6%	3.6%	4.7%	wholesale pharma	3.2	6.8	3.8
trade medical instr/equip	5.1%	5.0%	3.4%	trade med instr/equip	8.2	2.6	33.1
pharmacies & drug stores	8.7%	7.1%	5.0%	pharmacies & drug stores	1.3	2.0	1.6
cosmetic services & retail	6.5%	4.4%	8.4%	cosmetic services & retail	3.0	-12.5	2.6

* all ties between firms; DOTS represent individual firms in this cluster group; TIES between firms represent a competitive relationship, where firms have declared the same industry code and compete in the same product market; different colours of dots represent distinctive structural components and segments.

** The colour scheme of the cluster groups corresponds with the colours in Graph 1. The colour scheme for the results of Profit margins and Coefficient of variance discriminates between good performance (in GREEN) and poor performance (in RED)

- Each core code or a combination of core codes generates structural configurations such as *segments* (or large sub-groups in a cluster, connected via a *bridge*), *components* (or large disconnected sub-groups), and *isolates* (or individual disconnected actors). Firms in a segment have more strategic options for diversification across different interconnected segments. Firms in a component have similar specialisation that give a distinctive feature of the component, and demonstrate a tendency for diversification only within the component. Isolated firms are peripheral to the cluster groups, they do not represent the cluster group, and may not belong fully to it.
- The analysis of the sub-regional distribution of competences indicates a good spread of sector activities throughout the region (Map 2.). There is marginal specialisation of some sub-regions, where the two R&D clusters for example exhibit higher concentration around Oxford, Reading, and Guildford along with surgical and optical instruments manufacturing, while Health Products & Cosmetics have some more critical mass around Brighton and Redhill. In terms of Centres of Excellence, with significant research funding and publications, the main areas that emerge with higher concentration are Oxford and Southampton, followed by Reading, Surrey, and Sussex (see Graph 2).

Map 2. Interconnected Cluster Groups and Regions[*] *(normalised value $x^2 > 1$)*



- The survey results reveal that firms in the sector are involved in active collaborations that spread across the region, the UK, Europe and even the rest of the world. These collaborative relationships and practices have long history and are maintained with suppliers, clients, research organisations and funding bodies. This indicates that the cluster dynamic in the region is widely open to processes not only in the UK, but world-wide, and the high importance of the consultancy cluster groups in all value chains suggest that the need for business, management and support services is very high. This is one of the suggested lines of policy intervention at the conclusion part of this report.

[*] BLUE squares represent sub-regions; RED dots represent cluster groups; TIES represent significant concentration of cluster group activities in particular regions.

Graph 2. Centres of Excellence in the Region (based on numbers of funded research projects)

- Detailed results from the cluster mapping of the regional capabilities and the analysis of the unique cluster blend of activities, as well as the comparative analysis of cluster performance, the survey results and analysis of the Centres of Excellence, the mapping of the relationships with universities and publications and patenting activities in the region are exhibited in the Appendix to this report.

2. Overview of Methodology

The methodology employed for this project is an adaptation from the '*Multi-stage methodology for cluster mapping*' that was designed for the clustering of the economic activities in SEE and was described in Todeva (2006). The fundamental principles of this methodology are: 1) to select all firms from the region with relevant activity in the field of health technology, and to build a database for the region; 2) to identify the strategic industry groups (or ***cluster groups***) in the sector and to demarcate clear cluster boundaries with clear cluster centres where the cluster centres are described according to the core industry codes for each cluster group[1]; 3) to allocate all firms in cluster groups according to their 'best fit'; 4) to produce cluster maps containing the structure of interconnected industries that form the core of the value-chain activities in each cluster group, as well as the location of individual firms in the value chain; 5) to label each cluster group according to its core interconnected industries and to evaluate the performance of each cluster group[2].

Database for Cluster Mapping

The methodology is based on a database containing the population of firms in the region identified according to specific selection criteria for health technology[3]. The database contains Amadeus full

[1] Core industry codes per cluster are defined with the application of statistical clustering technique description below in this section

[2] 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.

[3] The selection criteria refers to 236 key words and selected codes from UK SIC, US SIC, NACE, NAICS, CSO - that represent: biotechnology, diagnostics, surgical / medical instruments and devices, pharmaceuticals, and medical

record for each firm with portfolio of activities and performance indicators. Amadeus business data-source is produced by the company Bureau van Dijk (December 2005). The population of firms in health technology in the South East of England includes 9 sub-regions, and the full firm records contains data for firm annual turnover, employment, and registration details. The distribution of employment and revenue in the database is presented in Table 1. A small group of new firms from other SEHTA projects were added to the database, including firms registered outside of the region, and firms that are known to work in the field, but have not declared any relevant code. (112). In addition, we excluded from the statistical analysis dissolved firms, firms under liquidation or receivership, and firms for which the last record is before 2003. For the statistical analysis we selected 5282 firms.

Multi-stage Methodology for Cluster Mapping with Industry Data

Our multi-stage methodology for cluster mapping is based on the systematic application of a number of statistical methods and analytical procedures for formal statistical cluster analysis and classification of objects. We use one of the most popular among the iterative methods for statistical clustering - K-means, which is applicable to large data sets with large number of variables (in our case 360 dichotomous variables representing industry activities).

The step-by-step multi-stage methodology combines formal statistical methods and analytical procedures and is adapted from Todeva (2006). All cluster groups were reviewed by looking at the text description of activities, and priority was given to industry text compared to industry codes. The validity of the cluster groups was tested first, with an in-depth case (Pharmaceutical consulting), where membership was reviewed; second, with the survey where a representative sample of one particular cluster was selected (Medical and Bio-Pharma R&D and Clinical Trials); and third, with assessment of cluster performance where closely related clusters were compared, and significant differences in performance were identified.

The ultimate purpose of the multi-stage cluster methodology is to identify cluster groups of interconnected industries based on synergies from inter-industry operations, and in the context of the entire regional economic infrastructure for individual cluster development.

Methodology for Cluster Analysis

We distinguish between cluster mapping and cluster analysis as these are two distinctive parts of the process of advancing our knowledge on regional and industrial clusters. While cluster mapping aims to demarcate clear cluster boundaries and cluster membership, the subsequent cluster analysis aims to identify stable intra-cluster and inter-cluster relations between firms and industries. The key questions that our cluster analysis addresses are:

- what are the inter-industry relations that bond certain industries together in a cluster group;
- what product and industry value chains can be identified in individual cluster groups, such as inter-industry relations that are part of a vertical integration within and between firms;
- how to represent and analyse the core structure of cluster groups and how to demarcate between the core and the periphery of a cluster;

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research. A firm is included in the database if it satisfies at least one of our selection criteria. The original Amadeus database was cleaned and amended with firms that were identified in the patent database, in SEHTA original membership database, and from other SEHTA projects and sources.

- what is the structure of a cluster group that supports the range of core and supplementary cluster activities;
- which industries participate in the core structure of individual clusters, and which industries play a supporting role to cluster activities;
- which industries connect different clusters, cluster-segments, and sub-groups of firms;
- what is the employment and revenue profile of each cluster as evidence of its role in the regional economy; and
- what is the concentration of cluster activities in different sub-regions in the South East of England.

Most of these questions crystallise in five different methodological approaches to cluster analysis that we undertook as part of this research:

1. Analysis of the intra-cluster relationships between industries and firms
2. Analysis of the inter-firm relationships in cluster groups
3. Analysis of the inter-industry relationships in cluster groups
4. Analysis of the inter-cluster relations in the context of the entire regional economy in the South East of England.
5. Analysis of the sub-regional location of cluster activities in the South East of England.

For the in-depth analysis of intra-cluster, inter-cluster, and inter-industry relations we applied network analysis techniques with weighted graphs and almost all of our methodological approaches to cluster analysis have been developed for the use of the network software UCINET that produces visualisations of various relations. For different research purposes we used different matrices (1-mode and 2-mode) and different methods of calculations of the weighted graphs (by number of firms and by calculated coefficients). The most typical inter-industry linkages internalised by firms are exhibited in the cluster maps in the Appendix, and they represent the dominant value chain relations for each cluster group.

Methodology for Assessment of Cluster Performance

The methodology for assessment of cluster performance represents an attempt to move from descriptive to a prescriptive dimension of cluster analysis. The descriptive dimension of cluster analysis is a depiction of the economic development of the health technology sector in the South East of England in three dimensions – geographically, across the value chain of economic activities, and across sub-industry segments. This analysis by itself is a significant contribution as it demarcates agglomerations of firms with different properties – as a potential target for policy intervention. The performance analysis is conducted on the bases of the boundaries drawn from the cluster mapping, and represents on one hand validation of these boundaries that demarcate groups of firms that perform differently, and on the other hand – it informs policy makers, business leaders, and investors regarding preferred cluster configurations with respect to economic performance.

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). We did not have data on innovation performance metrics (such as new product approvals and new product sales), and we attempted to measure the innovation potential using the survey.

We examine absolute and relative performance over time, and consider the distribution of performance for particular cluster configurations. The main performance indicators that we used are: revenue growth over time; employment growth over time; earnings before interest taxes depreciation & amortization (EBITDA); profit margins, cash flow; returns to shareholders (for sub-set of the entire sample); current, liquidity, and solvency ratios.

For the comparative analysis of cluster performance we tested two main hypotheses:

- clusters occupying similar position on the value chain of the entire health technology sector are expected to exhibit similar performance (for example 'surgical-medical instruments manufacturing and optical instruments manufacturing);
- clusters with different specialisation that are located closely to each other on the value chain are expected to perform differently due to different specialisation (for example 'R&D generic' and 'medical & bio-pharma R&D').

Survey Methodology

The sample for the survey (37 firms) included a representative selection of firms from one cluster group – 'Medical & Bio-pharma R&D & Clinical Trials' (15 firms or 40% of the sample), and some representation across the other cluster groups. The questions for the survey aimed to collect information on the inter-firm relationships and location of business partners; collaborations with Universities; cooperation practices in the region; motivations to locate in the region; internationalisation strategies; sources and driver of innovation in the region and within the company; R&D expenditure and patent activities; mapping of products, technologies, specialisation and diversification of the firms; mapping of target markets.

Other Mapping Methodologies and Analytical Procedures

We have attempted a preliminary mapping of the innovation potential in the sector building databases of publications from establishments in the region (using Web-of-Science publications database), patents by assignees located in the region (using European Patent Office), and Centres of Excellence in the region receiving research funding on health technology related projects (using published information by funding bodies in the UK). Preliminary results from these research initiatives are discussed in the final part of this report and preliminary findings are listed in the Appendix.

3. Analysis of Cluster Groups

All cluster groups were subjected to analysis of their value chain, and the structural maps[4] are listed in Appendix, with a brief description of the core activities and related diversification. Each cluster group contains a set of core activities, which are most representative for the member firms, and they are indicated as 'core industry codes'. Core activities for each cluster group give the name of the cluster group itself (see Table 3). In addition, each cluster group contains diversified firms that exhibit specialisation in other related activities, or business activities that generate value-added and synergies in operations. We distinguish between cluster related codes (expecting related

[4] All cluster maps represent inter-firm relations where by two firms have a tie when they have diversified their operations in the same industry. Two industries are connected when a number of firms have declared both industry codes as areas of operations. A firm is connected to an industry when it has declared this industry as an area of operations. The weighting of the tie varies between clusters and is determined by the size of the cluster and the cluster value-chain that generates the density of connections. In most cases (unless otherwise specified) a tie represent a single relationship. **All references to industry codes are based on the US NAICS system**.

diversification) and shared inter-cluster codes (expecting non-related diversification and peripheral non-core activities) (see Appendix p. 13). Among the most common diversification segments in multiple cluster groups are: 'other business support services' – adding value through management services, and 'holding companies' – adding value through secure financing. All 19 cluster groups represent 7 main areas of activities (Health Service Sector; Consulting and Other Related Business & Management Services; Pharma and Health Products Manufacturing; Medical Instruments Manufacturing; Wholesale / Trade of Pharma and Medical Instruments; and Related Retail and Services),. The first area of activities is the Health Service Sector, which comprises 5 distinctive cluster groups.

Table 3. List of Cluster Groups with Structural Maps

Outpatient Health Care	Map 4-5, p. 31-32
Medical Practice	Map 6, p. 34
Dental Practices and Laboratories	Map 7, p. 35
In-patient Health Care	Map 8, p. 36
Charities & Social Care with Housing	Map 9, p. 37
Other Outpatient Services	Map 10, p. 38
Other Hospital activity	Map 11, p. 39
Surgical & Medical Instruments Manufacturing	Map 12, p. 40
Optical Instruments	Map 13, p. 41
Other Related Manufacturing	Map 14, p. 42
R&D Generic	Map 15, p. 43
Medical & Bio-pharma R&D & Clinical Trials	Map 16, p. 44
Pharmaceutical Manufacturing	Map 17, p. 45
Health Products & Cosmetics	Map 18, p. 46
Pharmaceutical Consulting	Map 19, p. 47
Wholesale Pharmaceutical & Bio-products	Map 20, p. 48
Trade Medical Instruments & Equipment	Map 21, p. 49
Pharmacies & Drug Stores (Dispensing Chemists)	Map 22, p. 50
Cosmetic Services and Retail	Map 23, p. 51

Outpatient Health Services – This is the largest agglomeration of firms (1,535 establishments) in the region, and all of them have declared the 8 core industry codes characterising this cluster group. These industry activities refer in general to home healthcare services and general practitioners, medical laboratories, nursing care facilities, other residential care facilities, and outpatient care centres. In addition to this intense pool of core services, this cluster group exhibits the largest diversification of all other cluster groups. The same firms that specialise in residential care services declare diversification in 15219 other industries, and each firm operates in an average of 9 distinctive industries. Among these are non-clinical support services to organisations involved in healthcare, development and operation of bedside audio-visual services, and other human health activities. The profit margins in this cluster group are consistently very high – between 13% and 16% in the last three years, with fairly low coefficient of variance, which indicates that these performance results are equally spread across the cluster group. The operating revenue of the top 5 companies in this cluster group is between £50-140 mln BGP for the last reported year and the size of their employees are between 140 and 4350. The average revenue per firm for this cluster group is £3.3 mln GBP, while the average employment per firm is 110.

Medical Practice – This cluster group is significantly different from the previous one and contains 439 firms. Although these firms operate in a similar field of residential healthcare, they are more

focused. Most firms (89%) have declared only one core industry code for 'medical practice, and the average industry specialisation per firm is one industry only. The marginal diversification appears in the direction of other support and management consulting services, as well as personal services and electronic services. The profit margins for this cluster group are among the highest in the entire health technology sector – between 25% and 30% for the last three years and with diminishing variance, which suggests that these profits are spreading more equally across the firms in this cluster group. Among the top 5 best performers in this cluster group are companies providing care services for the elderly and handicapped, nursing homes and residential intensive care. Their operating revenue is between £687 th GBP and £17 mln GBP, and the number of employees vary between 65 and 297.

Dental Practice & Laboratories – This cluster group is the best performing one for the entire sector. All 124 firms have operations in the two core industry codes, and the marginal specialisation of some firms is in the direction of credit intermediation and repair and maintenance of dental laboratory equipment. The profit margins for the last three years have varied between 26% and 33%, and these results are consistent for almost all registered firms (very low coefficient of variance). The top five best performing dental practice laboratories have employees between 23 and 251, and operating revenue between £1 mln and £9 mln.

In-patient Health Care – This cluster group encompass 124 firms involved all of which have declared activities in the two core industry codes for general medical and surgical hospitals and miscellaneous ambulatory health services. These establishments are quite diversified as there are 44 cluster specific industry codes and the diversification is in the direction of various health practitioners, management consulting and other support services, holding companies, lessors and real estate, and other personal services. The profit margins in this cluster group for the last three years have been between 12% and 15%, but the coefficient of variance is significantly higher for the last year, which indicates that these profits are not equally distributed between firms and winners and losers emerge from the competition between them. The top 5 best performers in this cluster group have employment between 458 and 11559, and have registered operating revenue between £32 mln and £183 mln GBP.

Charities & Social Care with Housing – This cluster group is fairly large with 321 establishments, of which 98% operate in the three core codes encompassing community housing services, emergencies and other relief operations. The entire cluster group is quite diversified with 31 cluster specific codes and over one thousand other related industry activities. Among the core diversification activities are: ambulatory hospital activities, other personal and support services, schools and colleges, religious organisations, hotels and motels, other travel and accommodation services and lessors. Their profit margins for the last three years have been between 10% and 7%, although diminishing and with a significant variability across the cluster group. The employment of the top five best performers is between 76 and 1280, and the operating revenue of these establishments has been between £2 mln and £7 mln GBP.

The health service sector has also two distinctive consultancy types of cluster groups – other outpatient services and other hospital activities.

Other Outpatient Services – This cluster group comprises of 661 establishments that represent the second most diversified group in the health technology sector. 99% of these firms have declared activities in the 6 core industry codes that encompass various community services, child and youth, elderly, individual and family services, as well as food services and services for people with disabilities. The diversification in this cluster group is towards other personal and support services,

schools and instruction, religious organisations and temporary shelters. Their profit margins for the last three years are between 6.8% and 3.6% and diminishing, as well as with significant variability across the firms in the group. The best performing organisations in this group have employment between 167 and 6203 people, and operation revenue up to £17 mln GBP, although some of these establishments declare losses before tax of the magnitude of £11 mln GBP.

Other Hospital Activities – There are 234 firms in this cluster group and only 46% of them share a common industry code which identifies competencies in 'all other support services'. In general these are firms that declare in their trade description that they supply hospitals with various services including IT services, staff recruitment, property services, project management and consultancy, decision-support solutions – among others. The average number of declared industry codes for this cluster group is 2 and there are 73 cluster specific codes – none of which is core – representing the majority of firms. The profit margins of these firms are consistently between 15% and 16% for the last three years with very little variance, which suggests that there is little competition there to erode earnings, and the demand exceeds the supply of these services. The top five firms in this cluster group have between49 and 102 employees and operating revenue between £627 th and £48 mln BGP.

Surgical and Medical Instruments Manufacturing – The manufacturing sector for medial instruments and technologies has three specific cluster groups. The surgical and medical instruments manufacturing group is a mature industry group that comprises of 198 firms diversified across the value chain of related activities. 87% of these firms have the four core industry codes encompassing activities in electro-medical and irradiation apparatus, surgical & medical instruments and appliances and supplies manufacturing. This cluster group has 81 cluster-specific industry codes and on average firms operate in four industries. The value chain includes electrical equipment and components, metal and plastic products, as well as R&D. The interesting observation of this value chain is that the value chain ends with a small sub-set of holding companies that secure direct finance, and after that point, the value-chain splits into two separate streams - companies that specialise in wholesale and those that specialise in retail via personal care stores. In general this is the main cluster group that has exhibited significant growth in profit margins for the last three years and this growth has a very positive effect whereby the coefficient of variance diminishes over the same period. This suggests that the growing profits and more equally spread across the entire population of this cluster group. The best performers in this cluster group are large firms with employees between 952 and 1704 and operating revenue between £51 mln and 178 mln GBP.

Optical Instruments – This cluster group contrasts significantly from the previous one as it is a small one (46 firms only) where 91% are specialising in the two core industry codes for optical instruments and lenses and photographic equipment manufacturing. On average firms are more diversified – with operations in average of 4 industries, and the leading areas of diversification are measuring and controlling devices, industrial machinery, communication services, as well as the other support services and a large number of holding companies. The performance of this cluster group is rapidly diminishing over the last three years – from 5% profit margins to 1.8%, and these results are complicated by the negative variance ,which indicates that some firms make significant losses. Among the best performers in this cluster group are medium size companies with77 employees and up to 245. The operating revenue of the top five firms varies between £8 mln and £28 mln GBP.

Other Related Manufacturing – This cluster group is composed of 46 firms that have a weak core, where only 58% of them have declared operations in one industry code – other measuring

and controlling devices. The profit margins of this group are rapidly declining too for the last three years, and the cluster exhibits extremely high volatility where the coefficient of variance jumps to very high levels, which means that the discrepancy of profit making and loss-making firms in the same cluster group is extremely high. These are medium size companies with employees between 169 and 360 and operating revenue in the range of £12 mln to £69 mln GBP.

From the comparative analysis across the three manufacturing cluster groups we can conclude that the surgical and medical cluster has generated greater profitability over the last three years, and that the trend has moved towards sustained out-performance by this cluster. The optical instruments cluster exhibits the greatest deterioration in relative performance over time, while the other related manufacturing cluster shows a consistent underperformance throughout the last three years. In terms of the intra-cluster volatility of profitability, the distribution of profitability across the surgical/medical cluster is also lower, implying that not only does this cluster yield greater profitability, but appears to be doing so with less variability.

R&D Generic – This is a fairly diverse cluster group with one core industry code that has been declared by only 58% of the population of firms in this group (70 firms). Although this is the same core as for the medical & bio-pharma R&D, the firms in this group do not announce specific activities in bio-pharma related technologies. In general, a substantial number of firms are diversifying operations in either other management support activities, holding companies, or testing laboratories. Firms in this group have reported on average 2 industry codes, which suggests a more mature cluster group, compared with the 'bio-pharma R&D'. The performance, however, of this cluster group has rapidly deteriorated as their profit margins dropped fromnearly 6% down to 0.6%, and the gap between winners and losers has widened dramatically with coefficient of variance -6.8% and -4.4% for the last 2 years. The top performing companies still exhibit good results with operating revenue of up to £374 mln BGP, and employment in the thousands.

Medical & Bio-Pharma R&D & Clinical Trials – This is a very similar group to the R&D generis, with the same core industry code, which accounts for R&D activities in physical, engineering, and life sciences. However these 239 firms have explicitly described operations in pharma and bio-related technologies. The structure of this cluster is very similar to the structure of the previous one – including diversification in other management support activities, holding companies, or testing laboratories. However, the firms in this cluster group are more focused as the average industry code per firms is only one. There are a number of firms that have declared some R&D activities in life science, but coming from a very different industry competences, which is observed in the cluster map as 'isolates', or firms that do not share the cluster specific codes. The profit margins of the firms in this cluster group are rapidly increasing over the last three years from 5.7% to 7.9%, however, with significant magnitude in variance, which indicates volatility in performance results from year-to-year. The best performers in this group are very large companies with employees in the range between 1408 – 5887, and operating revenue from £134 mln to £1,925 bln GBP.

The comparative analysis of the two R&D clusters confirms that the firms in them are engaged in different value chains and experience different pressures from their business environment.

Pharmaceutical Manufacturing – This is one of the best performing clusters in the region with 186 firms that attract s41% of the regional employment (326 332 employed), and generate in total 55% of the revenue in the regional health technology cluster (or £58 bln GBP) for the last year. It comprises of five interconnected segments which include a group of firms that specialises in pharma manufacturing; another that specialises in medical and botanical manufacturing; a third

that specialises in both; a fourth that specialises in support services; and another one with expertise in chemical manufacturing. The profit margines of this cluster group are consistently high (between 8% and 10% for the last three years), and with fairly high variance across firms in the group. Comparative analysis of intra-cluster segments confirms that firms that are registered as holding companies exhibit profit margins slightly lower then non-holding companies, but are able to achieve this with less variability in their profitability, which demonstrates reduced risk. The top performers in this cluster group are very large firms that report up to 99503 employees and £21 bln GBP operating revenue for the last year.

Health Products & Cosmetics – This is another well performing cluster group with 308 firms that contribute 10% of the revenue for the health technology sector, and attract 10% of the sectoral employment in the region. This group does not have a core cluster code, although it has overall 74 cluster specific codes. Although many firms report manufacturing of health products, the structural map for this cluster group shows that the diversification of the firms is along the retail side. The distinctive segments in the cluster map are comprised of druggists, cosmetics & beauty stores, health & personal care stores, miscellaneous wholesale, department stores, electronic shopping, and general support services. The profit margins in this group have consistently risen over the last three years from 3.7% to 7.3%, and the general growth in this market has secured profits for all firms, where the coefficient of variance has decreased from 10% to 2.8%. The employment of the top five performers in this cluster is between 323 and 20300, and the operating revenue for the same firms is between £123 mln to £4,179 bln GBP for the last year.

Pharmaceutical Consulting – This cluster group includes 150 firms, 48% of which have declared activities in the core code for business and management support services. A large segment of firms indicates diversification in other management consulting services, and a large number of establishments are registered as holdings, i.e. responsible for financing. There is a separate component on the map identifying firms that have diversified into other personal services. The profit marging for this cluster group have deteriorated over the last three years (from 10% to 6.3%), which indicates increasing competition. The increasing coefficient of variance also indicates that as a result of this competition there is an increasing gap between underperforming and over-performing firms. The top 5 best performers are very large firms with significant number of employees (between 942 and 19468) and operating revenue between £75 mln and £2.2 bln GBP for the last reported year.

Wholesale Pharmaceutical & Bio-products – This cluster group comprises of 194 firms that are responsible for 12% of the revenue for the health technology sector in the region. The largest group of firms (89%) have declared the core code for the group, which represents drugs distribution. These establishments increasingly report wholesale of bio-products as well as pharmaceutical products. Their profit margins are fairly consistent over the last three years around 4-5%, however, this is consistently coupled with high variance in performance, or a big gap between under-performing and over-performing firms. The top five companies are large establishments with employees between 746 and over 2000, and operating revenue between £79 mln and £3 bln GBP.

For the four pharma-related cluster groups, the best performance is exhibited by the ‘pharma-manufacturing’, followed by ‘health products and cosmetics’ group, and the ‘pharma consulting’.

Trade Medical Instruments & Equipment – The cluster group of trading firms that deal with medical instruments and equipment comprises of 89 establishments that declare different wholesale-trade areas, among which 39% have declared the two core industry codes for trade

agents and brokers and wholesale miscellaneous non-durable goods. This group has improved performance over the last three years, where their profit margins have increased from 3.4% to 5.1% and the variance has diminished dramatically, indicating consistent results across the cluster group. The best performers employ between 49 and 1782 people and have operating revenue between £12 mln and £238 mln GBP for the last reported year.

Comparing the two trading clusters reveals that the performance of those who trade medical instruments and equipment is significantly better then the wholesale pharma, which is another indicator of two separate value chains in the health technology sector.

Pharmacies & Drug Stores (Dispensing Chemists) – These are 175 establishments focused on one activity – pharmacies and drug retail (96%) with very little diversification. Their profit margins however, are significantly increasing for the last three years from 5% to 8.7% with diminishing variance of results. The best performers are firms with employees between117 and 335 and operating revenue between £17 mln and £36 mln GBP over the last year.

Cosmetic Services & Retail – This is a small cluster group of only 46 firms, and it is not a complete representation of this activity, as it contains only firms that have declared special activities related to health and medical services. There are two disconnected components highlighting the different specialisation of barber and beauty shops, and all other support services. The profit margins of this group show significant variability with downwards and upwards trend and significant discrepancies of results across firms with substantial difference between under-performing and over-performing. The best performers in this group have employment between 37 and 203 people, and operation revenue between £426 th and £5.2 mln GBP.

If we look at the inter-cluster connectivity, there are two types of relationships that are observable. Some clusters are quite independent and not connected to others – outpatient healthcare, in-patient health care, medical practice, optical instruments, dental practice, and pharmacies and drug stores. Most of the other clusters are interconnected in three or four value chains of related activities. One of these value chains is 'pharmaceutical manufacturing', pharmaceutical consulting', and 'other hospital activity' (i.e. consulting to hospitals). The other value chain comprises of 'surgical and medical instruments', other related manufacturing', 'R&D generic' and 'medical and bio-pharma R&D'. The third value chain is 'health products and cosmetics', wholesale pharma' and 'wholesale medical instruments'. The bridging codes for the first value chain are the industry codes for the holding companies (551111, 551112) and management consulting services (541618). The bridging codes for the second value chain are: measuring and controlling device manufacturing (334519), miscellaneous electrical equipment and component manufacturing (335999), R&D in the physical, engineering, and life sciences (541710), and testing laboratories (541380). The bridging codes for the third value chain are the industry codes for miscellaneous durable and nondurable goods wholesalers (423990, 424990), other health and personal care stores (446199), and wholesale trade agents and brokers (425120).

