

# Research Excellence in key industrial sectors in the South East of England

Universities strengthening investment in industrial competitiveness

## Contents

1	Executive Summary	3
2	Introduction	6
3	Priority sectors in the South East of England	7
4	Research excellence – Overview	9
5	Research excellence – analysis by sector	13
	Advanced Engineering and Marine	13
	Aerospace and Defence	19
	Environment and Energy	25
	Financial and Professional Services	32
	ICT, Software and Digital Media	38
	Pharmaceuticals, Life Sciences and Health	45
6	Observations	52
A	Annex A – RAE 2008 Units of Assessment (UOAs) by priority sector	55

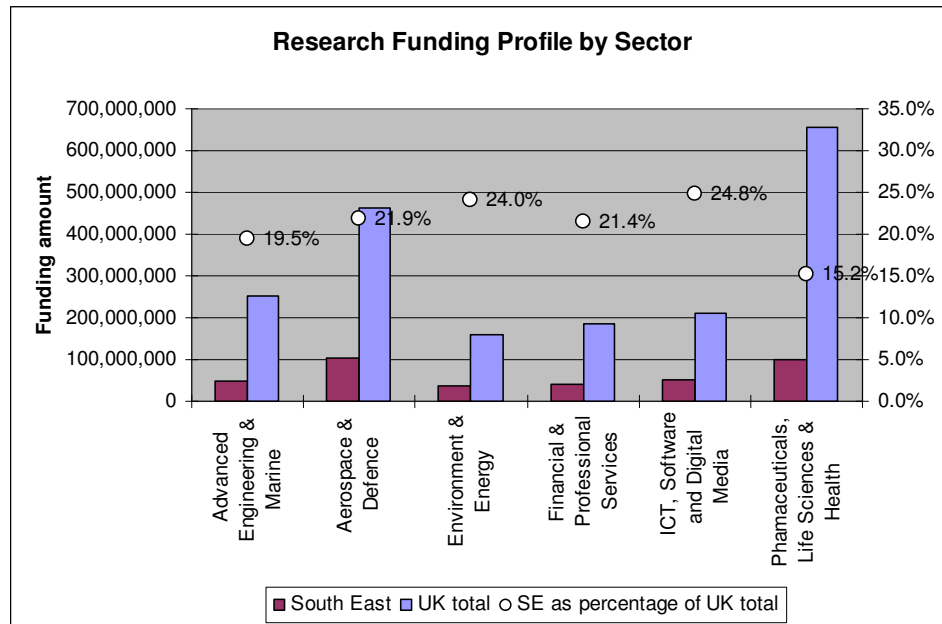
Author: Arno Schmickler | South East England Development Agency, Guildford

## 1 Executive Summary

- 1.1 To map research excellence of South East universities against the six priority sectors data from the Research Assessment Exercise 2008 (RAE 2008) has been analysed alongside invited submissions from universities setting out their research strengths in relation to the key sectors.
- 1.2 The report provides an overview of funding, critical mass and international excellence of research across the six priority sectors. A more detailed analysis by sector using the same categories is also provided to:
- Identify areas of relative strengths;
  - Understand funding position by sector;
  - Examine critical mass by sector;
  - Assess international research excellence by sector; and
  - Establish comparative UK/South East position by sector.