The map for interconnected cluster groups and regions shows that although the activities in the health technology sector are well spread throughout the region, there are some locations with more narrow specialisation. For example, competences in the area of surgical and medical instruments are more strongly concentrated around Oxford, Reading, Redhill and Portsmouth, while optical instruments have a higher concentration around Oxford, Reading and Guildford. The two R&D cluster groups also have some specific concentrations. R&D generic is localised around Oxford, Guildford, Southampton and Redhill, while medical & bio-pharma R&D firms have higher concentration around Oxford, Reading and Guildford. The table in Appendix gives a full account

of concentrations of firms from each cluster group into each of the sub-regions in the South east, and indicates the choices of micro-locations for specific activities.

4. Analysis of Cluster Depth and Innovation Potential (Survey results)

The survey results were obtained from a small sample (37 respondents), which aimed to represent one of the cluster groups – medical and bio-pharma R&D along some representation from other cluster groups where SEHTA membership is concentrated. The results show that 41% of the firms are old establishments existing from before 1995, and 32% are new firms with up-to 2-3 years of experience. 36% of these firms have revenue which is less then £100 th, and 64% are small firms with less then 10 employees. For these firms, only 27% of their suppliers are from the region, while the rest are from the UK (35%), EU (14%), and the rest of the world (23%). Similar is the picture with clients, where only 17% are located in the region, or with the research partners of which 31% are located in the region. These results show that the health technology sector is significantly exposed to processes beyond the regional boundaries and 48% of their clients are outside UK. On the other hand, in answer to the question on the significance of their location in the region, firms have indicated two factors: these that contribute the their sales (such as avoiding market risk, access to distribution channels, developing relationships with big companies, and new opportunities for growth), and factors that contribute to their capabilities (such as improvement of their management, establish business reputation, and improvement to quality of products). Other regional factors that have influenced their location choice are access to university research, and access to infrastructure.

The results from the survey show that 41% of the respondents represent one cluster group (medical & bio-pharma R&D, and the rest represent 10 other cluster groups. As companies were invited to report their diversification across the entire space in the health technology sector, they reported a complex chain of related diversification staring with R&D generic, pharma consulting, pharma R&D, pharma manufacturing. This chain is connected to an interrelated block comprised of the five health service cluster groups – outpatient healthcare, medical practice, in-patient health care, other hospital activities and dental practices. An interesting observation is the diversification chain between dental practices, other outpatient services, and trade medical instruments, which suggests a line of related diversification. The final end of the value chain in the health technology sector is represented by another densely connected component that comprises of optical instruments, health products and cosmetics, wholesale pharma, and business support – closely linked to surgical & medical instruments manufacturing and trade of medical instruments. The cluster of other related manufacturing is clearly an isolate, which suggests that it is not integrated with the main value chain.

The interconnected value chain for the health technology sector confirms that all cluster groups in our database have related activities that generate potential synergies and cross-fertilisation of innovation and technologies. The broad scale of interrelated specialisation is confirmed not only for the entire health technology sector, but also for one of its 'core engines' the bio-medical R&D. The map for additional specialisation of companies with main activities in this cluster group shows that the medical and bio-pharma R&D firms have been compelled to develop competences and to specialise additionally into eight other areas of activity (cluster groups) – R&D generic, pharma manufacturing, pharma consulting, outpatient health care, in-patient health care, other hospital activities, other outpatient services, and even other related manufacturing. This overwhelming set of competences is a challenge not only for the firms that have endeavoured to conquer the bio-

pharma world, but also for the policy makers, that attempt to nurture the development of these technologies.

The question that these firms are asking is where is the best environment for the scope of their activities. The answer is related to a range of internationalisation strategies including licensing (for 64% of the firms), export and sales in foreign markets (for 44% - to 72% of the firms), and to locate operations abroad (for 40% of the firms). In terms of their dependency on supplies, these firms report that for small supplies (1-10% from their total supply), their suppliers are located in the region (20% of respondents) and in other European country (17% of respondents). For significant supplies (11-50% from their total supply) firms report supply relationships with European suppliers (47% of respondents) and from the rest of the world (43% of respondents). Firms that are very dependent on their suppliers (50%+ from their total supply) prefer to deal mainly with suppliers in the UK (33% of respondents). Overall, only 8% of firms report that the majority of their sales come from the region, while for 31% of the firms, the majority of sales comes from customers in the UK, and for 39% of the firms – the majority of their sales comes from customers in Europe.

These data indicate that this industry is globalised and exposed to competition and sources of innovation worldwide. In answer to the question on the factors that affect their product and process innovation, firms have replied that there are two main factors. One is the competition and the market conditions, including specialised knowledge of potential market demand, the market potential, and the general conditions for exploitation of new technologies. The second factor refers more directly to the regional business environment, which includes: orders from the big firms, regional and cluster dynamics, investment opportunities in the region and government regulation.

Overall, firms indicate that both market relationships and collaborative relationships drive the innovation of the company. The most important factors are the collaborative relationships with UK, regional, and EU universities and research centres, joint R&D partnerships, and purchase of licences. Among the market relationships that drive innovation firms list customers and suppliers, but also scientific reviews and publications, conferences and trade fairs, or public forums with institutional facilitation. This clearly indicates their imperative needs for assisted collaboration.

In support to that, firms report significant collaborative relations over a long period of time. A significant number of firms report cooperation for more then three years with their suppliers (81% of firms), with their clients (67%), and with research organisations (64%). In these collaborative relationships, firms share and exchange not only material products, but also knowledge, technology, services, trust and even friendship. The collaborations with research partners in addition include significant sharing of equipment, joint contracts and shared risk, common history, financing and common partners. These collaborative relations are declared to have brought significant innovation, facilitated market access, increased profitability, stability and security, and other benefits that can not be measured.

The relationships that respondents have with universities show a rich and diverse picture. 68% of the respondent-firms have joint projects, 35% have co-development program, 24% have sponsored education, and 65% are attending meetings and seminars. The ties with the Universities however, show links not only with Universities in the region, but also universities throughout the UK, in Europe, and world-wide. These ties show a lot of co-location of projects, which links universities in an extended knowledge transfer network, where University of Oxford, of Surrey, and Bristol University represent identifiable hubs.

In terms of their R&D expenditure for 2006, 19% of the respondent-firms report more then £1 mln GBP, followed by 33% of respondents spending between £100 th and £1 mln GBP. However, the number of employees in R&D remains fairly small, as for 87% of the firms this refers to less then 10 people, and for 39% of the firms this represents less then 25% of their total employment.

Although the patent and publication activities are spread throughout the region, the centres of excellence that have received the majority of funding in health technology related projects are concentrated in the Oxford area, followed by Southampton, Sussex, Reading and Guildford. The concentration of research funding in research institutions in the Oxford area dwarf any other recipients of funding. The University of Oxford by itself has received 59% of the total number of projects and the 68% of the total value of funded research. For the last thirty years, the largest number of funded projects in bio-medical technologies has peaked in 2001, and is declining since then. The grants are spread from short 12 months projects to long-term financed projects for 6 and more years of funding. The majority of grants (79%) are dedicated to biotechnology, while the rest cover funding for clinical research (15%), diagnostics, therapeutics, regenerative medicine, public health, and insignificant number for medical devices.

The density of collaborations for co-funding between the centres of excellence show that in addition to collaborations between the region's champions (the Universities of Oxford, Reading, Southampton, Kent, and Surrey), collaborations with institutions throughout the UK are very popular. Most of the co-funding partnerships are between universities, with little collaborative funding with hospitals, and insignificant participation of businesses. The network analysis of the ties between funding bodies and centres of excellence reveal that there are some strong preferences, where Wellcome Trust prefers University of Oxford, MRC has allocated significant funding to Royal Marsden Hospital in Surrey, and the Cancer Research UK has allocated significant funding to 5 hospitals and medical centres in Oxford and one other academic establishment – the University of Sussex.

The main volume of academic publications in the field related to health technology are produced by authors from the University of Oxford, University of Southampton, University of Surrey, and two medical establishments – John Radcliffe Hospital and Rutherford Appleton Laboratory. Other active centres of excellence with strong publication record in related fields are: University of Reading, University of Portsmouth, University of Kent, Royal Berkshire Hospital, Kent & Canterbury Hospital, Southampton General Hospital, Nuffield Orthopaedic Centre, Royal Hampshire Hospital – among others. These publications are spread in four main areas of expertise – bio-pharma, clinical research, cancer and genetics research, and bio-medical related publications in physics/chemistry/engineering.

5. Conclusions and Recommendations

- The South East of England Region is very active in all areas of the health technology sector and is a substantial contributor to the developments in this global sector. The top five best-performing establishments in all cluster groups are medium, large, and very large firms with operating revenue in billions of GBP.
- There is a wide spread of competences in the region with concentration of activities in all major urban centres. The infrastructure of the region and particularly proximity of ports and airports, and the presence of important university partners appear to be an attractive force for firms to locate in the region. Among the region-specific factors that contribute to motivation for location in the South East are opportunities to develop a relationship with a

big company, to access distribution channels, to generate stable sales and avoid market risk, and to establish a business reputation.

- The use of common methodology for the comparative analysis with the Emilia Romagna highlights that the structure of health technology sector in the regions is similar in terms of value chain of activities, but differs in terms of the size of the establishments and the scale of their operations. There are also some evidence that the cluster in the UK has more depth and particularly the emergence of specialisations within the manufacturing and within the consultancy segments.
- There are strong evidence that the cluster in the UK is well integrated into the global chain of the health technology sector – both in terms of sources of supply and revenue, and in terms of R&D collaborations.
- There are multiple evidence that the future development of this cluster will be heavily shaped not only by the big pharmaceutical companies, but also by the developments in the health service sector, and the impact of various business, management, and support services, where policy intervention is recommended.

6. Glossary, Definitions and Abbreviations

R&D = research and development
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

3-digit industry codes are not represented on individual cluster maps as they are reported by firms as a single industry code, and therefore can not be connected to any other industry. However, in some clusters they represent significant industry groups and encompass multiple industry operations.

Cluster specific codes are the total selection of codes that are declared by firms in a particular cluster group as areas of operations.

Core industry codes per cluster are defined with the application of statistical clustering technique at the first step of the multi-stage cluster methodology for cluster mapping (see description in the methodology section). Core industry codes are declared by the majority (or a significant number) of firms in a cluster group.

Connectivity codes are industry codes that act as bridges between value-added activities in individual clusters, and are displayed on Map 1.

Strength of ties between firms is measured by the number of codes that firms declare simultaneously as areas of operations (or shared industry codes). Strength of ties between industries represents the number of firms that declare operations in each pair of industries. For normalised values, strength of ties represents the largest positive values selected as the most significant ties, which are calculated according to a formulae.

A component is a distinctive group of interconnected actors that are clearly identifiable from the visual representation of the structure of each cluster and stand as disconnected sub-group.

A segment is a smaller section of a component, which has distinctive features, but is still an interconnected part of the component. Each segment is automatically coloured by the UCINET software as having different relations from the rest of the actors.

Isolates are actors that have declared activities relevant to a particular cluster group, but their attributes (activities) are not declared by any other actor in this cluster group. *Nodes* that are located in the periphery of a map usually are shared with other clusters, and hence are pulled from the centre of the cluster to the periphery.

Map 3. Location of Firms by Cluster Groups

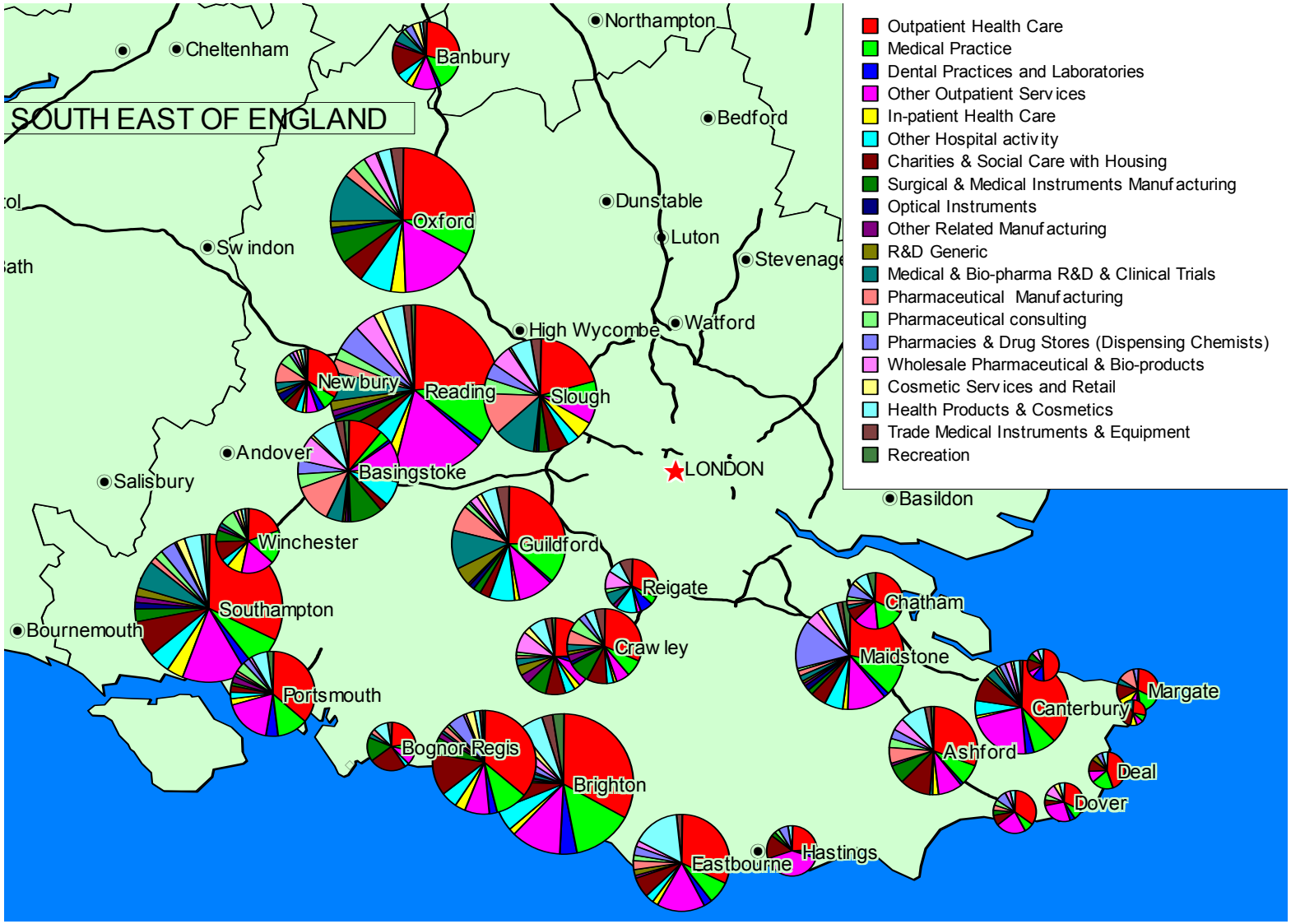


Table 4. Strategic Industry Groups in the Health Technology Sector – Number of Firms

CLUSTER	Number of firms in cluster	% from total population
Outpatient Health Care	1535	29,1%
Medical Practice	439	8,3%
Dental Practices and Laboratories	124	2,3%
Other Outpatient Services	661	12,5%
In-patient Health Care	124	2,3%
Other Hospital activity	234	4,4%
Charities & Social Care with Housing	321	6,1%
Surgical & Medical Instruments Manufacturing	198	3,7%
Optical Instruments	46	0,9%
Other Related Manufacturing	75	1,4%
R&D Generic	70	1,3%
Medical & Bio-pharma R&D & Clinical Trials	239	4,5%
Pharmaceutical Manufacturing	196	3,7%
Pharmaceutical consulting	150	2,8%
Pharmacies & Drug Stores (Dispensing Chemists)	175	3,3%
Wholesale Pharmaceutical & Bio-products	194	3,7%
Cosmetic Services and Retail	46	0,9%
Health Products & Cosmetics	308	5,8%
Trade Medical Instruments & Equipment	89	1,7%
Regulation and Administration	15	0,3%
Recreation	43	0,8%
Total	5282	100%

Table 5. Distribution of Employment per Cluster Group

Employment	Sum	% per cluster
Outpatient Health Care	19 109	5,86%
Medical Practice	1 336	0,41%
Dental Practices and Laboratories	448	0,14%
Other Outpatient Services	21 142	6,48%
In-patient Health Care	16 747	5,13%
Other Hospital activity	692	0,21%
Charities & Social Care with Housing	9 415	2,89%
Surgical & Medical Instruments Manufacturing	16 985	5,20%
Optical Instruments	751	0,23%
Other Related Manufacturing	1 768	0,54%
R&D Generic	7 241	2,22%
Medical & Bio-pharma R&D & Clinical Trials	17 908	5,49%
Pharmaceutical Manufacturing	133 710	40,97%
Pharmaceutical consulting	26 793	8,21%
Pharmacies & Drug Stores	1 524	0,47%
Wholesale Pharmaceutical & Bio-products	11 618	3,56%
Cosmetic Services and Retail	255	0,08%
Health Products & Cosmetics	32 237	9,88%
Trade Medical Instruments & Equipment	2 426	0,74%
Recreation	4 227	1,30%
Total	**326 332**	**100%**

Table 6. Distribution of Revenue per Cluster Group

Revenue	Sum	% per cluster
Outpatient Health Care	1 350 330	2,3%
Medical Practice	79 690	0,1%
Dental Practices and Laboratories	25 457	0,0%
Other Outpatient Services	95 918	0,2%
In-patient Health Care	325 966	0,6%
Other Hospital activity	201 815	0,3%
Charities & Social Care with Housing	54 847	0,1%
Surgical & Medical Instruments Manufacturing	2 135 175	3,7%
Optical Instruments	86 444	0,1%
Other Related Manufacturing	229 028	0,4%
R&D Generic	821 900	1,4%
Medical & Bio-pharma R&D & Clinical Trials	3 484 234	6,0%
Pharmaceutical Manufacturing	32 128 969	55,4%
Pharmaceutical consulting	3 419 767	5,9%
Pharmacies & Drug Stores	221 606	0,4%
Wholesale Pharmaceutical & Bio-products	6 859 649	11,8%
Cosmetic Services and Retail	7 668	0,0%
Health Products & Cosmetics	5 873 843	10,1%
Trade Medical Instruments & Equipment	416 433	0,7%
Regulation and Administration	214	0,0%
Recreation	177 920	0,3%
Total	**57 996 873**	**100%**

Table 7. Cluster Demographics*

CLUSTER	Number of firms in cluster	% from total population	Total revenue per cluster	% of total population revenue	Number of replied revenue data	% of replied revenue data	Mean revenue (average per replied firm)	Total employment per cluster	% of total population employment	Number of replied employment data	% of replied employment data	Mean employment (average per replied firm)
Outpatient Health Care	1535	29,1%	1350330	2,3%	409	26,6%	3302	19109	5,9%	174	11,3%	110
Medical Practice	439	8,3%	79690	0,1%	120	27,3%	664	1336	0,4%	24	5,5%	56
Dental Practices and Laboratories	124	2,3%	25457	0,0%	34	27,4%	749	448	0,1%	5	4,0%	90
Other Outpatient Services	661	12,5%	95918	0,2%	95	14,4%	1010	21142	6,5%	261	39,5%	81
In-patient Health Care	124	2,3%	325966	0,6%	31	25,0%	10515	16747	5,1%	22	17,7%	761
Other Hospital activity	234	4,4%	201815	0,3%	99	42,3%	2039	692	0,2%	30	12,8%	23
Charities & Social Care with Housing	321	6,1%	54847	0,1%	69	21,5%	795	9415	2,9%	118	36,8%	80
Surgical & Medical Instruments Manufacturing	198	3,7%	2135175	3,7%	94	47,5%	22715	16985	5,2%	62	31,3%	274
Optical Instruments	46	0,9%	86444	0,1%	15	32,6%	5763	751	0,2%	10	21,7%	75
Other Related Manufacturing	75	1,4%	229028	0,4%	29	38,7%	7898	1768	0,5%	17	22,7%	104
R&D Generic	70	1,3%	821900	1,4%	28	40,0%	29354	7241	2,2%	21	30,0%	345
Medical & Bio-pharma R&D & Clinical Trials	239	4,5%	3484234	6,0%	99	41,4%	35194	17908	5,5%	66	27,6%	271
Pharmaceutical Manufacturing	196	3,7%	32128969	55,4%	101	51,5%	318109	133710	41,0%	81	41,3%	1651
Pharmaceutical consulting	150	2,8%	3419767	5,9%	58	38,7%	58962	26793	8,2%	28	18,7%	957
Pharmacies & Drug Stores (Dispensing Chemists)	175	3,3%	221606	0,4%	44	25,1%	5037	1524	0,5%	12	6,9%	127
Wholesale Pharmaceutical & Bio-products	194	3,7%	6859649	11,8%	71	36,6%	96615	11618	3,6%	56	28,9%	207
Cosmetic Services and Retail	46	0,9%	7668	0,0%	19	41,3%	404	255	0,1%	4	8,7%	64
Health Products & Cosmetics	308	5,8%	5873843	10,1%	91	29,5%	64548	32237	9,9%	35	11,4%	921
Trade Medical Instruments & Equipment	89	1,7%	416433	0,7%	43	48,3%	9684	2426	0,7%	22	24,7%	110
Regulation and Administration	15	0,3%	214	0,0%	1	6,7%	214	0	0,0%		0,0%	
Recreation	43	0,8%	177920	0,3%	20	46,5%	8896	4227	1,3%	8	18,6%	528
Total	5282	100%	57996873	100%	1570	29,7%	36941	326332	100%	1056	20,0%	309

* Revenue in Thousands GBP – data collected from tax-returns filed by all companies in database and may include national or global revenue figures.

Table 8. Structural Characteristics of the Health Technology Sector*

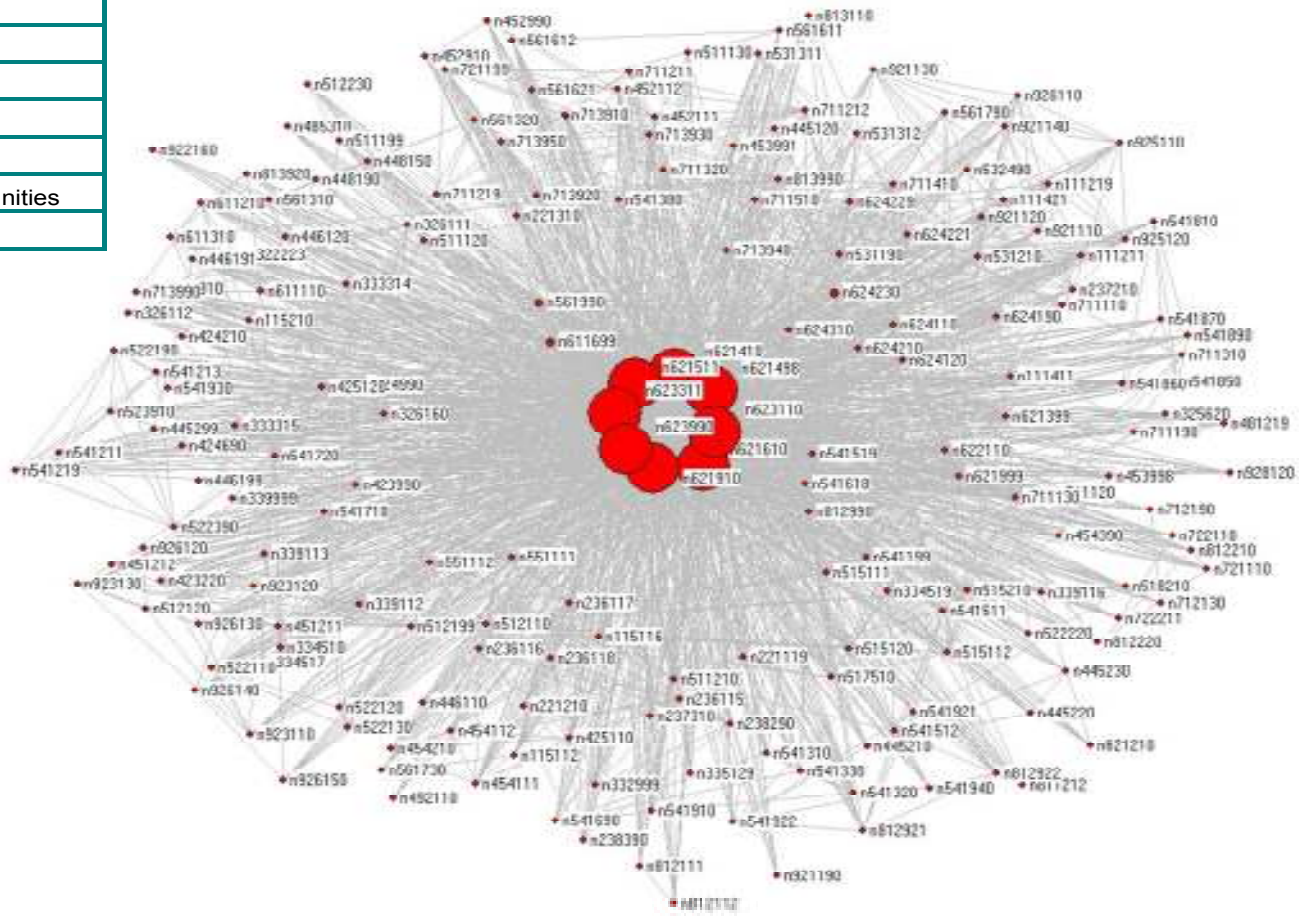
CLUSTER GROUP	Nb Firms	Cluster specific codes	Average Nb codes	Core codes (>90%)
Outpatient Health Care	1535	205	9	8
Medical Practice	439	41	1	1
Dental Practices and Laboratories	124	23	2	2
Other Outpatient Services	661	107	7	6
In-patient Health Care	124	44	3	2
Other Hospital activity	234	73	2	0
Charities & Social Care with Housing	321	31	3	3
Surgical & Medical Instruments Manufacturing	198	81	4	4
Optical Instruments	46	32	3	2
Other Related Manufacturing	75	46	2	0
R&D Generic	70	46	2	0
Medical & Bio-pharma R&D & Clinical Trials	239	36	1	0
Pharmaceutical Manufacturing	196	74	2	0
Pharmaceutical consulting	150	75	2	0
Pharmacies & Drug Stores (Dispensing Chem	175	16	1	1
Wholesale Pharmaceutical & Bio-products	194	39	2	1
Cosmetic Services and Retail	46	12	2	0
Health Products & Cosmetics	308	74	2	0
Trade Medical Instruments & Equipment	89	52	2	0
Regulation and Administration	15	15	5	0
Recreation	43	30	3	0
Total	**5282**	**358**	**4**	-

* *cluster specific codes* – the range of industry activities that are specific to each cluster group; *average number of codes* – average number of codes that firms in each cluster group have declared (an indicator of the scope of the group activities); *core codes* – industry codes that have been declared by more then 90% of the firms in a cluster group

Map 4 . CLUSTER "OUTPATIENT HEALTH SERVICES" (1,535 firms)*

(100 % of firms have the core codes; diversification in extremely large number of other industries)

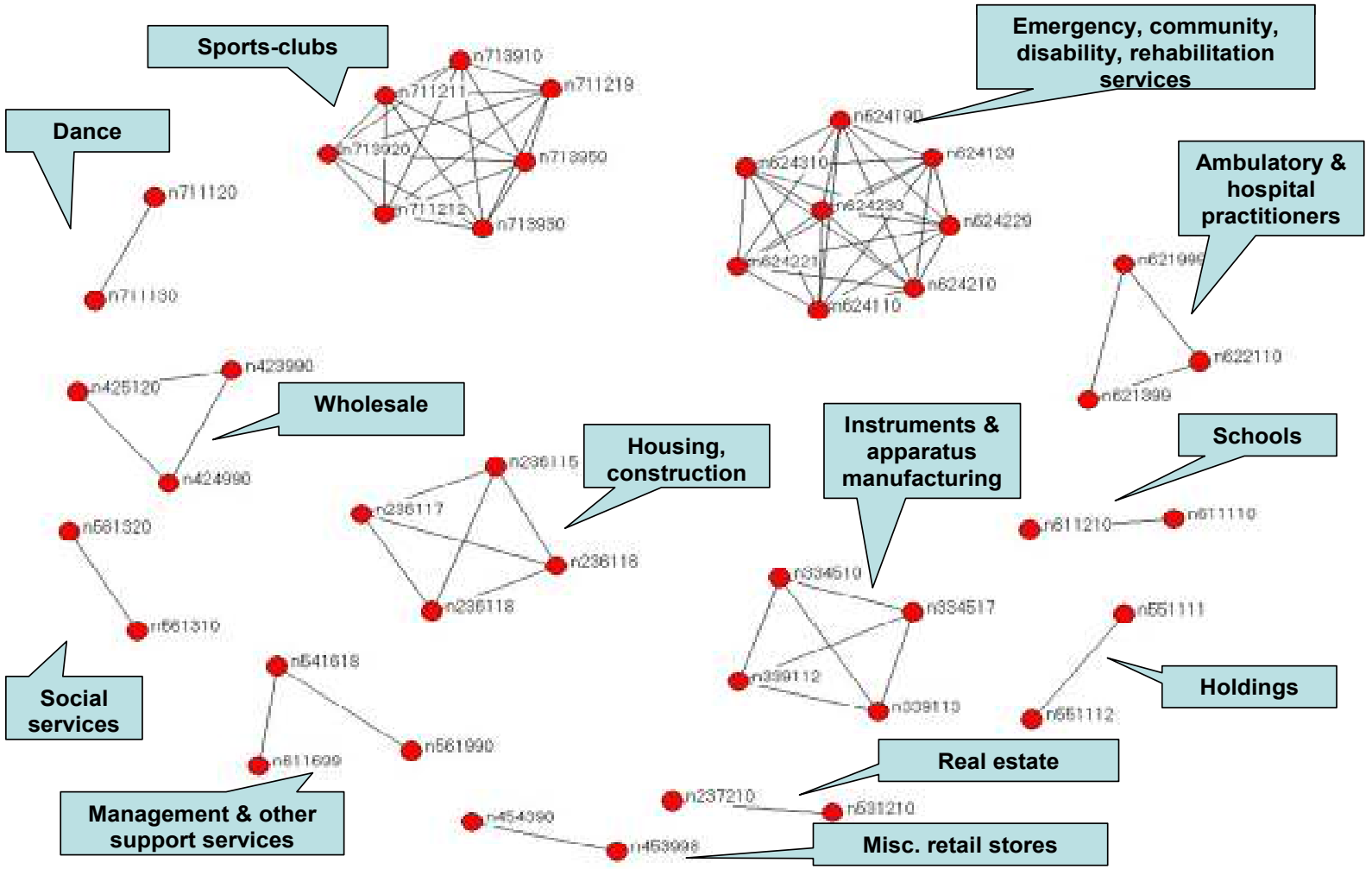
CORE industry codes
621410 Family Planning Centers
621498 All Other Outpatient Care Centers
621511 Medical Laboratories
621610 Home Health Care Services
621910 Ambulance Services
623110 Nursing Care Facilities
623311 Continuing Care Retirement Communities
623990 Other Residential Care Facilities



* all ties between industry codes; RED dots represent individual industry codes in NAICS; TIES between industry codes represent relationships between industries based on common specialisation of firms in this cluster group.

Map 5. CLUSTER "OUTPATIENT HEALTH SERVICES" (1,535 firms)[*]

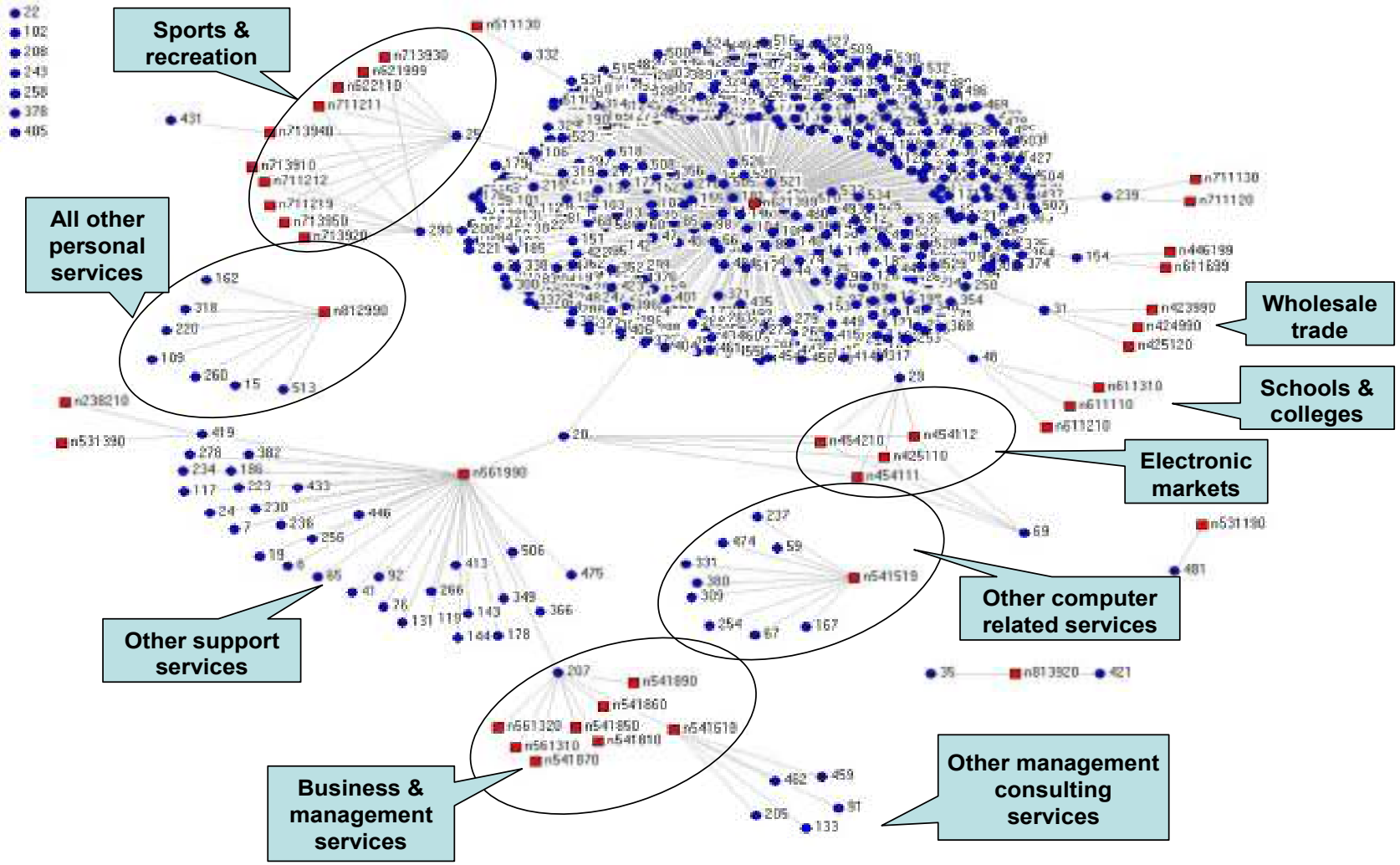
(100 % of firms have the core codes; diversification in extremely large number of other industries)



[*] all ties between industry codes – core codes excluded; RED dots represent individual industry codes in NAICS; TIES between industry codes represent relationships between industries based on common specialisation of firms in this cluster group.

Map 6. CLUSTER "MEDICAL PRACTICE" (439 firms)*

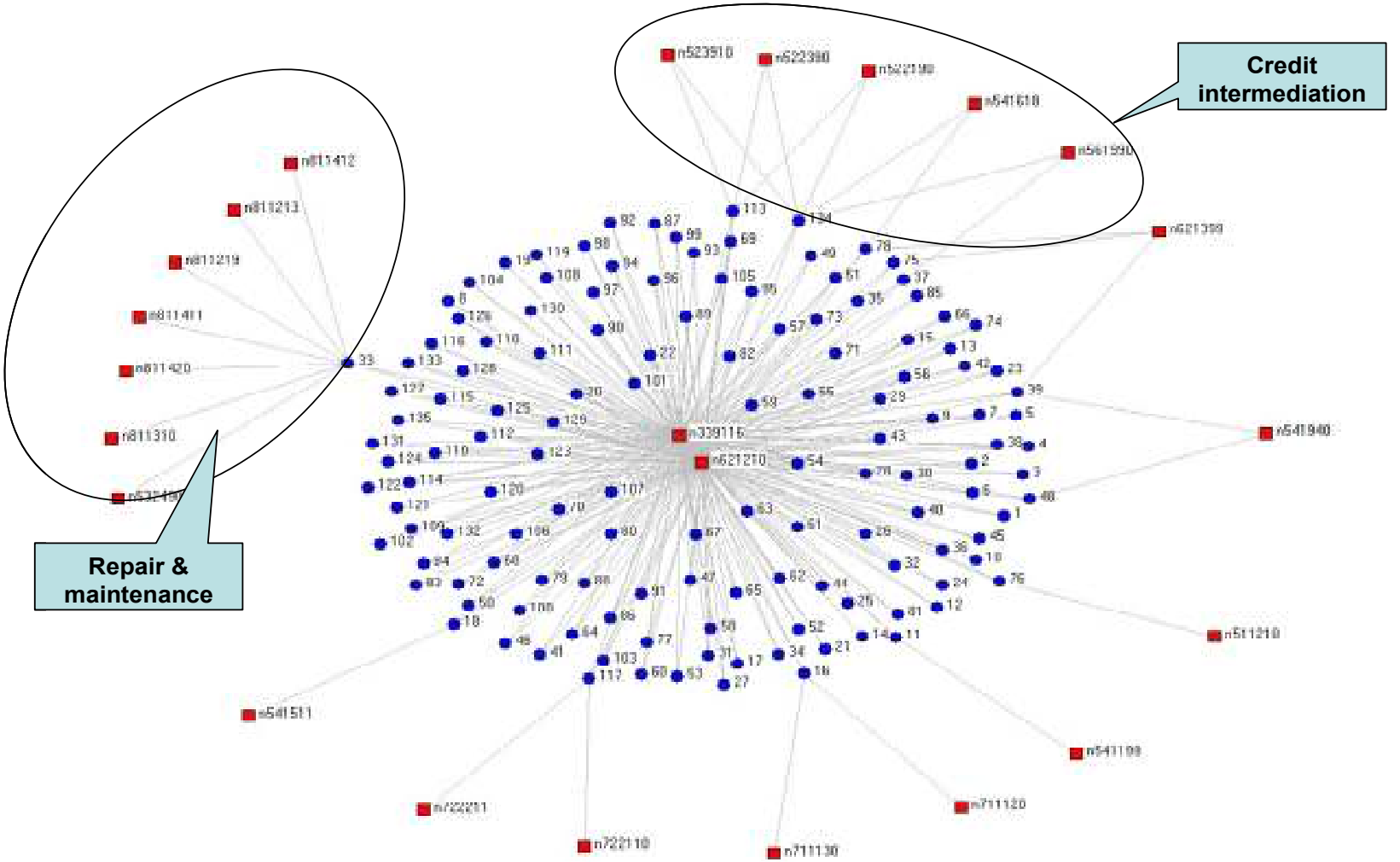
(89% of firms have the core code 621399: Offices of All Other Miscellaneous Health Practitioners)



* all ties between firms and industries; RED squares represent individual industry codes in NAICS; BLUE dots represent individual companies; TIES between companies and industry codes represent declared activities and operations by individual firms.

Map 7. CLUSTER "DENTAL PRACTICES AND LABORATORIES" (124 firms)*

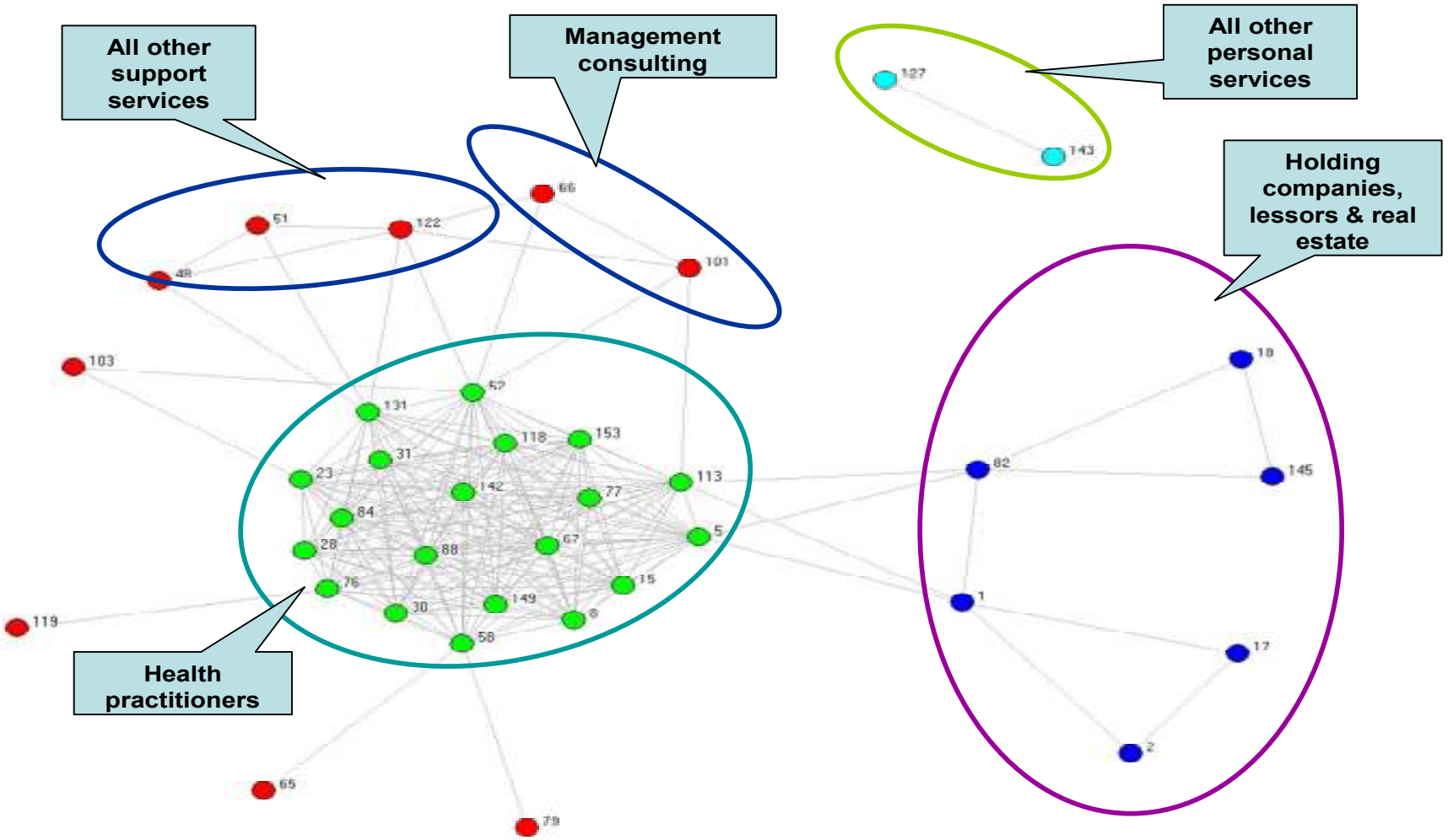
(100% of firms have the two core codes – 339116, 621210; Diversification of some firms in credit intermediation and in repair and maintenance services)



*all ties between firms and industries; RED squares represent individual industry codes in NAICS; BLUE dots represent individual companies; TIES between companies and industry codes represent declared activities and operations by individual firms.

Map 8. CLUSTER "IN-PATIENT HEALTH CARE" (124 firms)*

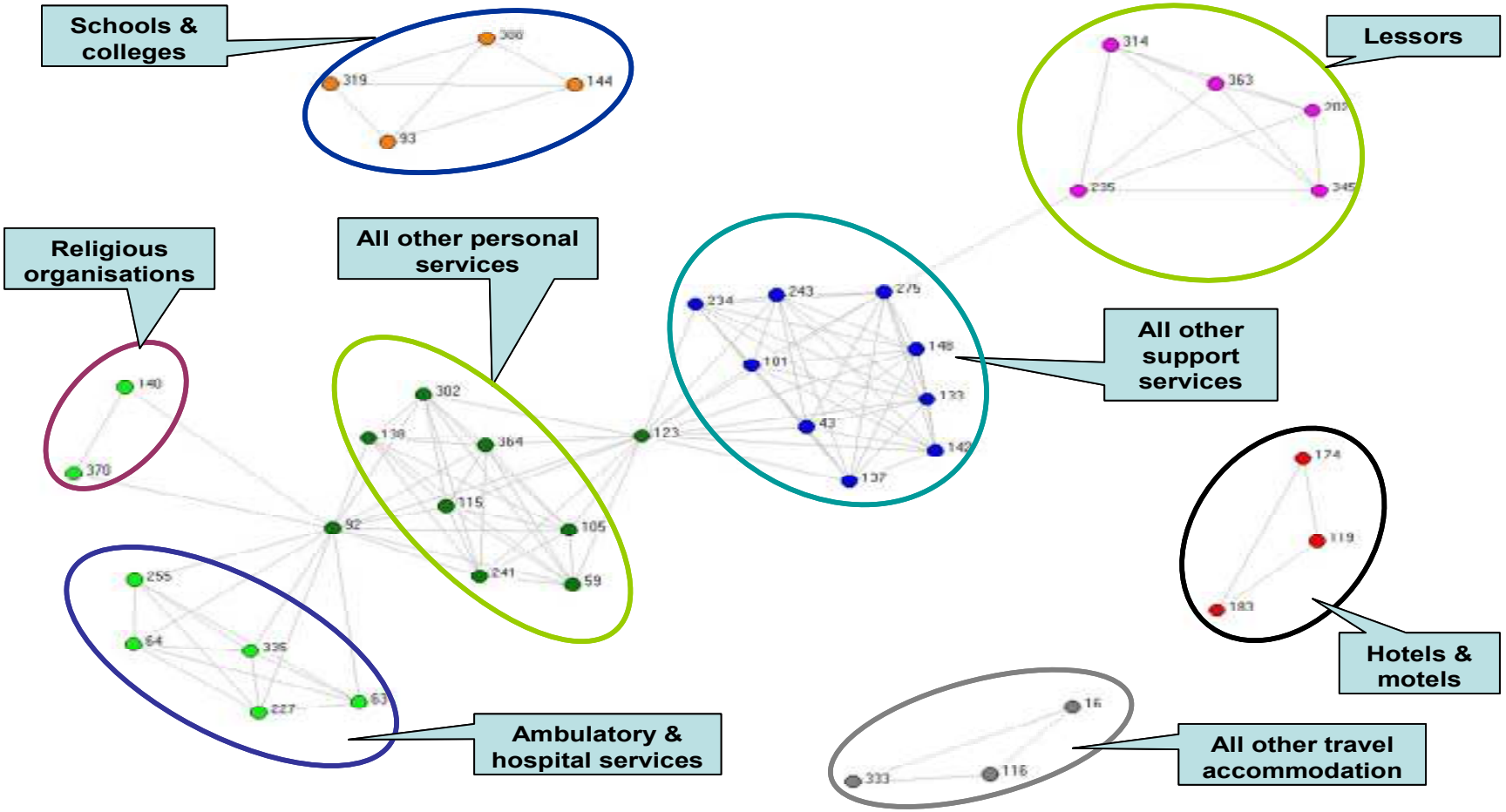
(100% of firms have the 2 core industry codes: 622110 - General Medical and Surgical Hospitals; and 621999 - Miscellaneous Ambulatory Health Care Services)



* ties between firms - core codes excluded; DOTS represent individual firs in this cluster group; TIES between firms represent a competitive relationship, where firms have declared the same industry code and compete in the same product market; different colors of dots represent distinctive structural components and segments.

Map 9. CLUSTER "CHARITIES & SOCIAL CARE WITH HOUSING" (321 firms)*

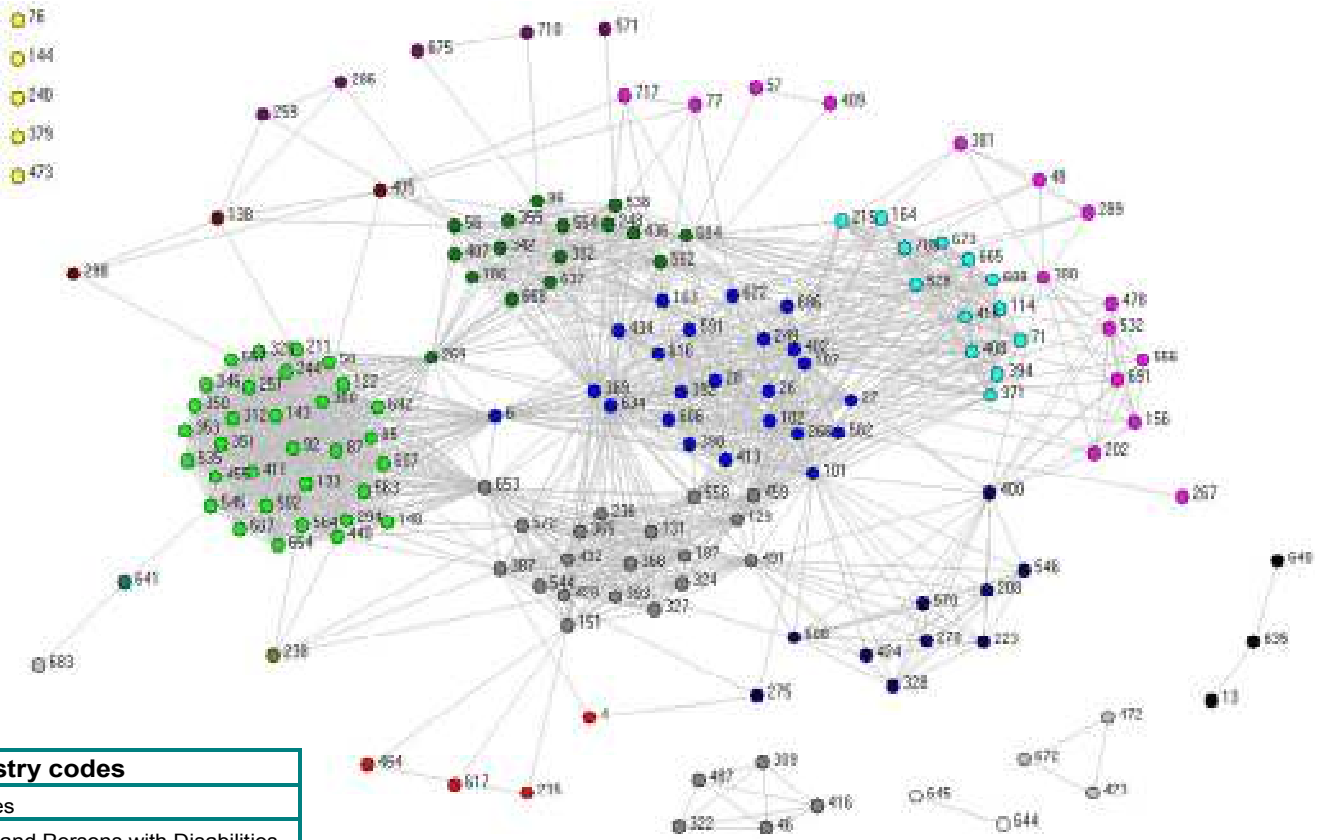
(98% of firms have the core industry codes: 624229-Other Community Housing Services; 624230-Emergency and Other Relief Services; 624221-Temporary Shelters)



*ties between firms based on 4 or more shared industry codes; DOTS represent individual firs in this cluster group; TIES between firms represent a competitive relationship, where firms have declared the same industry code and compete in the same product market; different colors of dots represent distinctive structural components and segments.

Map 10. CLUSTER "OTHER OUTPATIENT SERVICES" (661 firms)*

(99% of firms have the 6 core industry codes)

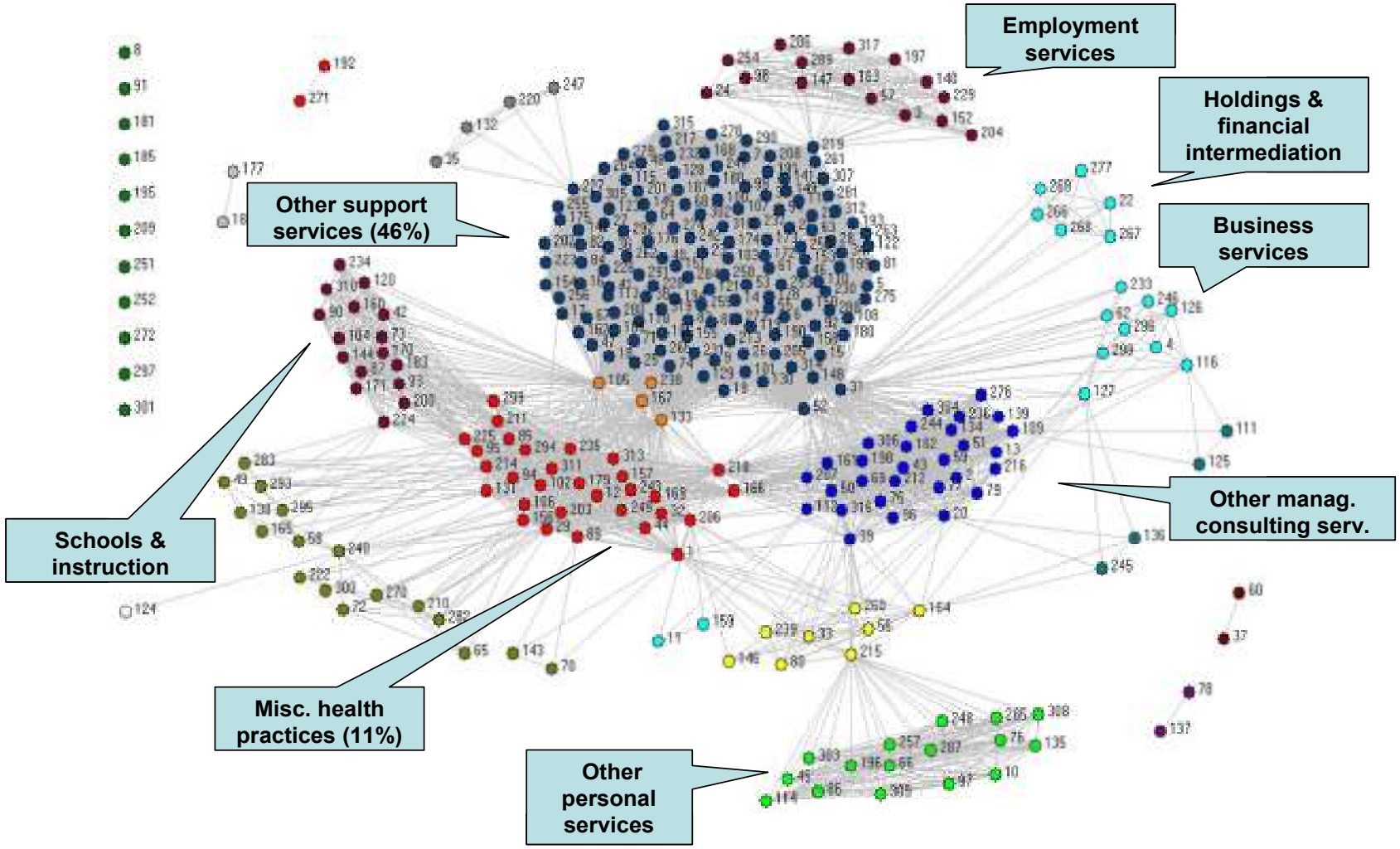


CORE industry codes
624110 Child and Youth Services
624120 Services for the Elderly and Persons with Disabilities
624190 Other Individual and Family Services
624210 Community Food Services
624230 Emergency and Other Relief Services
624310 Vocational Rehabilitation Services

* ties between firms - core codes excluded; DOTS represent individual firs in this cluster group; TIES between firms represent a competitive relationship, where firms have declared the same industry code and compete in the same product market; different colors of dots represent distinctive structural components and segments.