### RESEARCH FUNDING

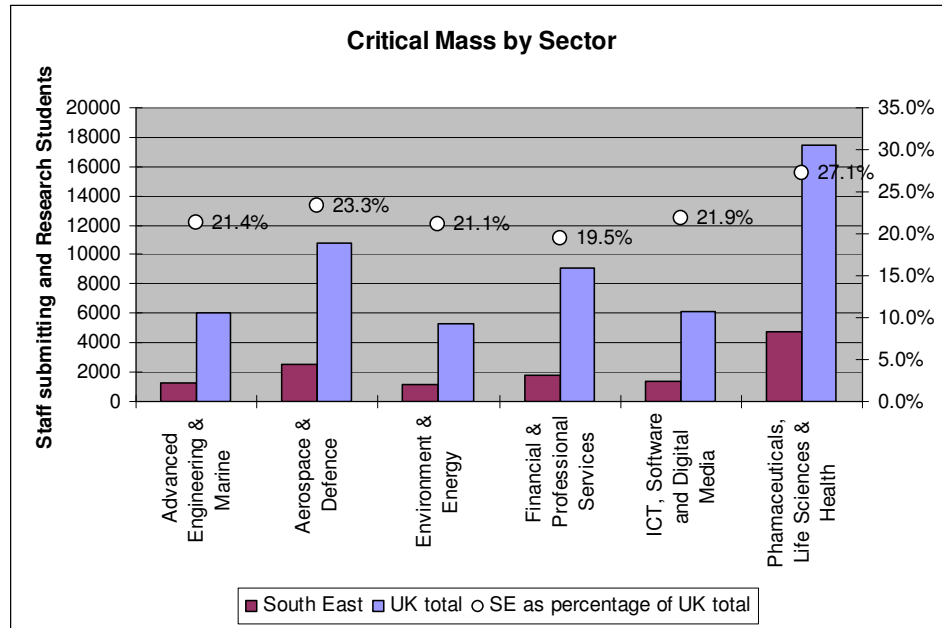
- 1.1 Some £290m funding from public and private sector sources (Research Council, UK industry and HEFCE) is awarded to South East universities for research relevant to the six priority sectors. The highest amount of funding is available for aerospace and defence (£102m) closely followed by pharmaceuticals, life sciences & health (£99m). With almost a quarter of the total (24.8%) ICT, software and digital media have the highest share of UK research funding coming into South East universities, followed by 24% in the environment and energy sector. The lowest percentage share of funding can be observed for pharmaceuticals, life sciences & health (15.2% of UK total).



### CRITICAL MASS

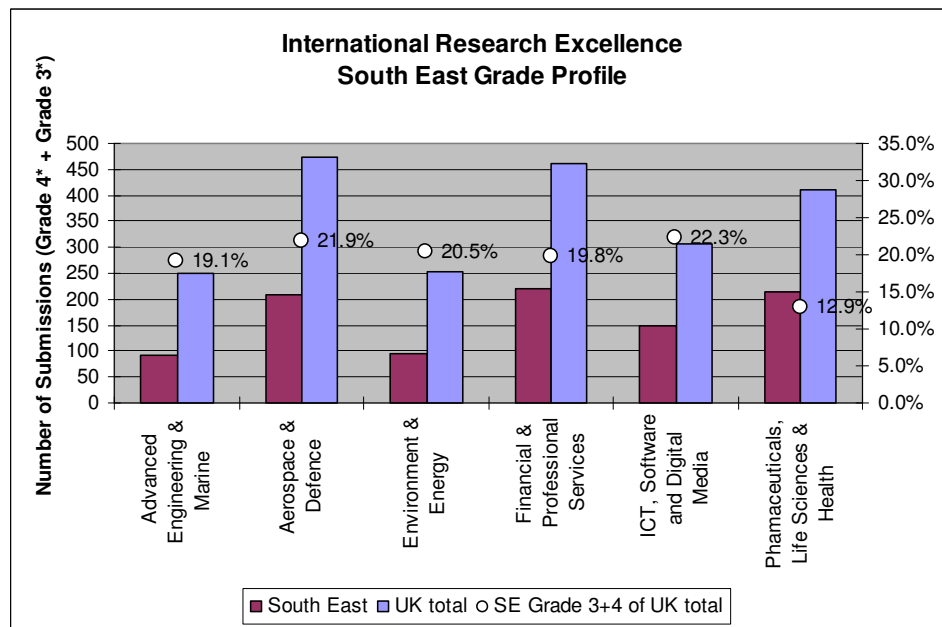
- 1.2 A similar picture emerges for critical mass in each of the six priority sectors with the South East Universities' staff submission and number of research students ranging between 19.5-27.1% of the UK total. The lowest critical mass can be observed in Financial and Professional Services (19.5% of the UK total). With some 27% of the UK total the critical mass of staff submitting and research students in topics related to

the pharmaceuticals, life science and health sector a significantly higher than average critical mass can be identified despite the below average funding.