Map 11. CLUSTER "OTHER HOSPITAL ACTIVITIES" (234 firms)*

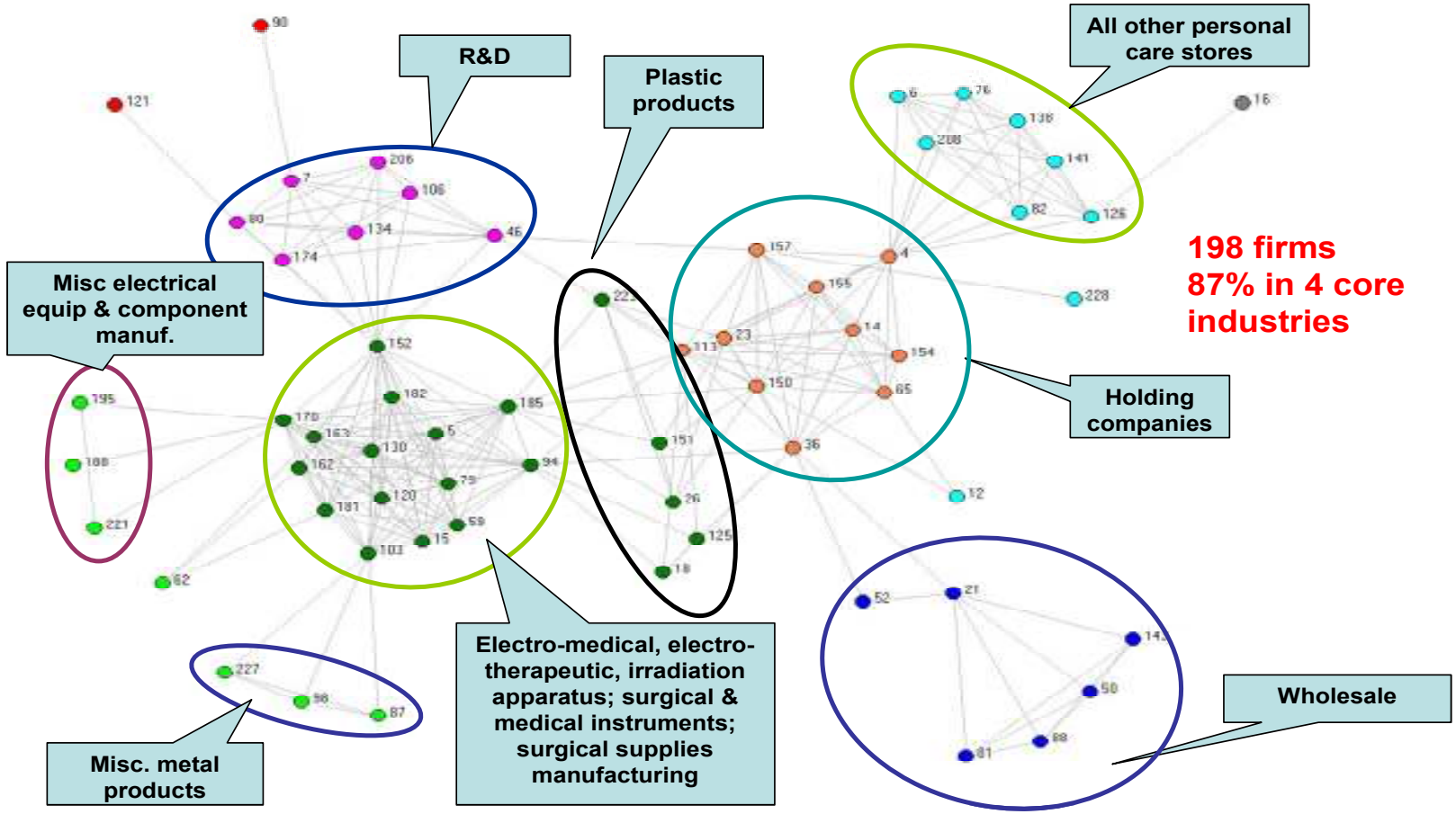
(46% of firms have the core industry code 561990 - All Other Support Services)



* all ties between firms; DOTS represent individual firs in this cluster group; TIES between firms represent a competitive relationship, where firms have declared the same industry code and compete in the same product market; different colors of dots represent distinctive structural components and segments.

Map 12. CLUSTER "SURGICAL & MEDICAL INSTRUMENTS MANUFACTURING" (198 firms)*

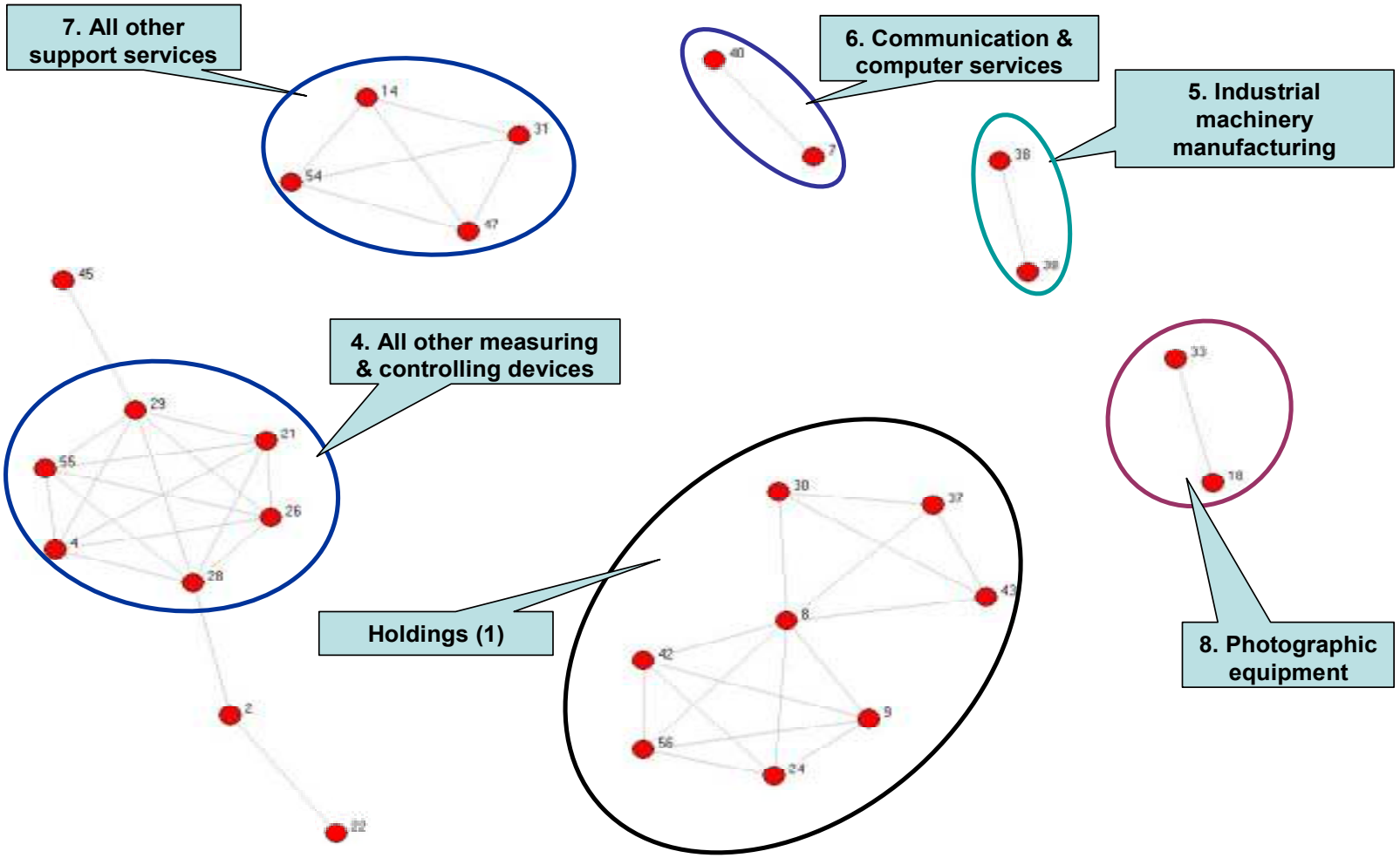
(87% of firms have the core industry codes: 334510 Electro-medical and Electrotherapeutic Apparatus Manufacturing; 334517 Irradiation Apparatus Manufacturing; 39112 Surgical and Medical Instrument Manufacturing; 339113 Surgical Appliance and Supplies Manufacturing)



* ties between firms based on 5 or more shared industry codes; DOTS represent individual firs in this cluster group; TIES between firms represent a competitive relationship, where firms have declared the same industry code and compete in the same product market; different colors of dots represent distinctive structural components and segments.

Map 13. CLUSTER "OPTICAL INSTRUMENTS" (46 firms)*

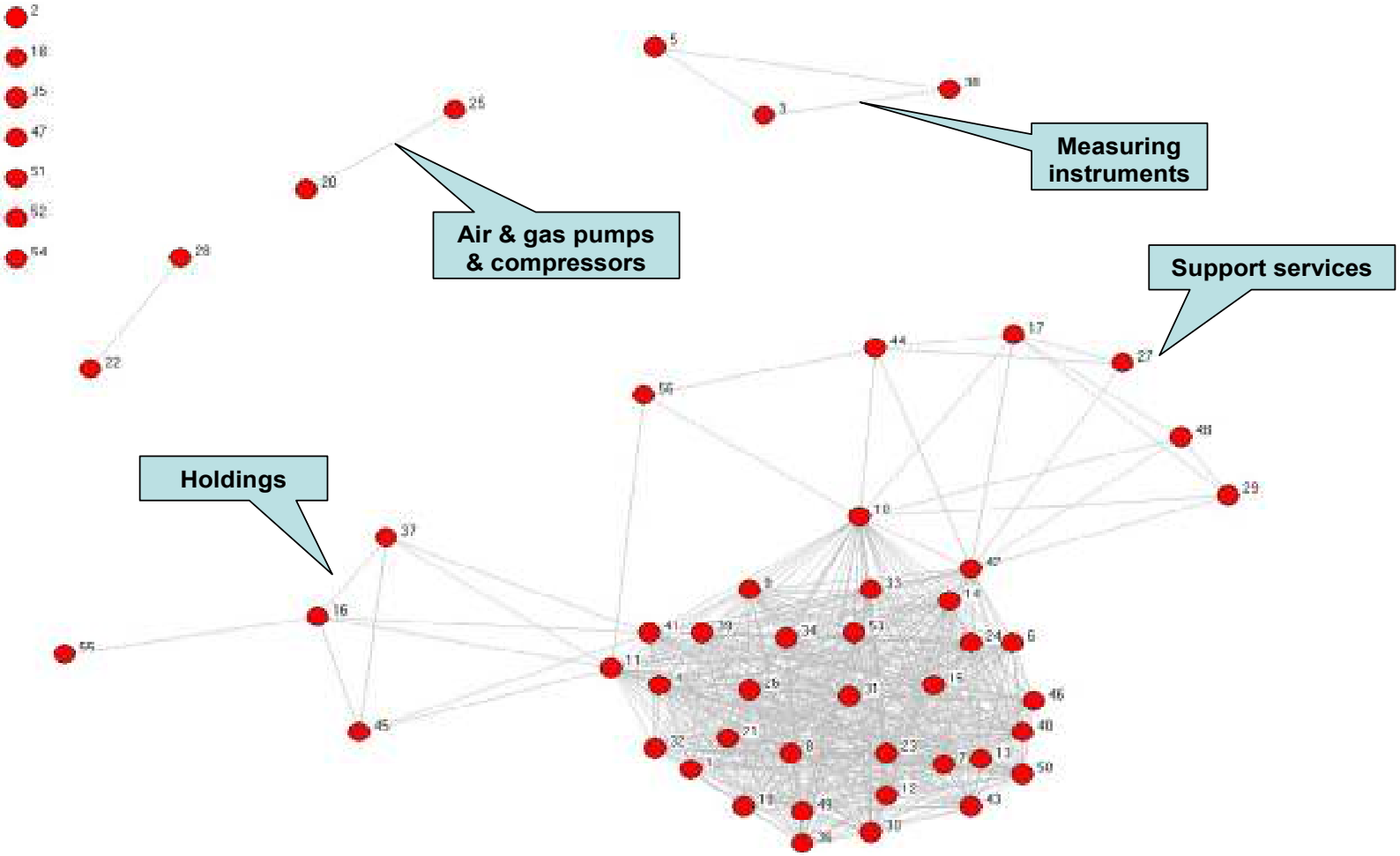
(91% of firms have the core industry codes: 333314 Optical Instrument and Lens Manufacturing; 333315 Photographic and Photocopying Equipment Manufacturing)



* ties between firms - core codes excluded; DOTS represent individual firs in this cluster group; TIES between firms represent a competitive relationship, where firms have declared the same industry code and compete in the same product market.

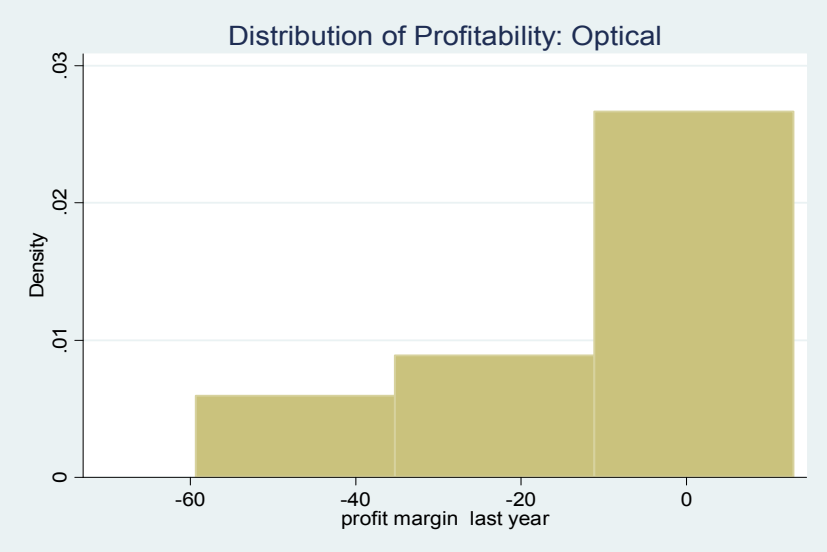
Map 14. CLUSTER "OTHER RELATED MANUFACTURING" (46 firms)*

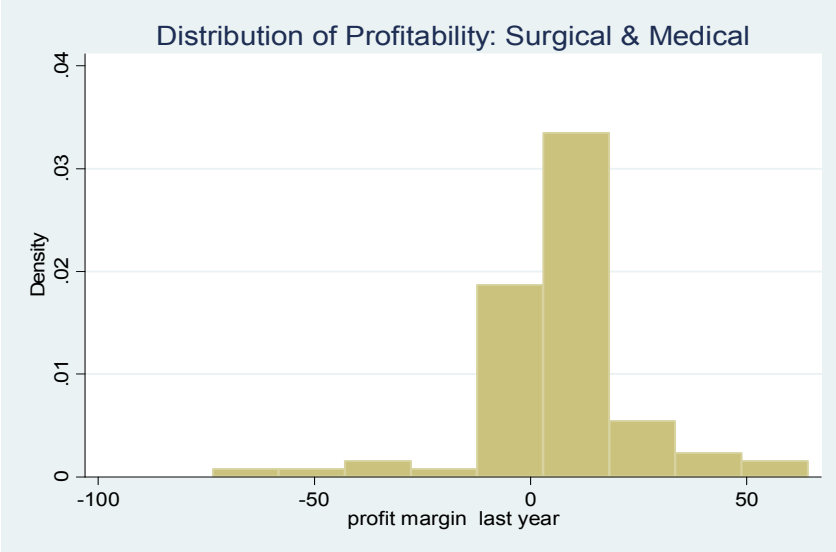
(58% of firms have the core industry code 334519 - Other Measuring and Controlling Device Manufacturing)

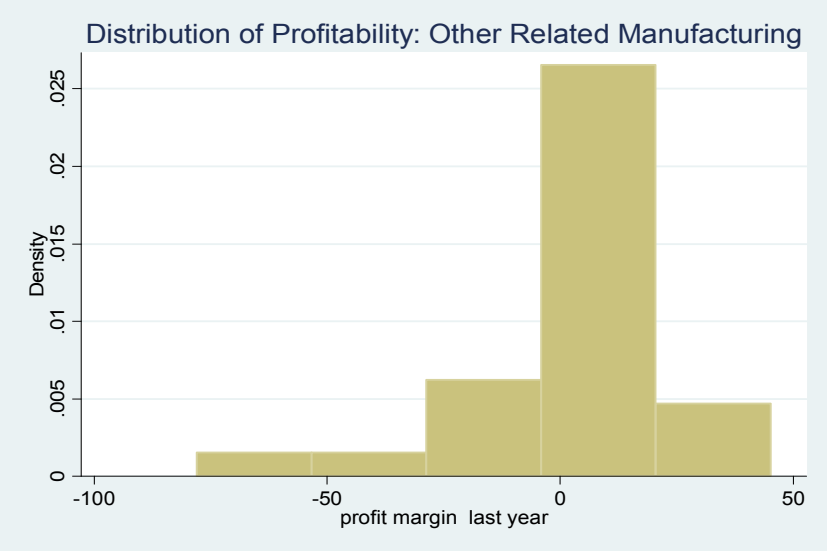


* all ties between firms; DOTS represent individual firs in this cluster group; TIES between firms represent a competitive relationship, where firms have declared the same industry code and compete in the same product market.

Graph 3. Comparative Performance Across the Three Manufacturing Sectors





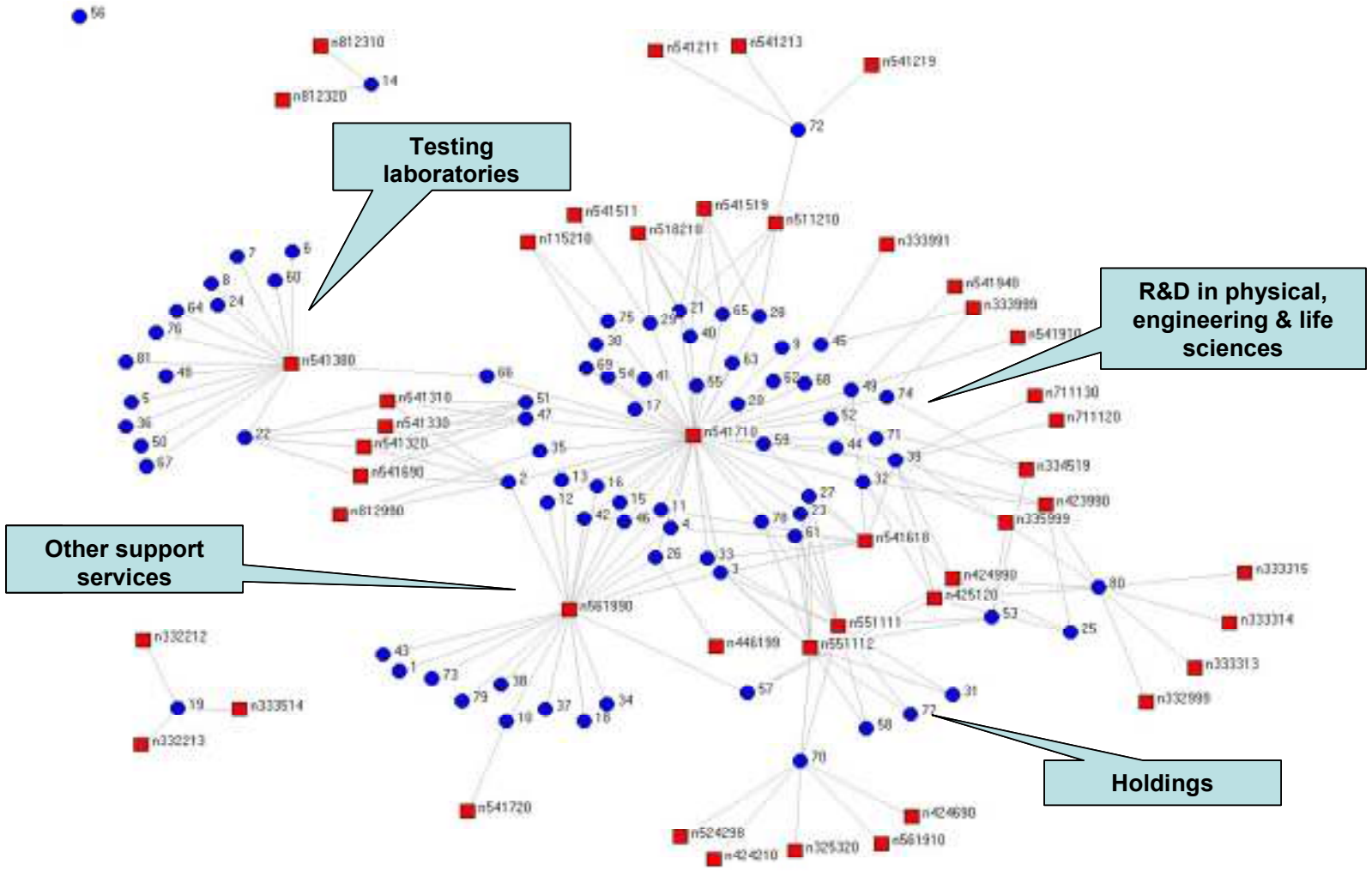


With this comparative inter-cluster analysis, we can conclude that the 'surgical and medical' cluster has generated greater profitability over the last three years, and that the trend has moved towards sustained out-performance by this cluster group. The 'optical' cluster exhibits the greatest deterioration in relative performance over time, while the 'other related manufacturing' cluster shows a consistent underperformance throughout the last three years.

Median Profitability Over the Last 3 Years			
	Profit Margin (t)	Profit Margin(t-1)	Profit Margin(t-2)
Optical	**0.01805**	**0.0673**	**0.0495**
Surgical/Medical	**0.07235**	**0.0591**	**0.0367**
Other Related Manufacturing	**-0.00265**	**0.0213**	**0.00515**

Map 15. CLUSTER "R&D GENERIC" (70 firms)*

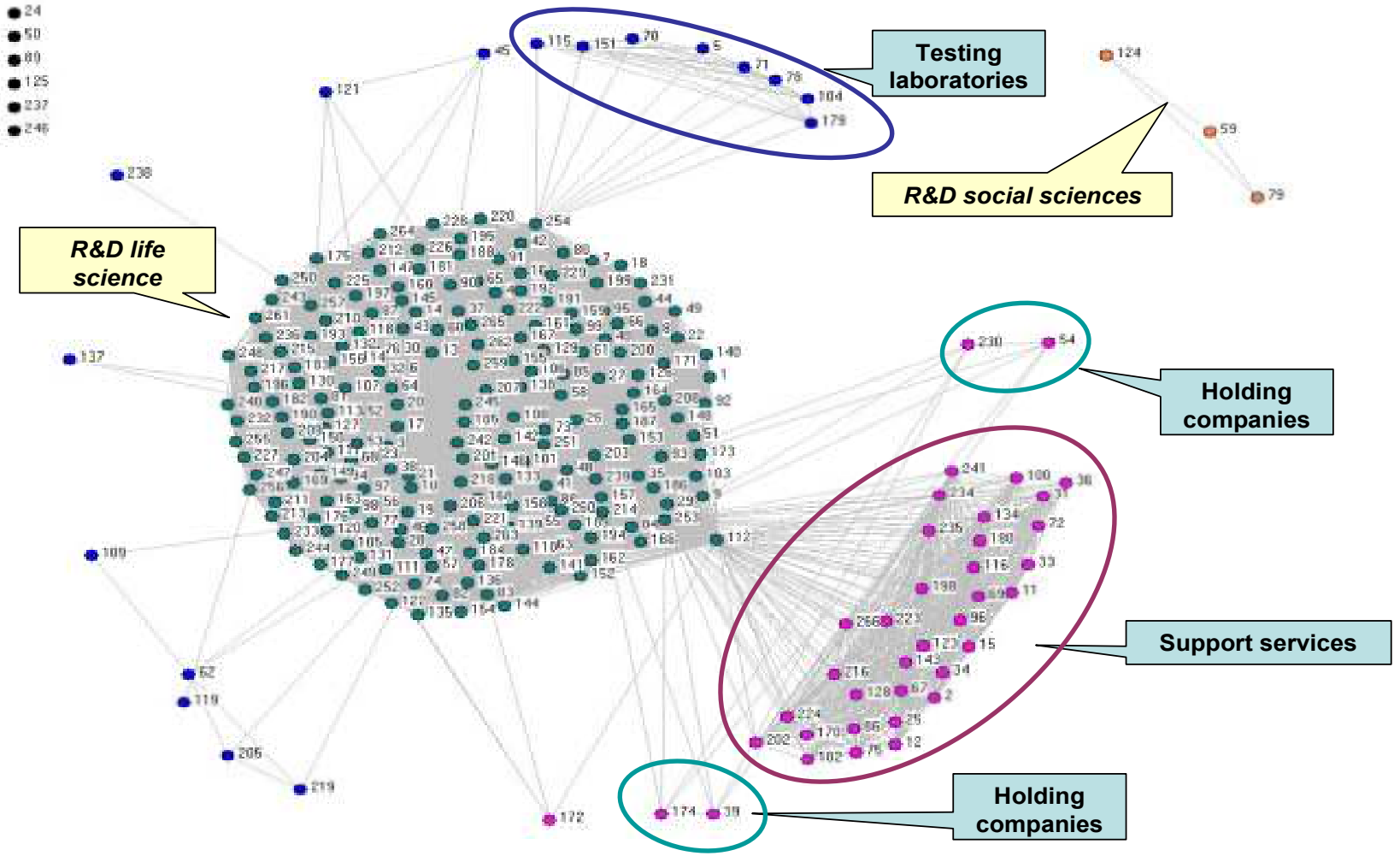
(58% of firms have the core industry code 541710-Research and Development in the Physical, Engineering and Life Sciences)



* all ties between firms and industries; RED squares represent individual industry codes in NAICS; BLUE dots represent individual companies; TIES between companies and industry codes represent declared activities and operations by individual firms.

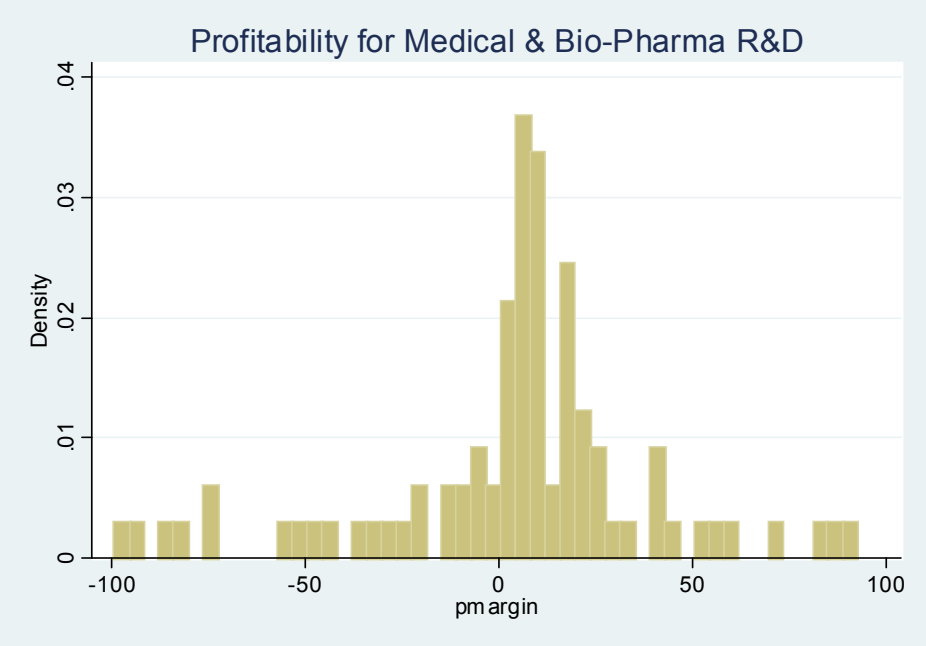
Map 16. CLUSTER "MEDICAL & BIO-PHARMA R&D & CLINICAL TRIALS" (239 firms)*

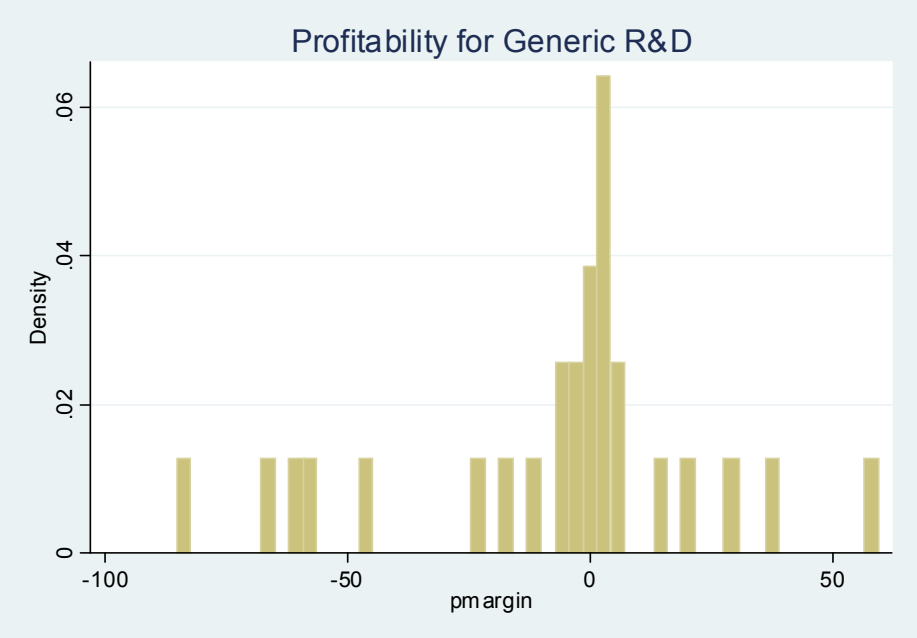
(77% of firms have the core industry code 541710 Research and Development in the Physical, Engineering and Life Sciences)



* all ties between firms; DOTS represent individual firs in this cluster group; TIES between firms represent a competitive relationship, where firms have declared the same industry code and compete in the same product market; different colors of dots represent distinctive structural components and segments.

Graph 4. Comparative Performance Across the Two R&D Sectors

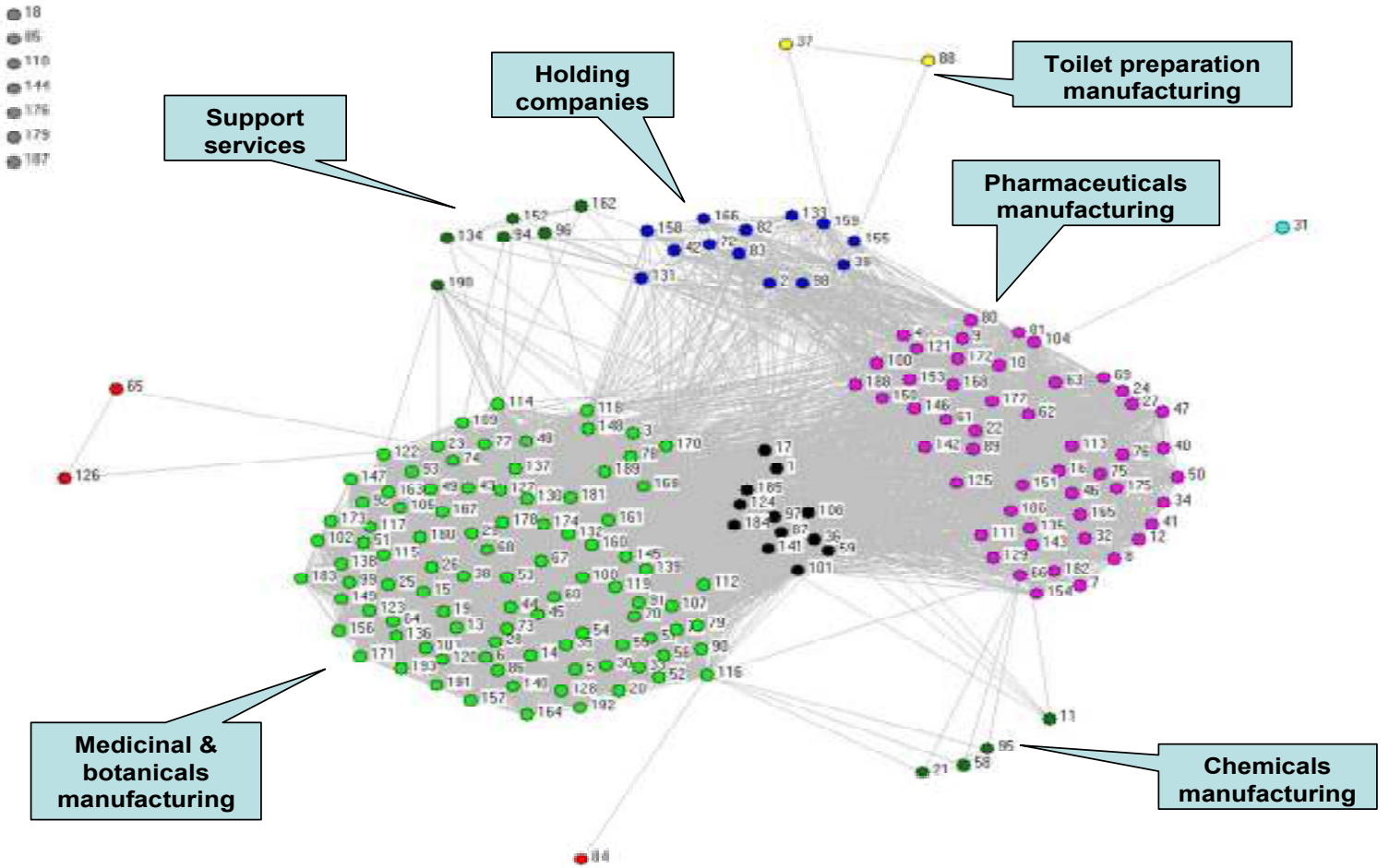




Medical & bio-pharma R&D has exhibited median profitability of 8% versus much lower median profitability of nearly 0% for generic R&D. Both performance distributions exhibit relatively high variability, but medical & bio-pharma R&D is definitely the more attractive venue for investments. This comparison confirms that the two cluster groups are distinctively different inspite of the similar nature of their activities, which can be explained that they are located on different value chains – i.e. health services and bio-pharma.

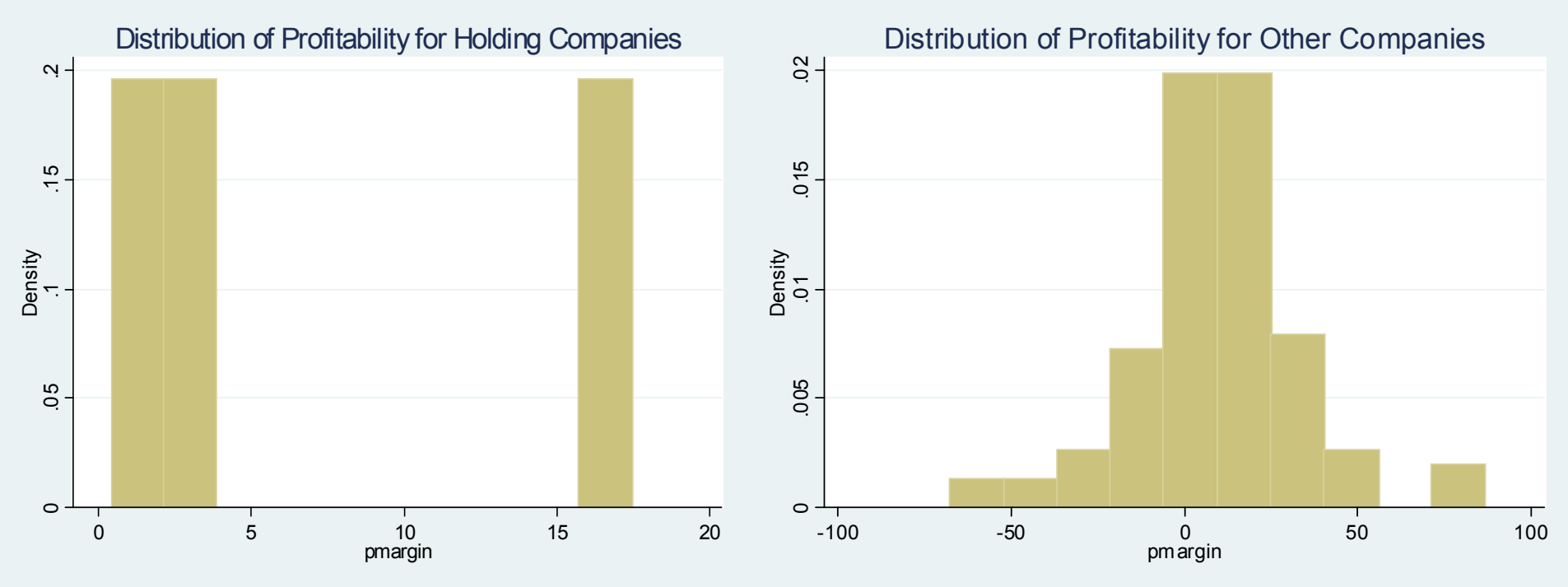
Map 17. CLUSTER "PHARMACEUTICAL MANUFACTURING" (196 firms)*

(56% of firms have the core industry code 325411 Medicinal and Botanical Manufacturing)



* all ties between firms; DOTS represent individual firs in this cluster group; TIES between firms represent a competitive relationship, where firms have declared the same industry code and compete in the same product market; different colors of dots represent distinctive structural components and segments.

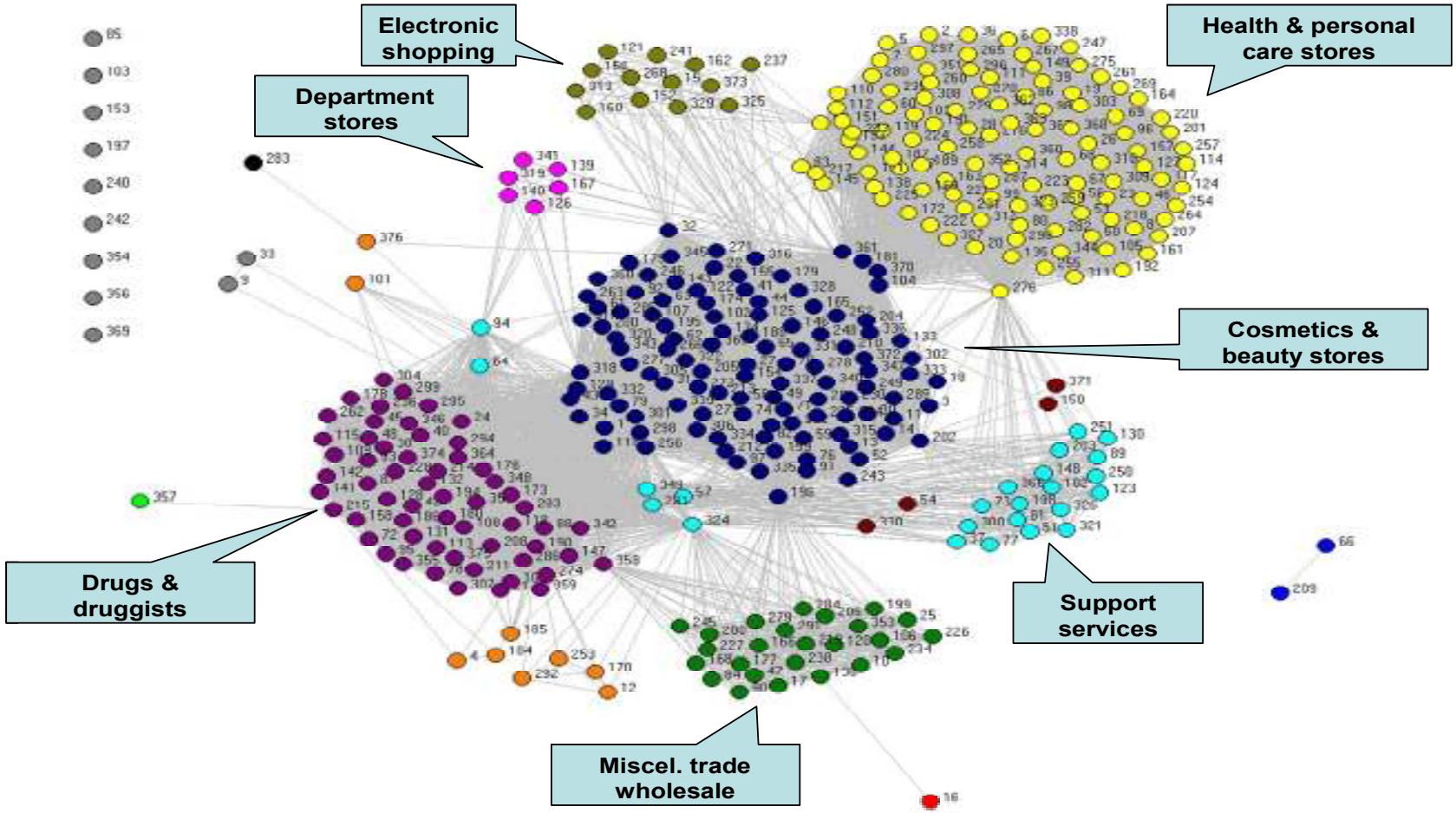
Graph 5. Distribution of Performance for the Pharmaceutical Manufacturing Cluster - Holding Companies vs. Non-Holding Companies



Although holding companies exhibited median profit margins that were lower than non-holding companies (+7.6% vs. 9%), within our sample, they were able to achieve lower variability in their profitability. => On a risk-adjusted basis, holding companies do well due to a significant reduction in performance variability.

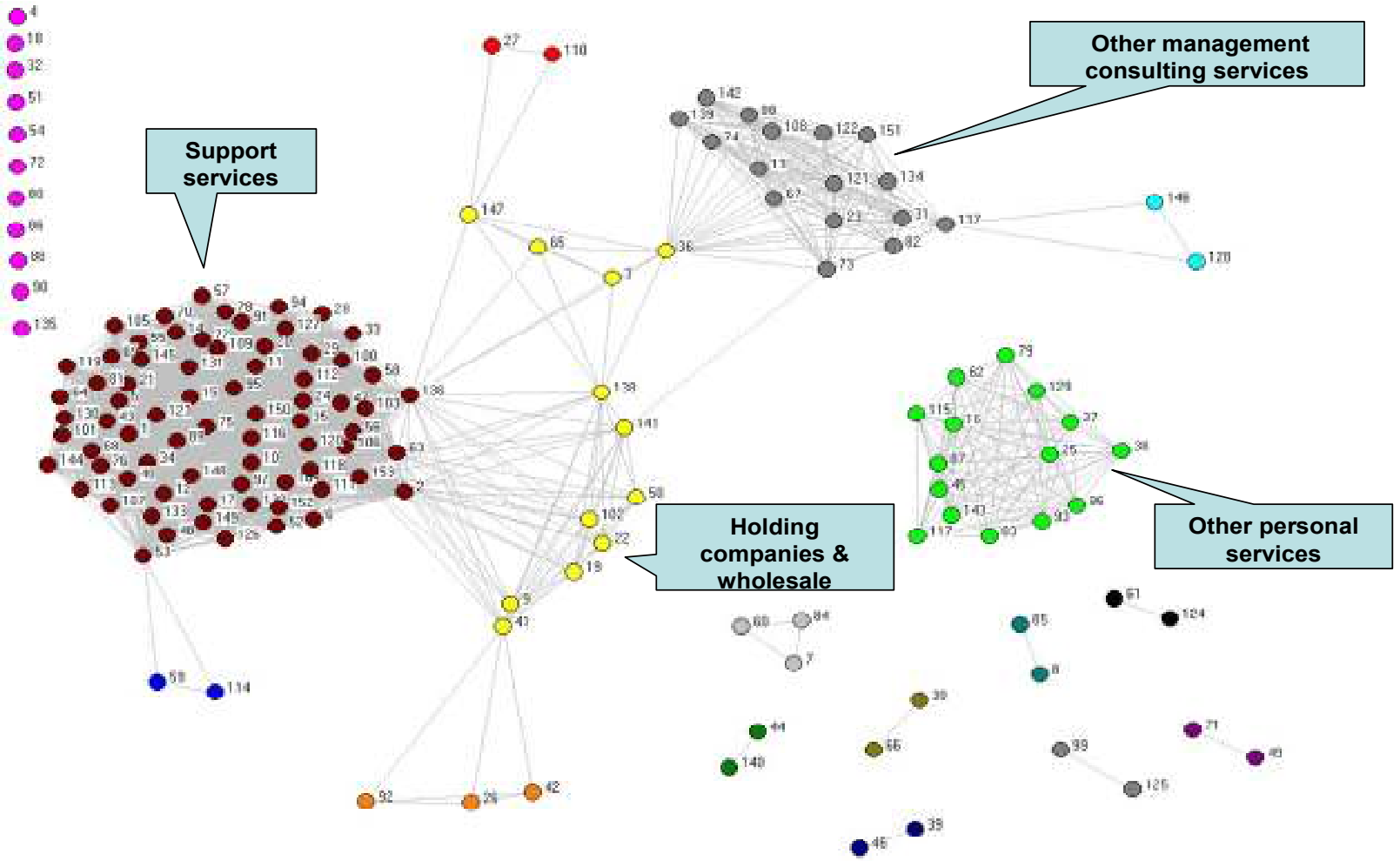
Map 18. CLUSTER "HEALTH PRODUCTS & COSMETICS" (308 firms)*

(31% of firms have the core industry code 446199 - All Other Health and Personal Care Stores and 30% of firms have the core industry code 446120 -Cosmetics, Beauty Supplies and Perfume Stores)



* all ties between firms; DOTS represent individual firs in this cluster group; TIES between firms represent a competitive relationship, where firms have declared the same industry code and compete in the same product market; different colors of dots represent distinctive structural components and segments.

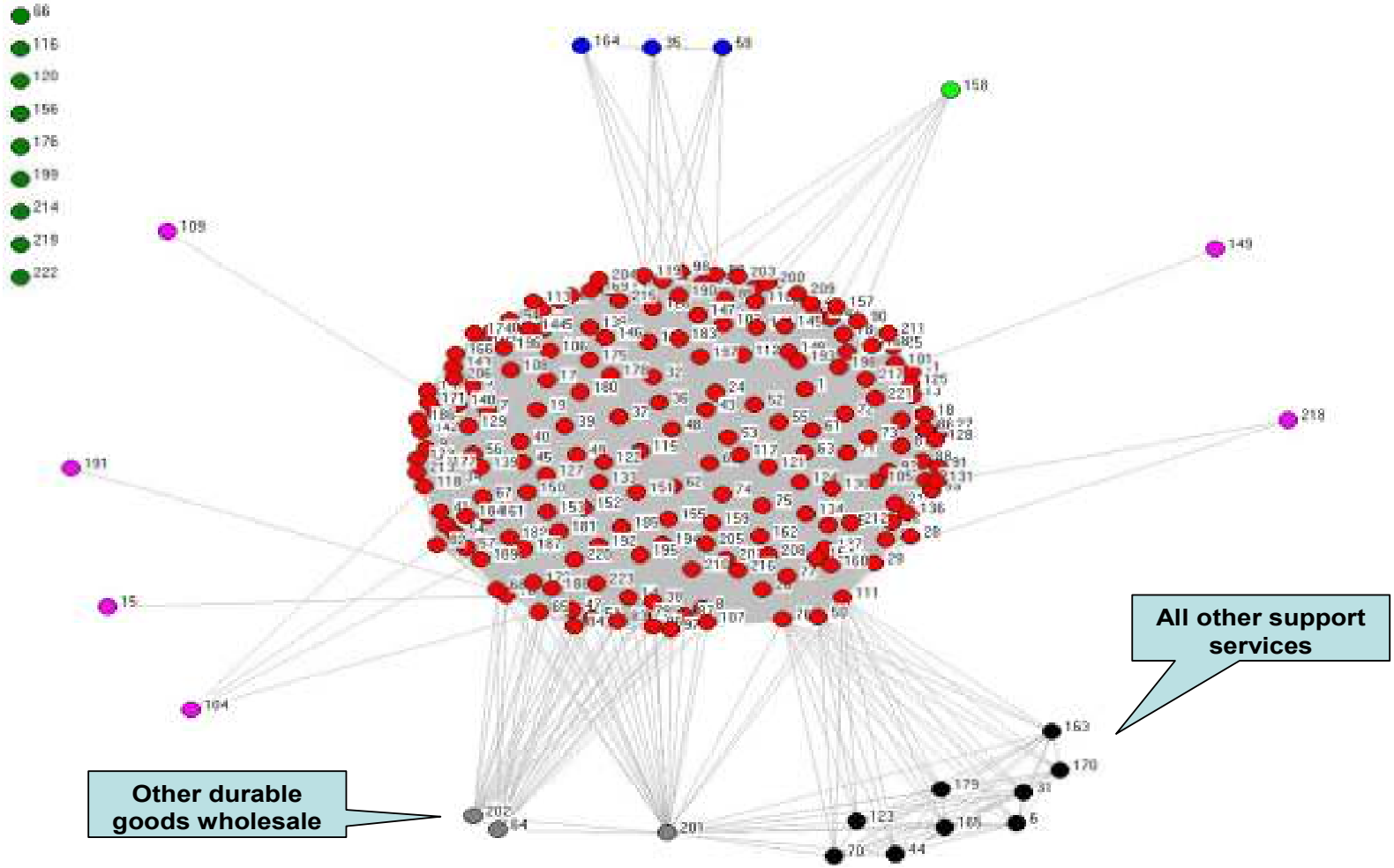
Map 19. CLUSTER "PHARMACEUTICAL CONSULTING" (150 firms)*
(48% of firms have the core industry code 561990 All Other Support Services)



* all ties between firms; DOTS represent individual firs in this cluster group; TIES between firms represent a competitive relationship, where firms have declared the same industry code and compete in the same product market; different colors of dots represent distinctive structural components and segments.