**INTERNATIONAL RESEARCH EXCELLENCE**

1.3 Based on three overarching components of the RAE submissions – research outputs, research environment and indicators of esteem – the RAE assessment panels provided a graded profile for each Unit of Assessment (UOA) by university. The two highest grades signify ‘world-leading research’ (grade 4\*) and ‘internationally excellent research’ (grade 3\*) and are therefore used in this analysis as an indicator of the international research excellence of South East universities in each of the six priority sectors.



1.4 The highest percentage of international research excellence is achieved in ICT, Software and Digital Media (22.3% of UK total), closely followed by Aerospace and Defence (21.9%). Environment and Energy (20.5%), Financial and Professional

Services (19.8%) and Advanced Engineering and Marine (19.1%) also have strong grading profiles. With 12.9% the international research excellence in pharmaceuticals, life sciences and healthcare is lower than expected with the critical mass and number of South East HEIs with RAE submissions in this sector.

**ANALYSIS BY SECTOR**

- 1.5 For each of the six priority sector a detailed analysis is provided covering:
- List of South East HEIs submitted returns
  - Funding profile (OST/RC, UK industry and Quality Research from Hefce)
  - Critical mass profile
  - Grade profile
  - Comparison to national grade-point average
  - List of individual universities' strengths and specialised facilities (supported by detailed sector research mapping tables in annex)

**SECTOR SPECIFIC OBSERVATIONS**

**Advanced Engineering and Marine**

- Particular strengths in Mechanical, Aeronautical and Manufacturing Engineering (UOA28)
- Balanced funding profile: £18.5m OST/RC + £9.1m UK industry + £21.8m QR
- Strong dominance of University of Oxford and University of Southampton (international research excellence)

**Aerospace and Defence**

- Highest funding amount in absolute terms
- Highest UK industry funding in absolute terms
- Consistently high grade profile

**Environmental and Energy Technologies**

- Lowest absolute amount of funding; but
- One third of total UK industry funding to South East HEIs; and
- One quarter of UK total OST/RC funding

**Financial and Professional Services**

- High dependency on QR funding
- Very low private sector funding (UK and SE)

**ICT, Software and Digital Media**

- Strong public sector funding
- Low level of industry funding (absolute and relative)

**Pharmaceuticals, Life Sciences & Healthcare**

- Lowest relative funding profile (15.2% of UK total)
- High absolute funding amount (£99m)
- High relative critical mass (27.1% of UK total)
- Low international excellence (12.9% of UK total)

**Other areas of strengths**

- South East HEIs particularly strong in mathematics and computing (statistics & operational research and applied mathematics) – fundamental to many industry sectors.
- Significant strengths across South East HEIs in languages, cultural and area studies – relevant for doing international business.