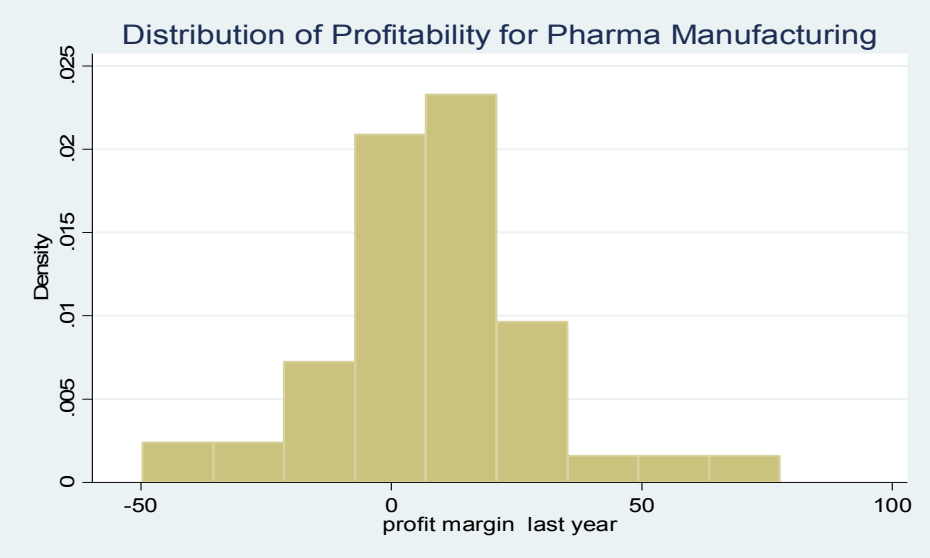
Map 20. CLUSTER "WHOLESALE PHARMACEUTICAL & BIO-PRODUCTS" (194 firms)*

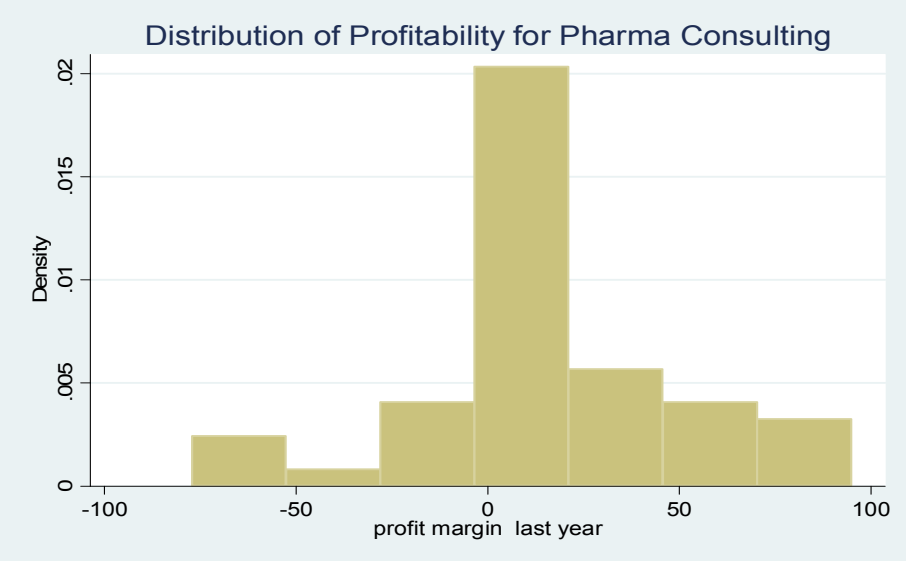
(89% of firms have the core industry code 424210 - Drugs and Druggists)

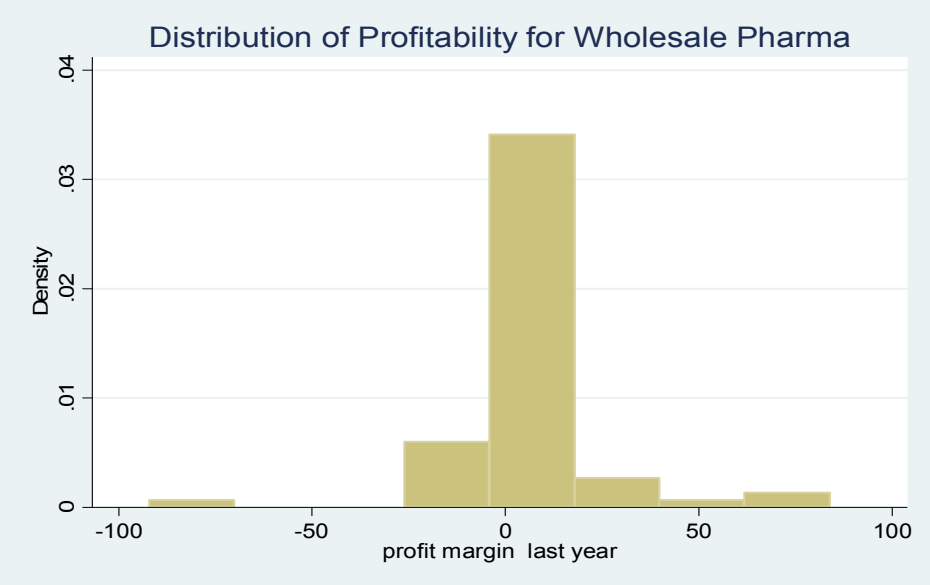


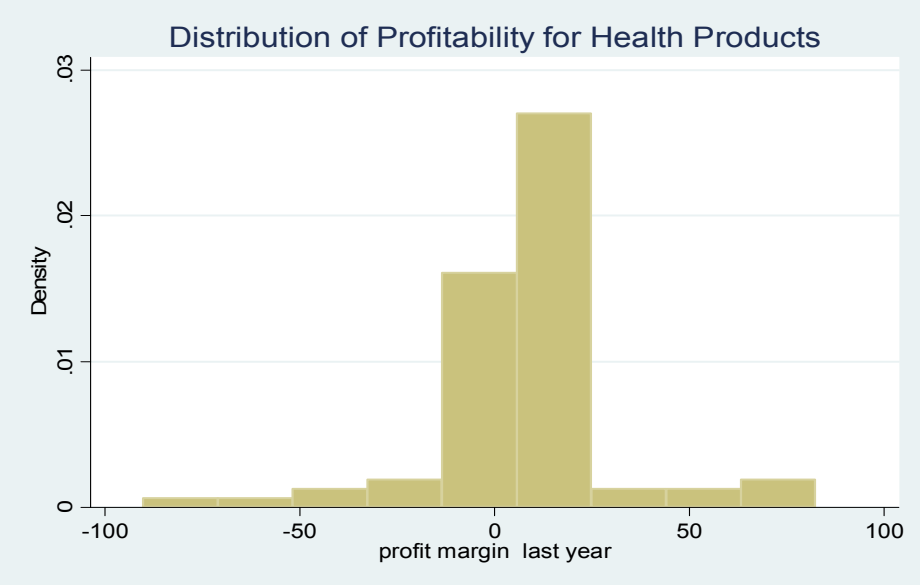
* all ties between firms; DOTS represent individual firs in this cluster group; TIES between firms represent a competitive relationship, where firms have declared the same industry code and compete in the same product market; different colors of dots represent distinctive structural components and segments.

Graph 6a. Distribution of Performance Across the Four Pharma-Related Sectors - charts









Graph 6b. Distribution of Performance Across the Four Pharma-Related Sectors - tables

In this analysis, pharmaceutical manufacturing has generated the most consistent profitability of these three cluster groups with a median profitability level consistently around 9%. Pharmaceutical consulting profitability has trended downwards from 10% three years ago down to 6.25% last year, as more entrants into this space appear to have driven the median level of profitability for this cluster lower. Wholesale manufacturing consistently exhibits both the lowest level of median profitability and the least volatile. Per unit of profitability, however, the pharmaceutical manufacturing cluster generates the lowest level of volatility adjusted profitability, as confirmed by its lower coefficient of variance.

	Median Profitability Over Last 3 Years		
	Profit Margin (t)	Profit Margin(t-1)	Profit Margin(t-2)
pharma manufacturing	0.0912	0.0987	0.081
pharma consulting	0.0625	0.0969	0.104
wholesale pharma	0.0459	0.0361	0.0468

	Coefficient of Variance		
	Profit Margin (t)	Profit Margin(t-1)	Profit Margin(t-2)
pharma manufacturing	2.477192982	3.539540816	2.465140479
pharma consulting	2.611356932	1.78292556	1.55806142
wholesale pharma	3.19554849	6.756892231	3.795719844

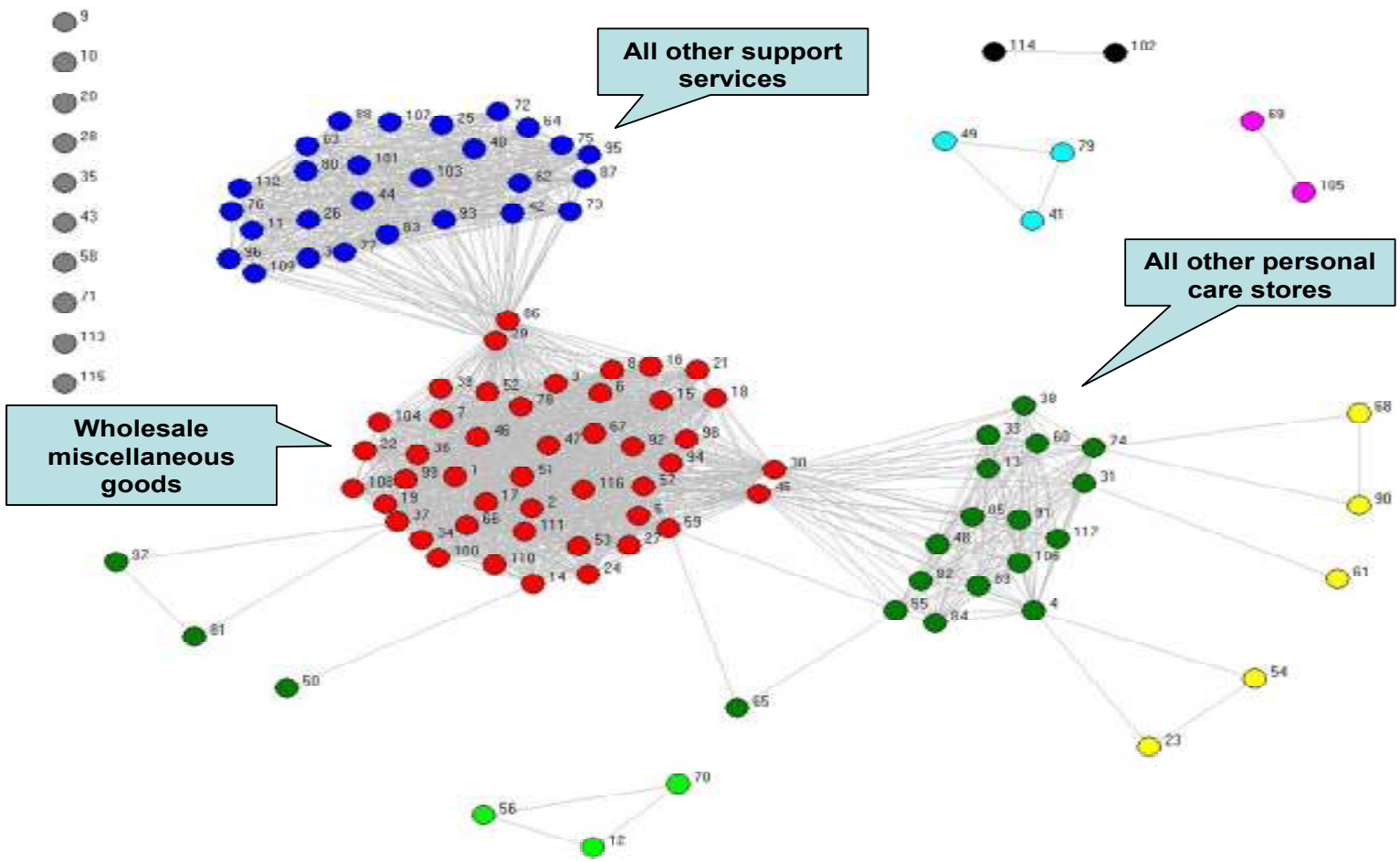
The Pharma manufacturing cluster outperforms the health products cluster, although health products has been trending up. Pharma manufacturing also exhibits a lower volatility per unit of profitability than health products, although health products has improved significantly on this dimension as well over the last three years.

	Median Profitability Over Last 3 Years		
	Profit Margin (t)	Profit Margin(t-1)	Profit Margin(t-2)
pharma manufacturing	0.0912	0.0987	0.081
health products	0.0729	0.0421	0.03655

	Coefficient of Variance		
	Profit Margin (t)	Profit Margin(t-1)	Profit Margin(t-2)
pharma manufacturing	2.477192982	3.539540816	2.465140479
health products	2.7997543	6.284337349	10.00847458

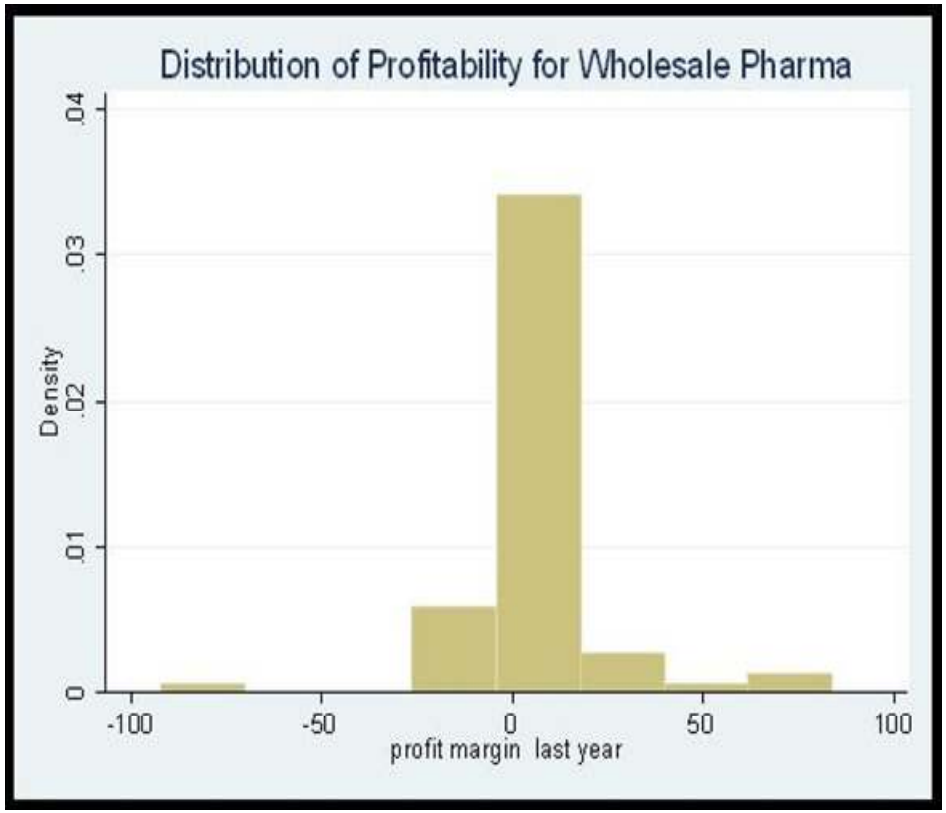
Map 21. CLUSTER "TRADE MEDICAL INSTRUMENTS & EQUIPMENT" (89 firms)[*]

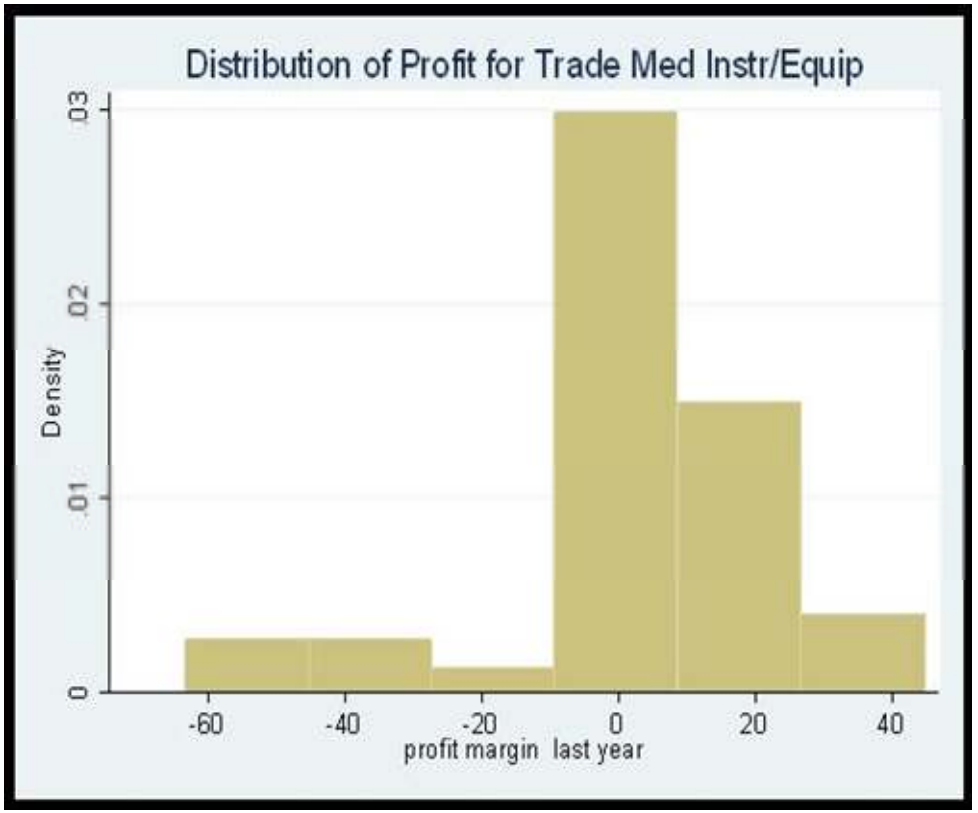
(39% of firms have the core industry codes: 425120 Wholesale Trade Agents and Brokers; 424990 Other Miscellaneous Nondurable Goods Merchant Wholesalers)



[*] all ties between firms; DOTS represent individual firs in this cluster group; TIES between firms represent a competitive relationship, where firms have declared the same industry code and compete in the same product market; different colors of dots represent distinctive structural components and segments.

Graph 7. Comparative Performance Across the Two Wholesale/Trade Sectors





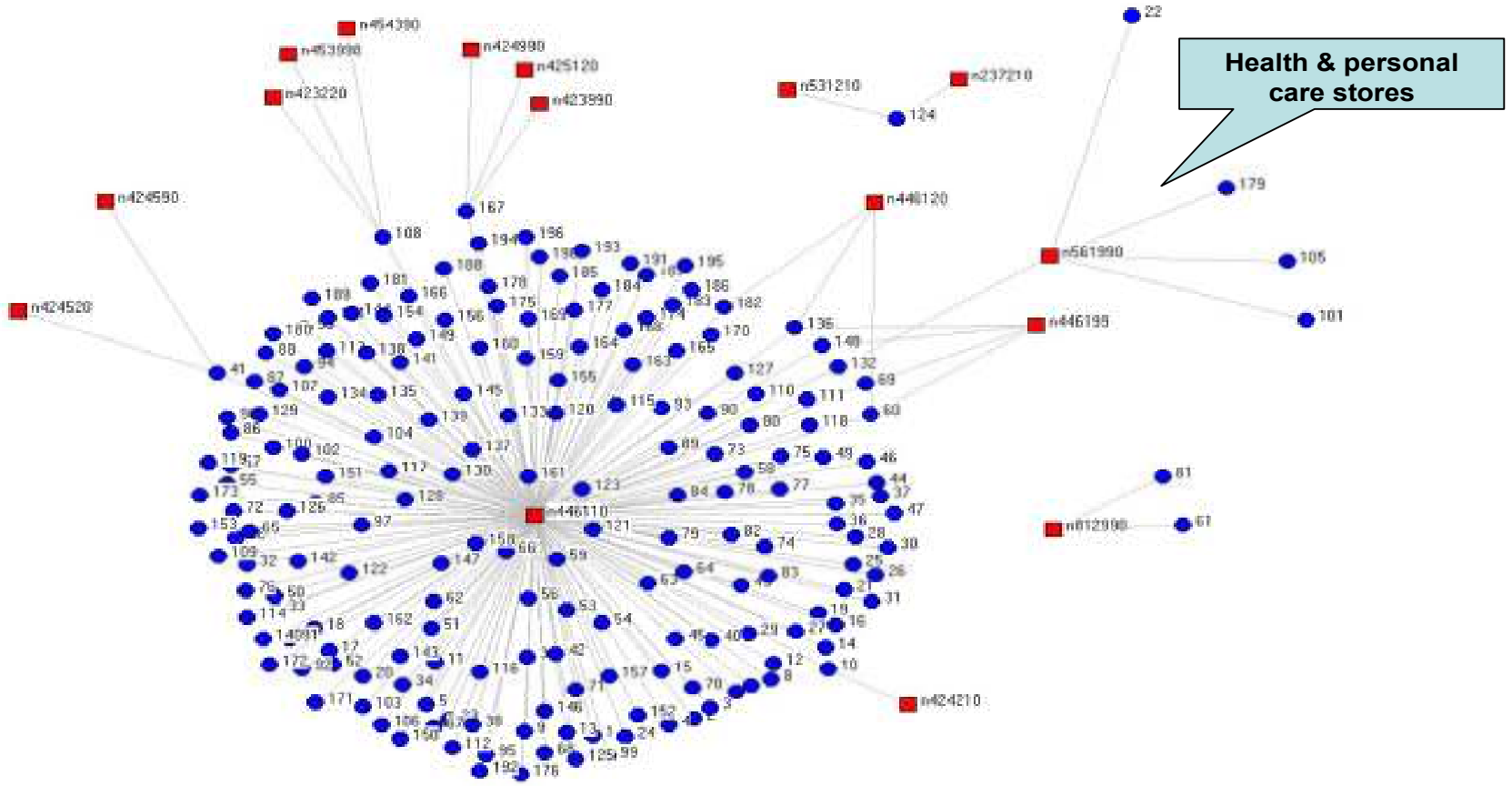
In this comparison, we observe two clusters with consistently low profitability with 'trade medical instruments & equipment' exhibiting a slightly higher median profitability level, although not statistically different. The volatility of both well-established clusters is relatively low, again with no statistical difference between the two clusters.

	Median Profitability Over Last 3 Years		
	Profit Margin (t)	Profit Margin(t-1)	Profit Margin(t-2)
trade medical instruments	0.0509	0.05	0.0338
wholesale pharma	0.0459	0.0361	0.0468

	Coefficient of Variance		
	Profit Margin (t)	Profit Margin(t-1)	Profit Margin(t-2)
trade medical instruments	8.238866397	2.629842181	33.06349206
wholesale pharma	3.19554849	6.756892231	3.795719844

Map 22. CLUSTER "PHARMACIES & DRUG STORES (DISPENSING CHEMISTS)" (175 firms)*

(96% of firms have the core industry code 446110 Pharmacies and Drug Stores)



* all ties between firms and industries; RED squares represent individual industry codes in NAICS; BLUE dots represent individual companies; TIES between companies and industry codes represent declared activities and operations by individual firms.

Map 23. CLUSTER "COSMETIC SERVICES AND RETAIL" (46 firms)*

(69% of firms have the core industry codes 812111 Barber Shops; 812112 Beauty Salons)

* * all ties between firms; DOTS represent individual firs in this cluster group; TIES between firms represent a competitive relationship, where firms have declared the same industry code and compete in the same product market; different colors of dots represent distinctive structural components and segments.

Table 9. Regional Distribution of Cluster Activities

CLUSTER	Brighton	Canterbury - Medway- Tonbridge	Guildford	Milton Keynes	Oxford	Portsmouth	Reading - Slough	Redhill	Southampton	Total
Outpatient Health Care	31,9%	31,8%	27,4%	20,9%	25,8%	34,7%	23,7%	32,9%	30,5%	29,1%
Medical Practice	10,9%	7,8%	11,2%	4,6%	6,8%	8,4%	7,3%	5,7%	10,3%	8,3%
Dental Practices and Laboratories	3,0%	1,9%	1,6%	,5%	1,6%	4,7%	2,6%	3,0%	1,6%	2,3%
Other Outpatient Services	13,3%	15,1%	12,6%	18,9%	12,7%	13,3%	8,4%	9,4%	13,5%	12,5%
In-patient Health Care	1,9%	2,0%	3,2%	3,1%	1,6%	3,1%	3,1%	,9%	2,4%	2,3%
Other Hospital activity	3,7%	2,0%	6,1%	5,6%	6,4%	2,2%	5,7%	6,6%	3,7%	4,4%
Charities & Social Care with Housing	7,5%	8,1%	3,1%	4,6%	3,9%	5,8%	5,7%	5,3%	8,5%	6,1%
Surgical & Medical Instruments Manufacturing	3,0%	2,3%	2,9%	2,6%	7,6%	5,3%	3,9%	4,6%	2,7%	3,7%
Optical Instruments	,7%	,8%	1,1%	2,0%	1,4%	,7%	,8%	,2%	,8%	,9%
Other Related Manufacturing	1,3%	1,2%	2,0%	1,5%	1,4%	,4%	1,4%	2,1%	1,9%	1,4%
R&D Generic	,3%	1,3%	2,3%	,5%	2,0%	,4%	1,4%	1,6%	1,9%	1,3%
Medical & Bio-pharma R&D & Clinical Trials	1,3%	2,0%	5,2%	3,6%	12,5%	2,2%	6,5%	3,4%	4,8%	4,5%
Pharmaceutical Manufacturing	2,1%	3,3%	5,1%	3,1%	3,3%	2,4%	6,6%	2,7%	1,3%	3,7%
Pharmaceutical consulting	,6%	4,2%	2,5%	1,0%	3,3%	,9%	4,5%	2,3%	2,4%	2,8%
Pharmacies & Drug Stores (Dispensing Chemists)	3,3%	4,9%	1,6%	5,6%	1,0%	4,0%	3,7%	2,1%	2,9%	3,3%
Wholesale Pharmaceutical & Bio-products	2,5%	3,7%	2,7%	9,2%	2,3%	2,0%	4,9%	5,5%	2,7%	3,7%
Cosmetic Services and Retail	,9%	,7%	1,1%	2,0%	,8%	,2%	,8%	,7%	1,9%	,9%
Health Products & Cosmetics	9,4%	4,8%	5,2%	7,1%	2,5%	6,7%	5,9%	7,8%	3,7%	5,8%
Trade Medical Instruments & Equipment	1,5%	,7%	2,2%	2,0%	1,8%	1,3%	2,3%	2,3%	1,9%	1,7%
Regulation and Administration	,3%	,3%	,2%		,2%	,7%	,2%	,2%	,5%	,3%
Recreation	,6%	1,1%	,5%	1,5%	1,2%	,4%	,8%	,9%	,3%	,8%
Number of firms	671	1076	554	196	512	450	1008	438	377	5282

Table 10. Overview of Survey Results

		Nb	%
Year of Establishment	**before 1995**	**15**	**40,5%**
	1996-2002	**10**	**27,0%**
	after 2003	**12**	**32,4%**
Total		**37**	**100,0%**

		Nb	%
Annual revenue 2006	**<£100k**	**10**	**35,7%**
	£101k -£1m	**9**	**32,1%**
	>£1m	**9**	**32,1%**
Total		**28**	**100,0%**

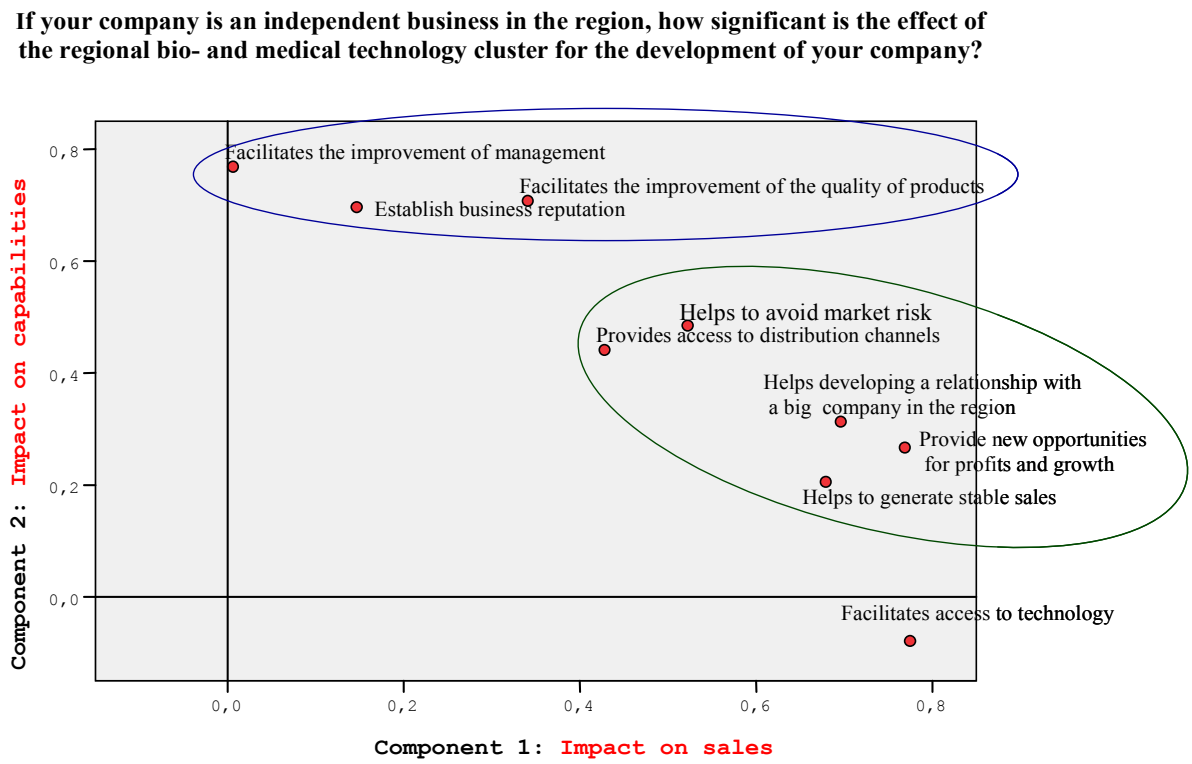
		Nb	%
Nuber of Employees 2006	**<10**	**23**	**63,9%**
	11-20	**5**	**13,9%**
	21-50	**5**	**13,9%**
	130	**1**	**2,8%**
	300	**1**	**2,8%**
	452	**1**	**2,8%**
Total		**36**	**100,0%**

		Nb	%
Please identify what is the origin of your company?	university spin-out	11	28,9%
	private entrepreneurial venture	23	60,5%
	other	4	10,5%
Total		38	100,0%

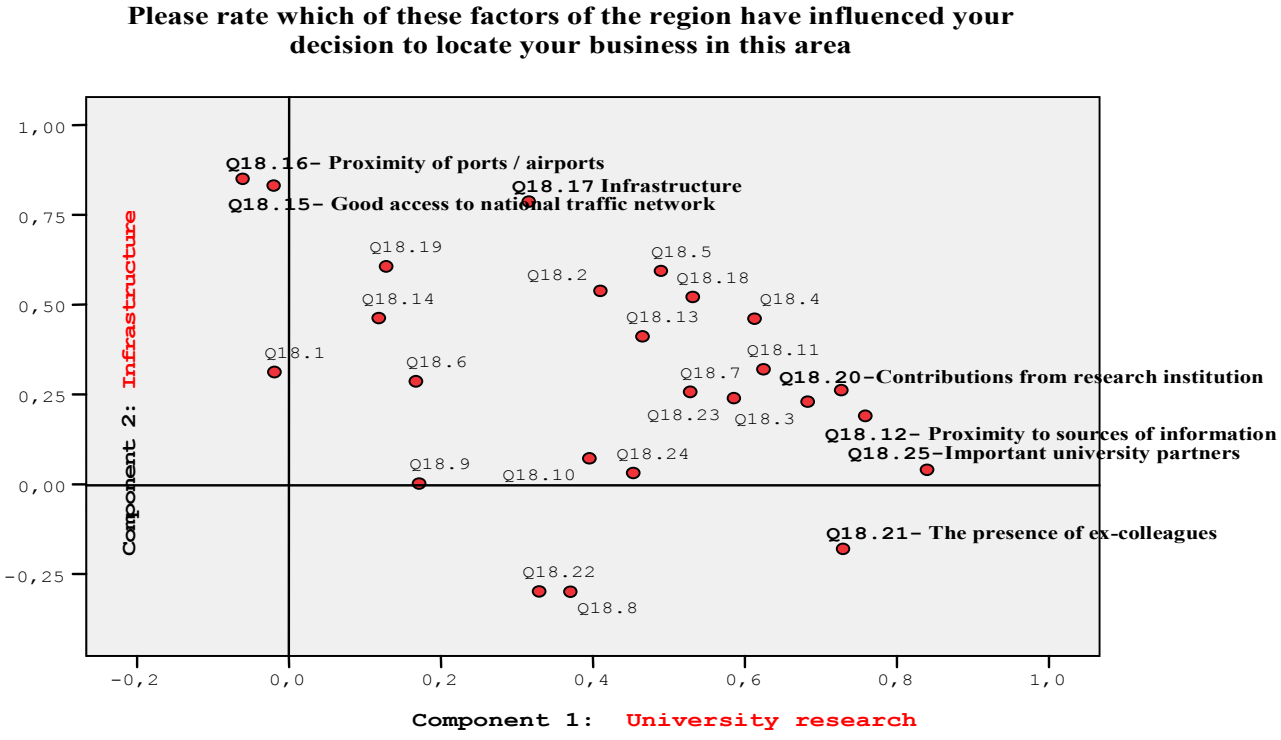
		Cases	%
You as the manager of the firm had previous employment in:	another life-science company	19	51,4%
	other field	14	37,8%
	have founded other enterprises in the field	4	10,8%
	have founded other enterprises in other fields	2	5,4%
Total		37	105,4%

		Cases	%
What are the aspirations of your company	to grow & float	9	23,7%
	to grow	11	28,9%
	to grow & trade /sale	18	47,4%
	stable revenue	3	7,9%
Total		38	107,9%

Graph 8a. Motivations to Locate in the Region*



Graph 8b. Motivations to Locate in the Region - 2



* All graphs containing results from the Component analysis display the two leading groups of factors, described in the RED label for the each component

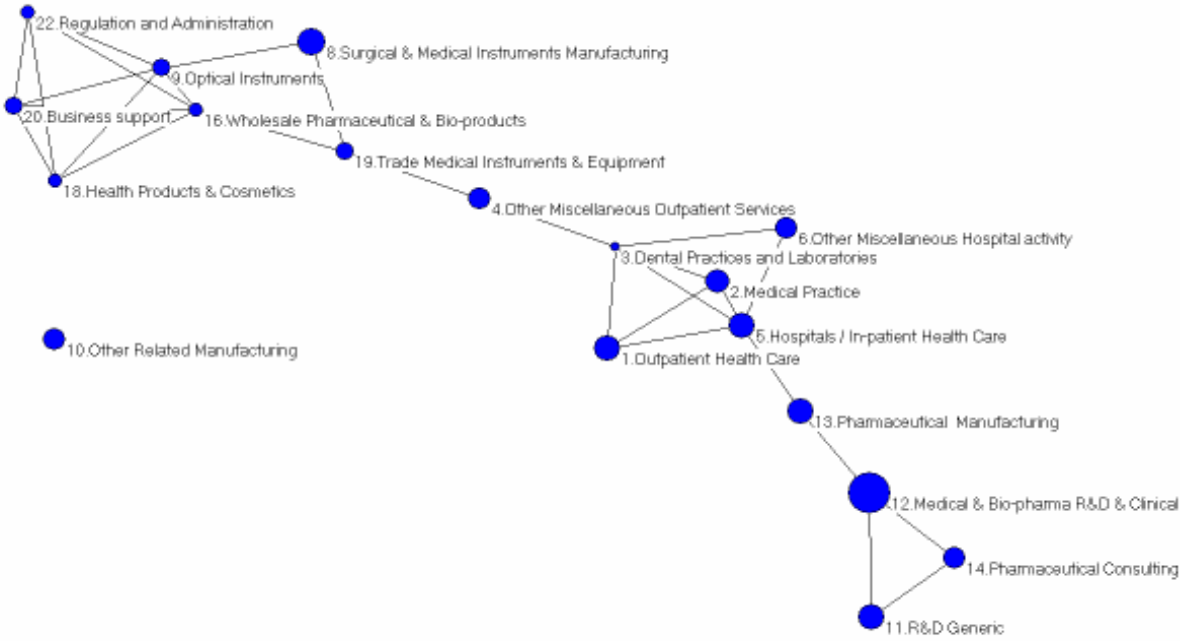
Table 11. Mapping Products / Technologies

		Cases	%
What are your main products or service	Biotechnology	11	29,7%
	Contract Research and development	12	32,4%
	Contract manufacturing	6	16,2%
	Diagnostics	12	32,4%
	Medical, surgical and orthopaedic equipment	10	27,0%
	Medical and surgical instrumentation	7	18,9%
	Pharmaceuticals	9	24,3%
	Research and development	14	37,8%
	Veterinary products	1	2,7%
	Health products	4	10,8%
	Food products	3	8,1%
	Environmental products/technologies	3	8,1%
	Industrial products/technologies	3	8,1%
Total		37	256,8%

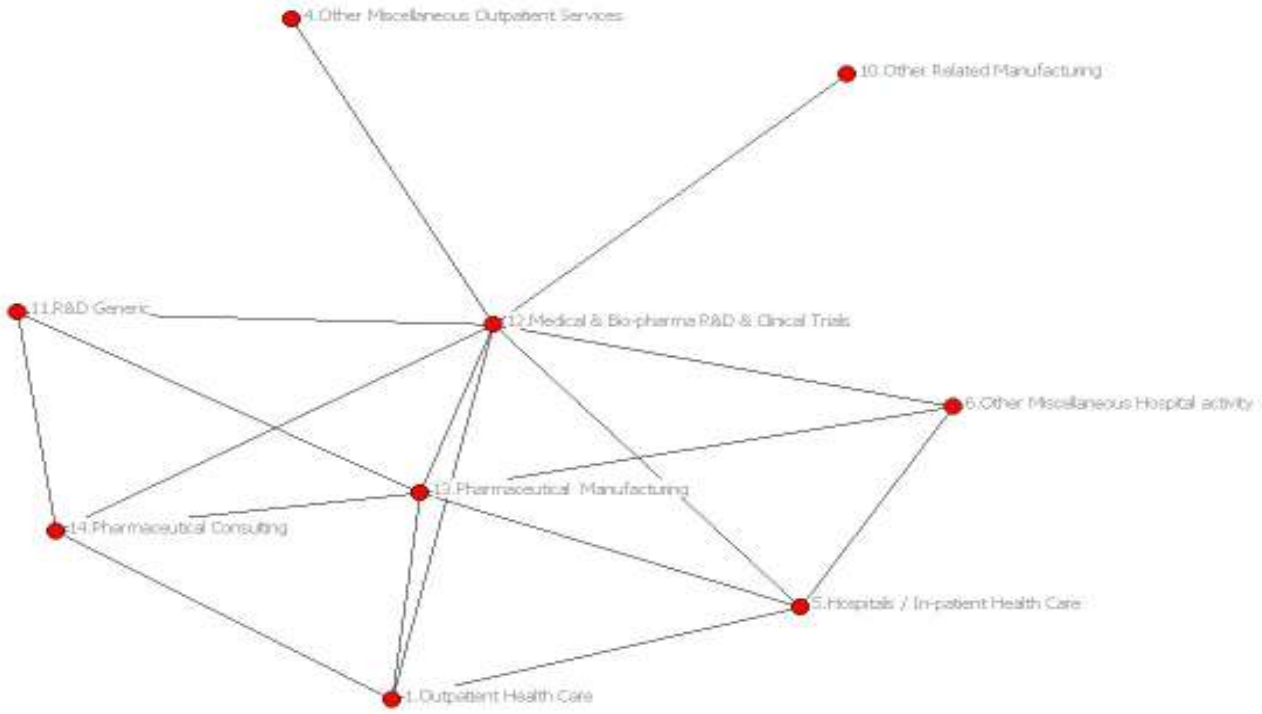
Table 12. Areas of Specialisation for the Sample

		Count	%
Please indicate the main area of specialisation for your company - ONE MAIN	1.Outpatient Health Care	1	2,7%
	5.Hospitals / In-patient Health Care	3	8,1%
	8.Surgical & Medical Instruments Manufacturing	5	13,5%
	9.Optical Instruments	1	2,7%
	10.Other Related Manufacturing	4	10,8%
	11.R&D Generic	1	2,7%
	12.Medical & Bio-pharma R&D & Clinical Trials	15	40,5%
	14.Pharmaceutical Consultin	1	2,7%
	18.Health Products & Cosmetics	1	2,7%
	19.Trade Medical Instrument & Equipment	2	5,4%
	20.Business support	3	8,1%
Total		37	100,0%

Map 24. Ties Between Areas of Specialisation for the Companies in the Sample* *(normalised value > 0,5)*



Map 25. Areas of specialisation of companies with main activities in cluster group "Medical & Bio-pharma R&D" (all ties)**



* blue dots represent areas of specialisation of the firms in the sample; size of the dot represent number of firms that have declared these competences; ties represent connected areas of specialisation, declared simultaneously by the same firms.

** red dots represent areas of additional specialisation of the Medical and Bio-R&D firms; ties represent inter-related activities declared as areas of specialisation by the sane firms.

Table 13. Internationalisation Strategies and Mapping of Target Markets

		Cases	%
What are the international business development opportunities in your sector?	Licensing	23	63,9%
	Export	16	44,4%
	Sales	26	72,2%
	To join a large distribution network	7	19,4%
	Other	7	19,4%
Total		36	219,4%

		Cases	%
Do you have plans to relocate or extend your activities in the future in one of the following areas	In the UK	10	26,3%
	In Europe	5	13,2%
	In other country in the world	15	39,5%
	No	12	31,6%
Total		38	

Please estimate what proportion of your sales come from the following areas:

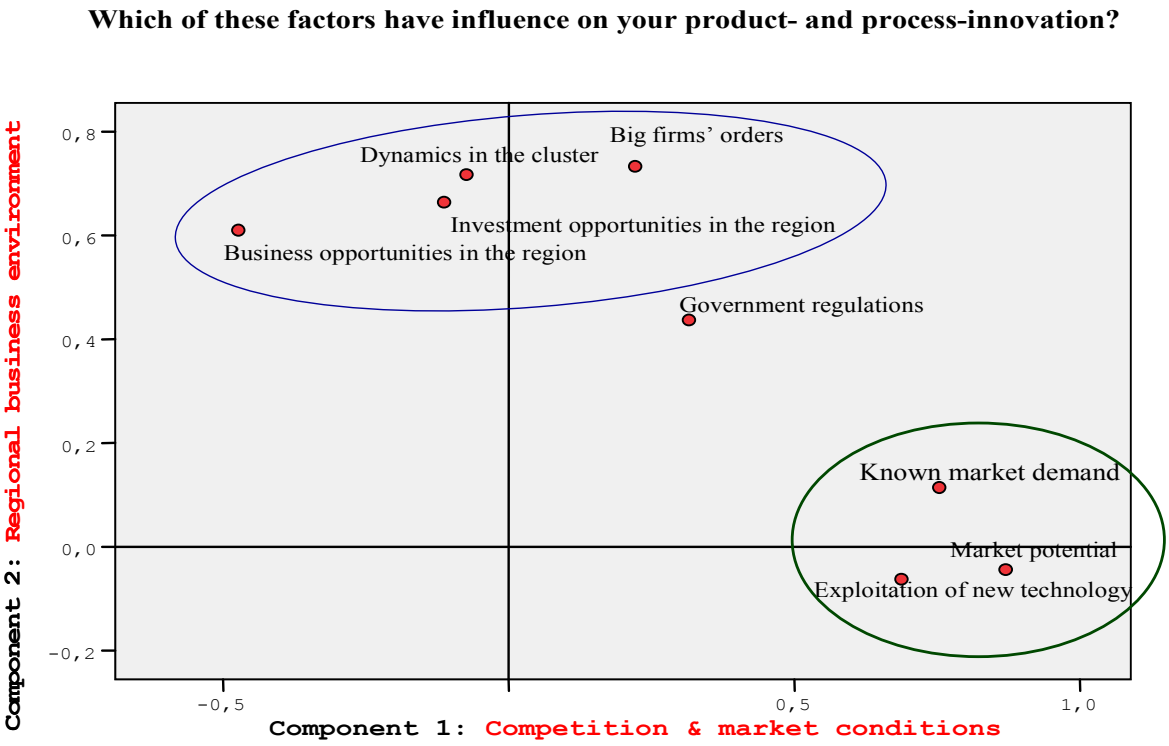
	The region		The UK		Europe		Other main region	
	Count	%	Count	%	Count	%	Count	%
0%	15	50,0%	4	13,3%	10	33,3%	11	36,7%
1-10%	6	20,0%	2	6,7%	5	16,7%	3	10,0%
11-50%	6	20,0%	14	46,7%	14	46,7%	13	43,3%
50%+	3	10,0%	10	33,3%	1	3,3%	3	10,0%
Total	30	100,0%	30	100,0%	30	100,0%	30	100,0%

		Count	Col %
Please estimate what proportion of your sales come from the following areas	More then 50% in the region	3	8,3%
	More then 50% in the UK	11	30,6%
	More then 50% in Europe and in the rest of the world	14	38,9%
	Mixed	1	2,8%
	I am at a Pre-revenue stage	7	19,4%
Total		36	100,0%

Table 14. Distance of Partners

	Suppliers		Clients		Research Institutions	
	Nb	%	Nb	%	Nb	%
In the same region	25	27%	10	17%	17	31%
In the UK	32	35%	21	36%	20	37%
In the EU	13	14%	17	29%	6	11%
Worldwide	21	23%	11	19%	11	20%
Total	91	100%	59	100%	54	100%

Graph 9. Sources and Driver of Innovation in the Region



Graph 10. Sources and Driver of Innovation for the Company

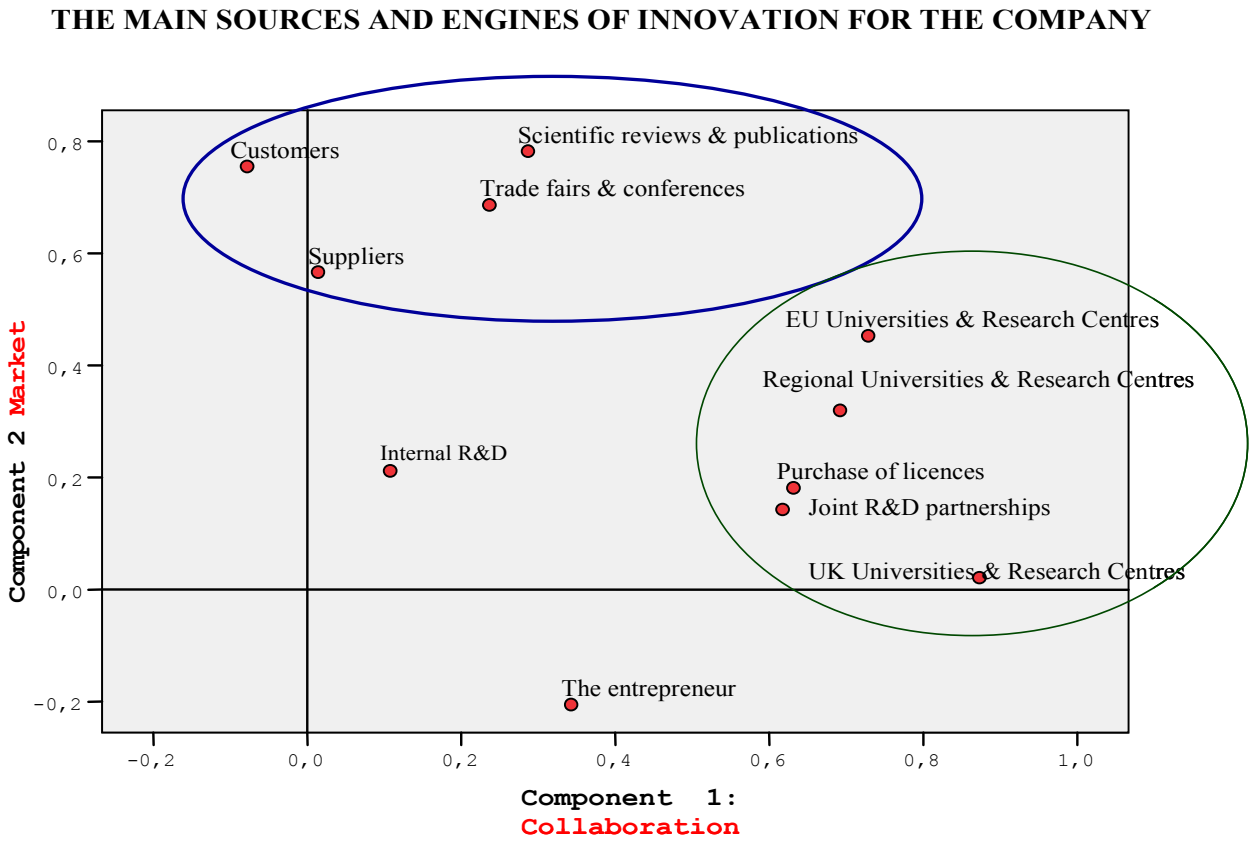


Table 15. Cooperation Practices in the Region

		Nb responces	%
Amount of time you have cooperated with your suppliers	1-2 years	15	18,8%
	3-5 years	31	38,8%
	6-10 years	25	31,3%
	11+ years	9	11,3%
Total		80	100,0%

		Nb	%
Amount of time you have cooperated with your clients and distributors	1-2 years	12	33,3%
	3-5 years	13	36,1%
	6-10 years	7	19,4%
	11+ years	4	11,1%
Total		36	100,0%

		Nb	%
Amount of time you have cooperated with this research organisation	1-2 years	12	36,4%
	3-5 years	10	30,3%
	6-10 years	9	27,3%
	11+ years	2	6,1%
Total		33	100,0%

		Partners						Total	
		Banks and Investment Institutions		Government Agencies		Other Public Organisations			
		Nb	%	Nb	%	Nb	%	Nb	%
Amount of time you have cooperated	1-2 years	2	9,1%	4	36,4%	2	50,0%	8	21,6%
	3-5 years	5	22,7%	6	54,5%	2	50,0%	13	35,1%
	6-10 years	7	31,8%					7	18,9%
	11+ years	8	36,4%	1	9,1%			9	24,3%
Total		22	100,0%	11	100,0%	4	100,0%	37	100,0%

		Cases	Response %
What do you exchange and share with each supplier?	Material products	61	71,8%
	Knowledge	45	52,9%
	Technology	33	38,8%
	Equipment	13	15,3%
	Services	29	34,1%
	Management consulting	3	3,5%
	Joint contracts	12	14,1%
	Shared risks	7	8,2%
	Common clients	7	8,2%
	Common partners	5	5,9%
	Common financing	3	3,5%
	Common history	4	4,7%
	Common interests	8	9,4%
	Trust	23	27,1%
	Friendship	13	15,3%
Total		85	

		Cases	%
What do you exchange and share with each client?	Material products	38	60,3%
	Knowledge	35	55,6%
	Technology	23	36,5%
	Equipment	7	11,1%
	Services	30	47,6%
	Joint contracts	6	9,5%
	Shared risks	10	15,9%
	Common clients	4	6,3%
	Common financing	2	3,2%
	Common interests	7	11,1%
	Trust	22	34,9%
	Friendship	18	28,6%
Total		63	

		Cases	%
What do you share and exchange with each research partner?	Material products	28	54,9%
	Knowledge	45	88,2%
	Technology	40	78,4%
	Equipment	16	31,4%
	Services	15	29,4%
	Management consulting	4	7,8%
	Joint contracts	14	27,5%
	Shared risks	14	27,5%
	Common clients	2	3,9%
	Common partners	10	19,6%
	Common financing	9	17,6%
	Common history	9	17,6%
	Common interests	18	35,3%
	Trust	28	54,9%
	Friendship	24	47,1%
	Other	2	3,9%
Total		51	

		Partners						Total	
		Banks and Investment Institutions		Government Agencies		Other Public Organisations			
		Nb	%	Nb	%	Nb	%	Nb	%
What do you share and have in common with each organisation?	Knowledge	6	37,5%	6	66,7%	4	80,0%	16	53,3%
	Technology	1	6,3%	1	11,1%	3	60,0%	5	16,7%
	Services	11	68,8%	7	77,8%	4	80,0%	22	73,3%
	Management consulting	3	18,8%	2	22,2%	2	40,0%	7	23,3%
	Joint contracts	1	6,3%	1	11,1%	2	40,0%	4	13,3%
	Shared risks	1	6,3%	1	11,1%	1	20,0%	3	10,0%
	Common clients	1	6,3%			1	20,0%	2	6,7%
	Common partners			1	11,1%	2	40,0%	3	10,0%
	Common financing	1	6,3%	1	11,1%	1	20,0%	3	10,0%
	Common history			1	11,1%	2	40,0%	3	10,0%
	Common interests	1	6,3%	2	22,2%	2	40,0%	5	16,7%
	Trust	6	37,5%	4	44,4%	2	40,0%	12	40,0%
	Friendship	4	25,0%	2	22,2%	3	60,0%	9	30,0%
	Other	1	6,3%					1	3,3%
Total		16	100,0%	9	100,0%	5	100,0%	30	100,0%

Map 26. Ties Between Universities & Research Partners*

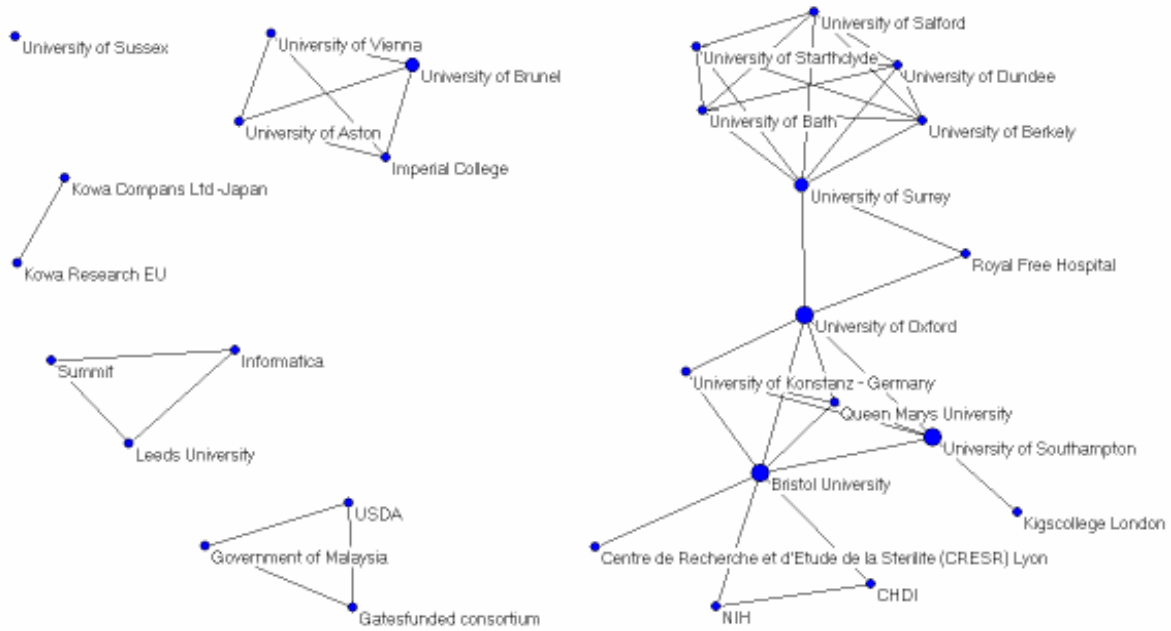


Table 16. R&D Expenditure and Patent Activities

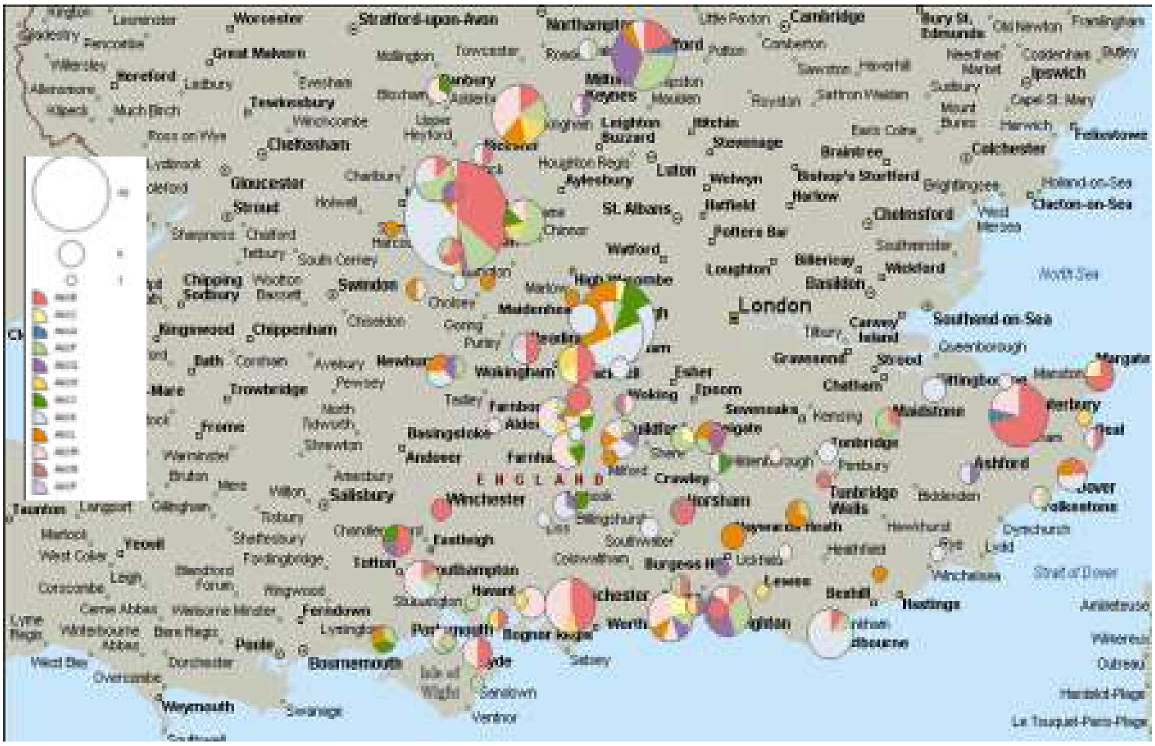
		Nb	%
R&D expenditure 2006	<£20k	4	19,0%
	£20k -£100k	6	28,6%
	£100k -£1m	7	33,3%
	>£1m	4	19,0%
Total		21	100,0%

		Nb	%
% of R&D expenditure from Annual revenue 2006	<10%	8	50,0%
	17%	1	6,3%
	20%	1	6,3%
	24%	1	6,3%
	72%	1	6,3%
	91%	1	6,3%
	190%	1	6,3%
	200%	2	12,5%
Total		16	100,0%

* dots represent research institutions that have been named as research partners by the firms in our sample; ties represent relationship between research centres based on collaborating with the same firms; the map represents a knowledge sharing network.