## 2 Introduction

- 2.1 This paper takes forward a report on “*The Role of Universities in Raising the UK’s Business Competitiveness – South East England*”, compiled by SEEDA in March 2010 in collaboration with Higher Education South East (HESE) and the South East’s universities. It complements SEEDA’s economic research papers on key industry sectors in the South East by setting out research excellence of South East higher education institutions (HEIs) in relation to these sectors.
- 2.2 Commercialisation of science and research – embedded in a supportive innovation environment with a strong university-industry-government partnership – is an essential driver of economic growth based on the exploitation of international knowledge advantage. Understanding the current and emerging global assets of the South East’s research and industry base is essential for the region’s competitiveness. Analysing the region’s research and business excellence in partnership with industry, benchmarked internationally, is vital to translate the South East’s core strengths into economic benefits.
- 2.3 To enhance the South East’s ability to attract high value investment, both from indigenous as well as international businesses, SEEDA initiated collaborative work with HESE and South East universities to **map out research excellence of higher education institutions in priority sectors**.
- 2.4 This research excellence mapping against clusters/industrial strengths is intended to inform **an integrated offer for overseas promotion and attracting Foreign Direct Investment (FDI)** – including cross-regional networks to strengthen UK proposition in global market – as well as to **support universities in positioning their offer vis-à-vis industry**.
- 2.5 Bringing this analysis of research strengths together with UK Trade and Investment (UKTI) and SEEDA inward investment expertise will allow **high quality industry sector value propositions** to be developed detailing the benefits and value of South East assets including the region’s research capabilities, business critical infrastructure, skills and existing industry base and cluster strengths.
- 2.6 Due to the UK government’s decision in 2010 to close Regional Development Agencies in England, SEEDA is implementing a professional closure. The safeguarding of research and knowledge assets is an essential element of the agency’s closure. This report on the research excellence of South East universities will form an integral part of the transfer of knowledge to successor bodies and Government. The detailed submissions from South East universities collated by SEEDA to inform this report will be deposited with Higher Education South East (HESE), Higher Education Funding Council for England (hefce) and UK Trade & Investment.

### 3 Priority sectors in the South East of England

3.1 SEEDA identified a group of six traded industries<sup>1</sup>, which it has designated as priority sectors:

- Advanced Engineering and Marine;
- Aerospace and Defence;
- Environment and Energy;
- Financial and Professional Services;
- ICT, Software and Digital Media; and
- Pharmaceuticals, Life Sciences and Health.

3.2 In 2007 the six priority sectors contributed £65.9 billion to the South East economy or **42% of total regional Gross Value Added (GVA)**. Over the decade 1997-2007, total GVA in the six priority sectors in the South East expanded by around 4.7% per year (regional average 4%). Output in the six priority sectors in the South East, taken together, is expected to contract at a faster rate than the regional average in 2009 (-6.5%), although over the decade 2010-2020, GVA in these sectors is expected to expand at a faster rate than the regional average (3.3% per year, compared to 2.7%).

3.3 According to the Office for National Statistics (ONS) data there are 128,000 businesses in the South East in the six priority sectors – 18% of the UK total for these sectors. Aerospace and Defence and ICT, Software and Digital Media have the highest share of the UK market. Within the South East, the Financial and Professional Services sector accounts for almost half of the region's businesses within the priority sectors, while ICT, Software and Digital Media accounts for around one third.

3.4 In 2007 there were 1.53 million people employed in the six priority sectors in the South East, or **35% of total regional employment**. Over the decade 1997-2007, total employment in the six priority sectors in the region expanded by around 0.7% per year – below the South East average of 1.1% per year. Employment in the priority sectors, taken together, is expected to contract at a faster rate than the regional average in 2009 (-2.1%), but over the decade 2010-2020, employment in these sectors is expected to expand at a slightly faster rate than the regional average (0.9% per year compared to 0.8%).

3.5 Spatial concentration of priority sectors:

- The concentration of both businesses and employment in the **Advanced Engineering and Marine** sector in the South East is similar to the national average. The greatest concentration of businesses in the Advanced Engineering and Marine sector is in Hampshire and Adur in West Sussex, with significant concentrations of businesses and employment also in Oxfordshire, the Thames Valley and Kent.