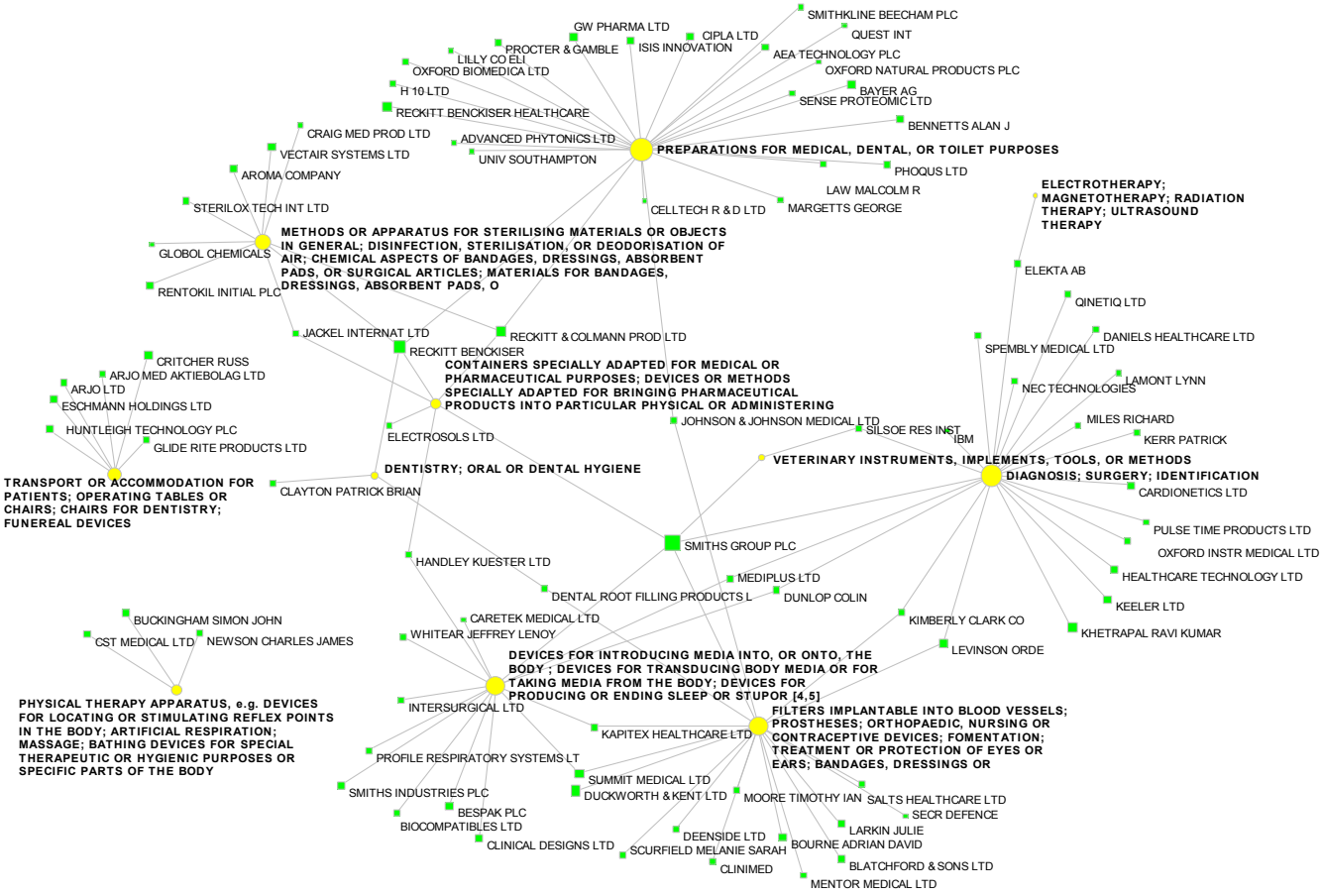
		Nb	%
Do you have IP owned up for licensing?	no	10	28,6%
	yes	25	71,4%
Total		35	100,0%
How many patents do you own?	1	4	17,4%
	2	6	26,1%
	3	2	8,7%
	5	1	4,3%
	6	2	8,7%
	7	2	8,7%
	10	1	4,3%
	13	1	4,3%
	20	1	4,3%
	25	1	4,3%
	250	1	4,3%
	450	1	4,3%
Total		23	100,0%

Map 27. Number of Patents by City and by International Patent Codes



Map 28. Network of Ties Between Companies & Institutions vs. IPC Patent Classification*

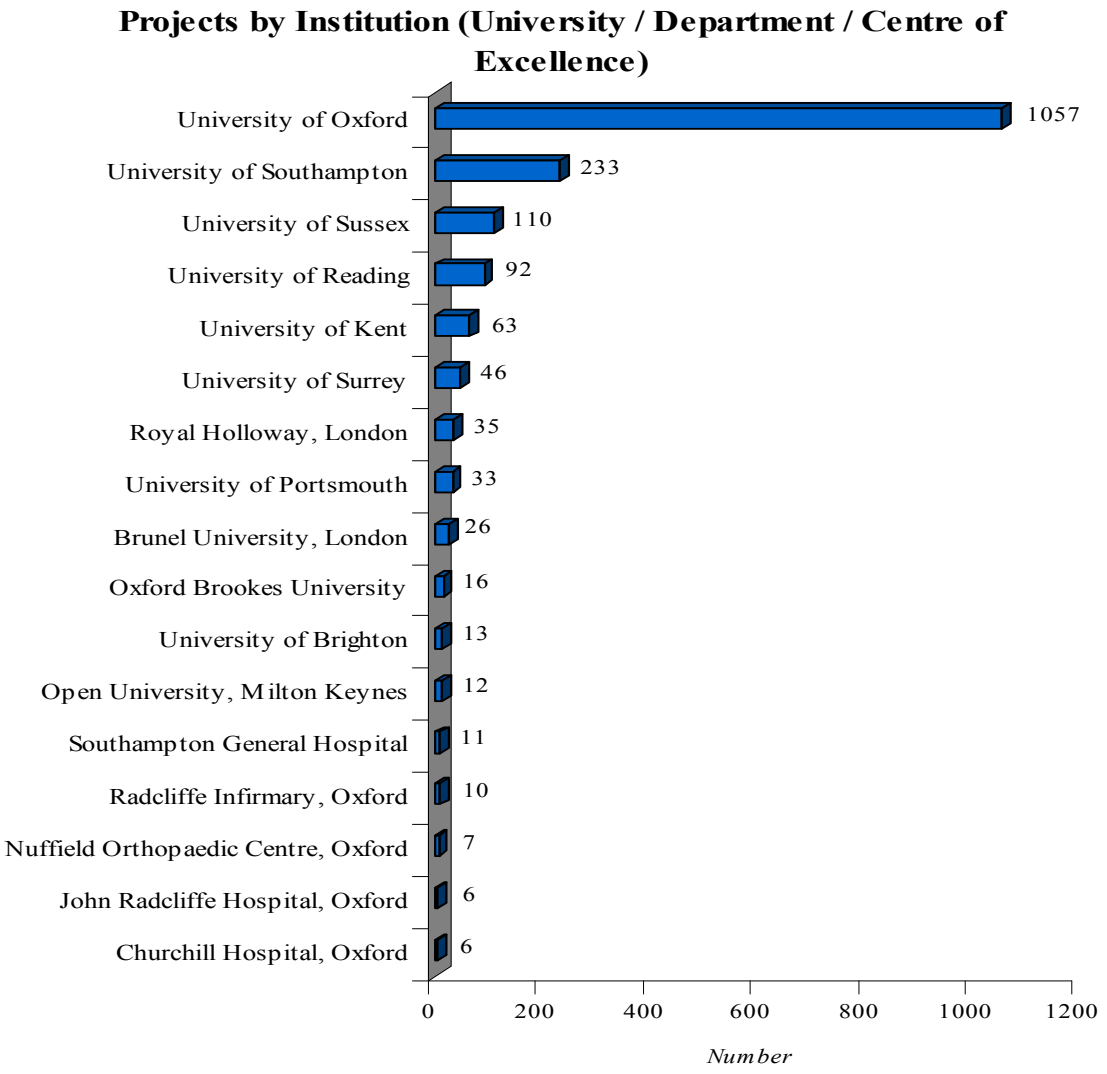
(preliminary analysis of patents)

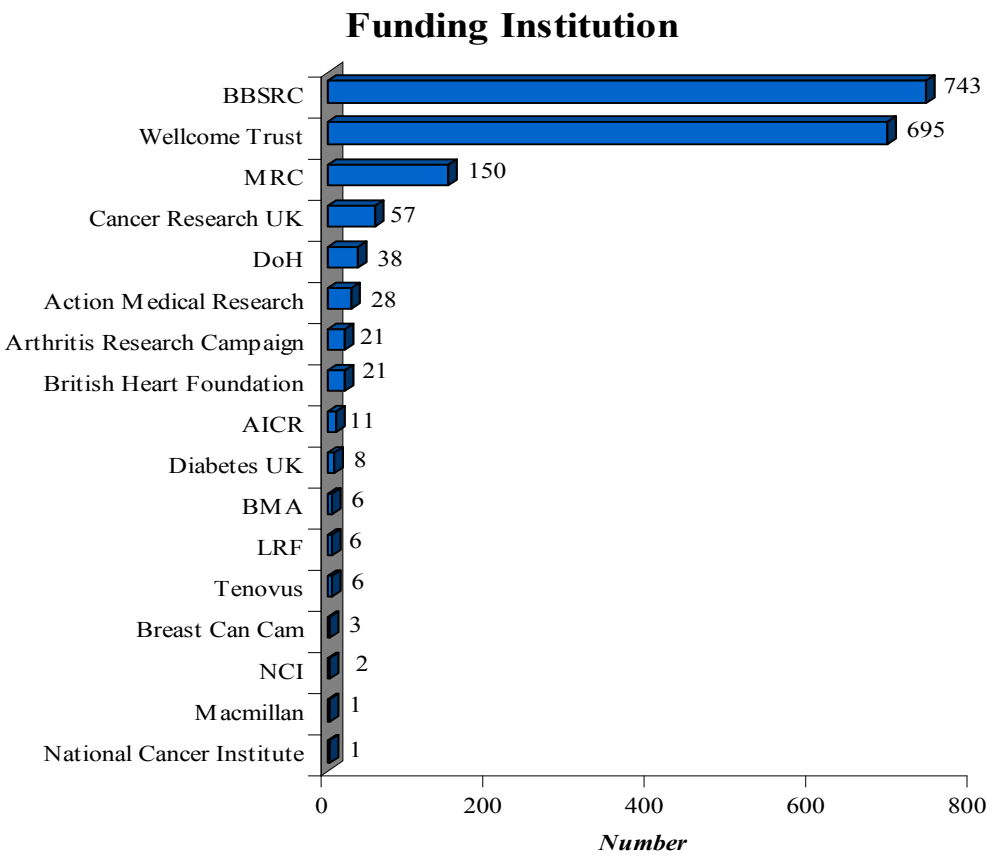


* YELLOW dots represent key IPC categories, under which patents are filed; GREEN squares represent patent holders with significant number of registered patents; size of the dot / square represent volume (number) of registered patents.

Table 17. Funded Research in the Health Technology Cluster in the South East

Institution	Nb of projects	Nb of projects %	Nb of projects reported data	Total funding (in GDP)	Total funding %	Median (in GDP)	Mean (in GDP)	Std Deviation (in GDP)
University of Oxford	1 057	58,8%	928	262 126 436	68,0%	148 367	282 464	566 666
University of Southampton	233	13,0%	186	34 228 550	8,9%	165 952	184 024	151 361
University of Sussex	110	6,1%	90	18 705 339	4,9%	176 315	207 837	163 955
University of Reading	92	5,1%	84	20 716 228	5,4%	180 081	246 622	279 425
University of Kent	63	3,5%	57	12 642 431	3,3%	189 786	221 797	154 910
University of Surrey	46	2,6%	42	8 220 494	2,1%	180 053	195 726	155 189
Royal Holloway, London	35	1,9%	34	6 465 648	1,7%	199 602	190 166	90 758
University of Portsmouth	33	1,8%	30	5 586 330	1,4%	171 268	186 211	136 326
Brunel University, London	26	1,4%	21	5 067 877	1,3%	140 176	241 327	364 605
Oxford Brookes University	16	,9%	15	2 669 697	0,7%	178 884	177 980	62 660
University of Brighton	13	,7%	12	1 878 856	0,5%	158 788	156 571	62 049
Open University, Milton Keynes	12	,7%	11	2 193 972	0,6%	215 036	199 452	118 361
Southampton General Hospital	11	,6%	2	76 600	0,0%	38 300	38 300	18 809
Radcliffe Infirmary, Oxford	10	,6%	4	317 247	0,1%	71 616	79 312	53 416
Nuffield Orthopaedic Centre, Oxford	7	,4%	7	1 625 715	0,4%	192 584	232 245	156 216
John Radcliffe Hospital, Oxford	6	,3%	3	289 325	0,1%	135 456	96 442	71 080
Churchill Hospital, Oxford	6	,3%	2	1 342 916	0,3%	671 458	671 458	877 439
Other	21	1,2%	11	1 482 632	0,4%	108 179	134 785	77 454
Total	**1 797**	**100%**	**1 539**	**385 636 293**	**100%**	**161 552**	**250 576**	**456 970**





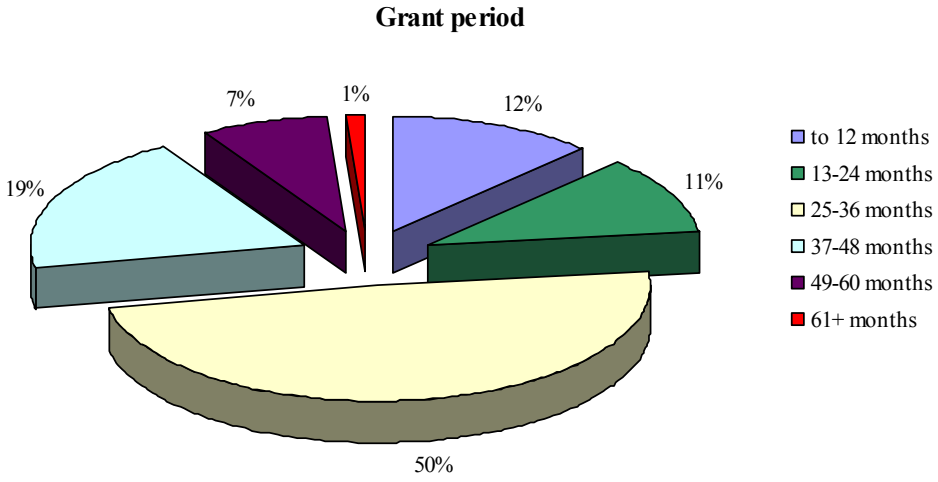
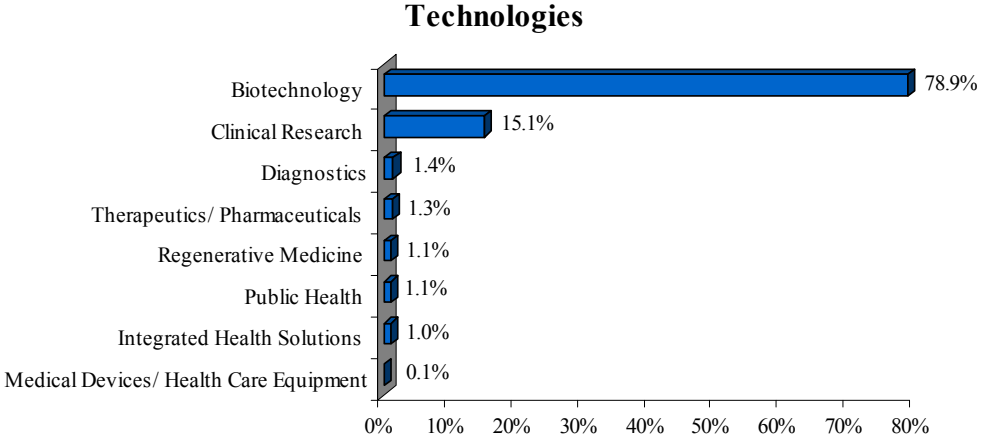
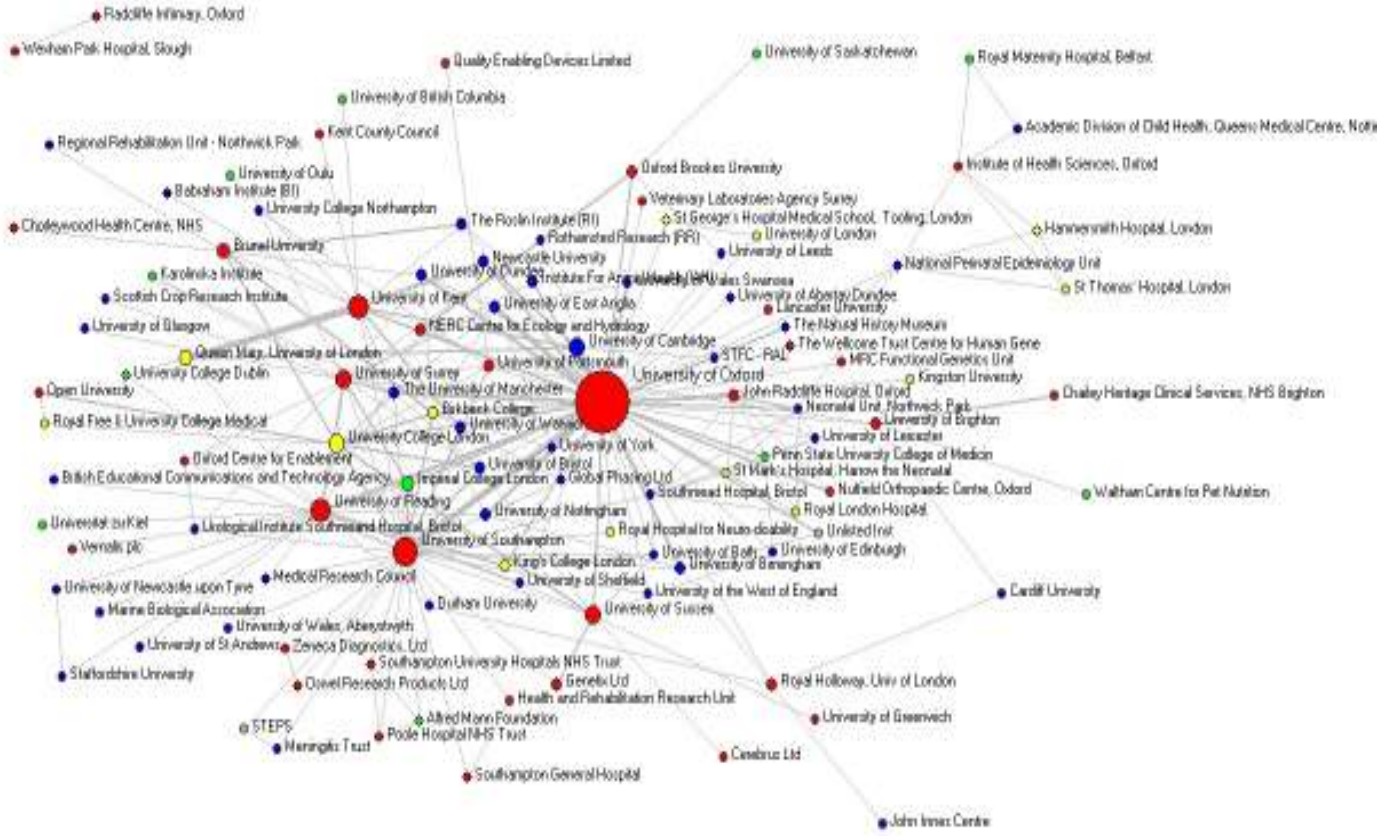


Table 18. Allocation of Grants to Research Fields

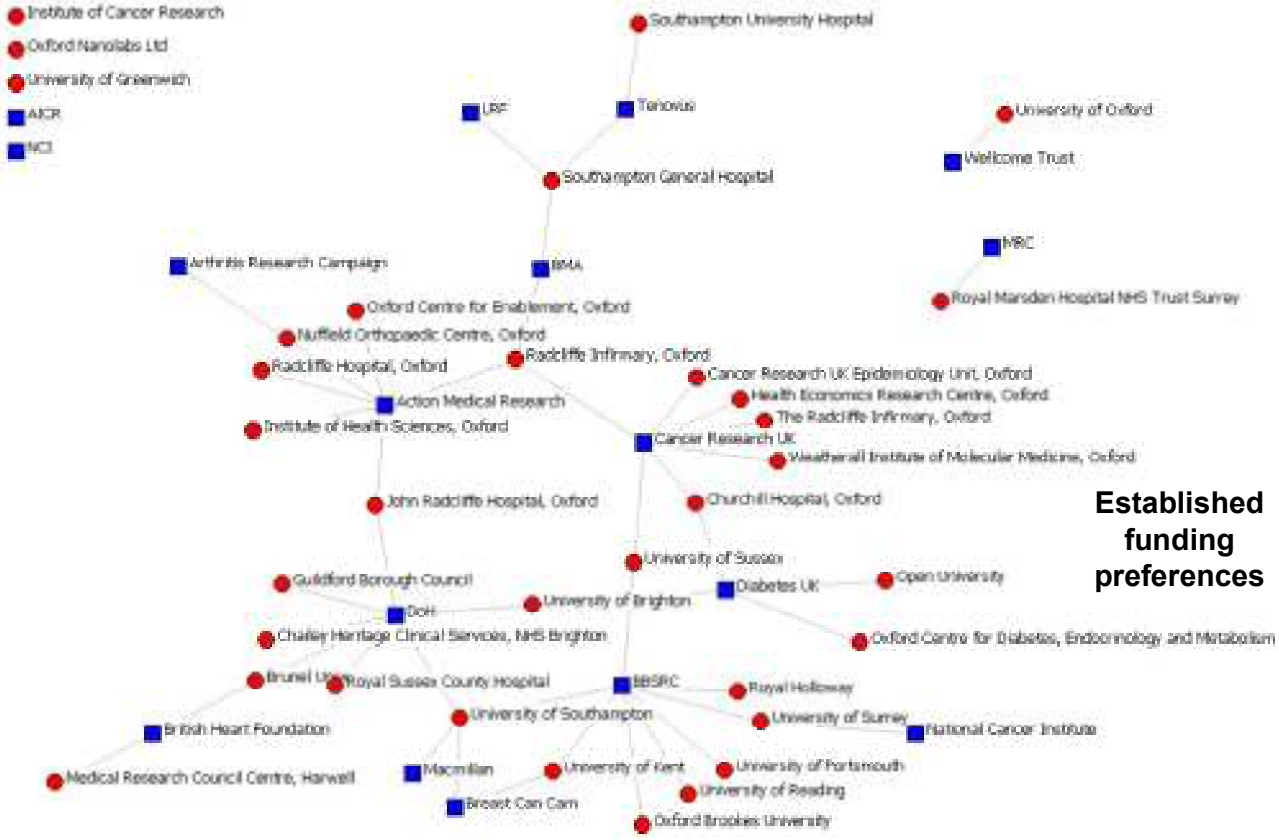


Map 29. Links Between Collaborative Partners & Location - *absolute value*[*]

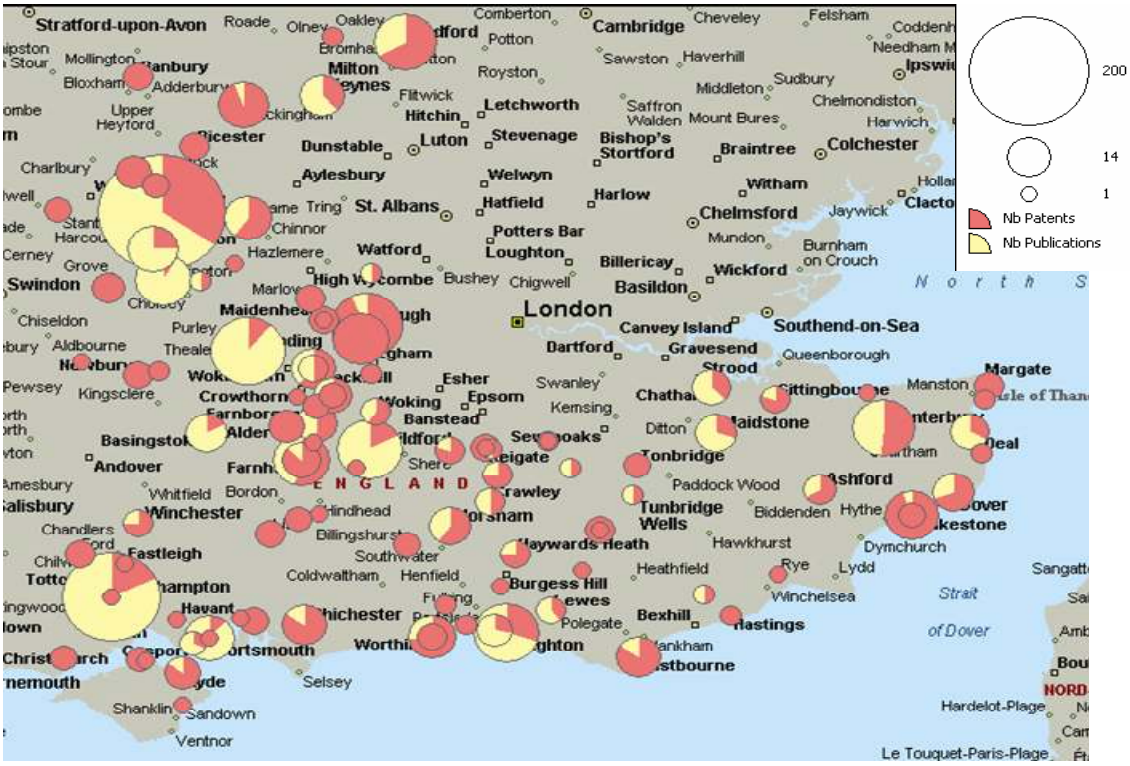


[*] DOTS represent individual institutions collaborating on funded research projects; TIES represent collaboration between institutions; Red dots – institutions located in the SE region; blue dots –institutions located in the UK; yellow dots – institutions located in London; green dot – institutions located worldwide*)*

Map 30. Ties Between Funding Bodies and Centres of Excellence[*] *(normalised value)*



Map 31. Number of Patents and Publications by Location



[*] BLUE squares represent funding bodies; RED dots represent Centres of Excellence – recipients of funding; TIES represent significant relationships between awarding bodies and recipients of grants based on awarded research grants; isolates represent actors that have relationships with most other – without preference.