---

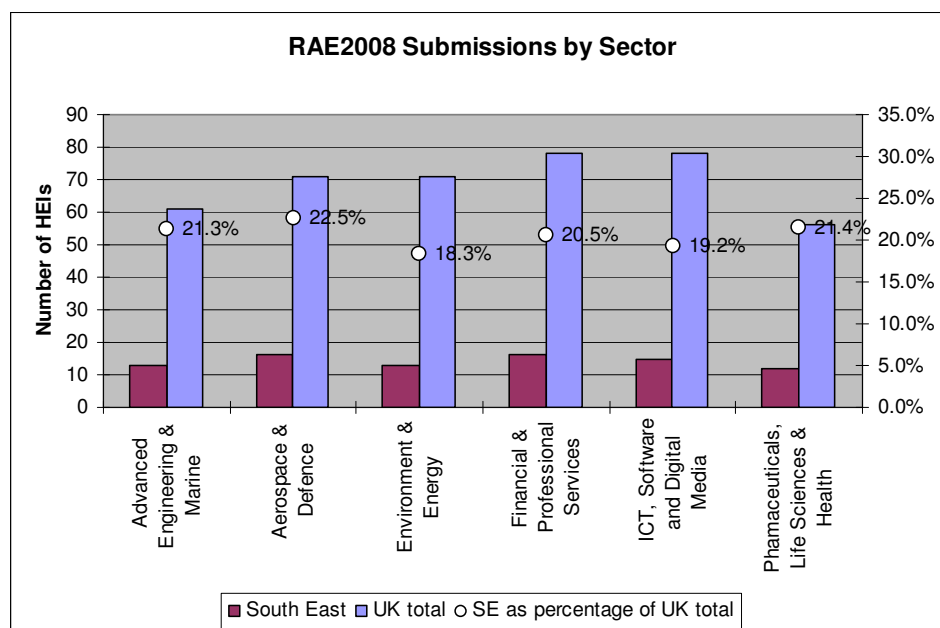
<sup>1</sup> According to M. Porter there are three broad types of industries – local industries, resource dependent industries and traded industries – each of which has a distinctive spatial pattern. Traded industries are those that sell their products and services across regions and often to other countries. They tend to be spatially concentrated, reflecting the location of specialist demand, skilled labour, technological infrastructure, supply chains and other competitive factors.

- The concentration of **Aerospace and Defence** businesses in the South East is around 30% above the national average, while the concentration of employment in this sector is around 20% above the national average. A high concentration of businesses in the Aerospace and Defence sector is found in West Sussex (notably Crawley), Hampshire (notably Rushmoor), parts of Surrey, and Shepway in Kent. Employment in this sector is heavily concentrated in Crawley, large parts of Hampshire, West Berkshire and South Buckinghamshire.
- The concentration of **Environment and Energy** businesses and employment in the South East is 20% and 10% below the national average, respectively. Sub-regionally, there is a concentration of businesses in this sector in parts of Kent, the Inner South East (eg. West Oxfordshire and Slough) and areas along the coast (such as Lewes, the Isle of Wight and Portsmouth). The highest concentration of employment in the Environment and Energy sector is in eastern parts of Kent, parts of Hampshire, parts of the Thames Valley and Brighton and Hove.
- The concentration of businesses in the **Financial and Professional Services** sector in the South East is above the national average, but the concentration of employment is in line with the UK average. Financial and Professional Services businesses are most heavily concentrated in Surrey and neighbouring areas in Buckinghamshire and the Thames Valley. The highest concentration of employment in financial and professional services is in Surrey and a number of large urban areas, including Southampton, Reading and Brighton & Hove.
- The concentration of **ICT, Software and Digital Media** businesses in the South East is 25% above the national average, while the concentration of employment is 40% greater than the national average. Businesses and employment in the ICT sector are most heavily concentrated in the Thames Valley, with significant concentrations also in Milton Keynes and Brighton & Hove, and smaller concentrations in parts of Hampshire (Basingstoke and Hart principally).
- The concentration of both businesses and employment in **Pharmaceuticals, Life Sciences and Health** is similar to the national average. Within the region, the greatest concentration of businesses in this sector is along the coast of Kent and Sussex, with a significant concentration in Oxford also. The highest concentration of employment in the Pharmaceuticals, Life Sciences and Health sector is in parts of Surrey, Sussex and in Oxford.



## 4 Research excellence – Overview

- 4.1 To map research excellence of South East universities against the six priority sectors data from the Research Assessment Exercise 2008 (RAE 2008)<sup>2</sup> has been analysed alongside invited submissions from universities setting out their research strengths in relation to the key sectors.
- 4.2 The 2008 Research Assessment Exercise (RAE2008) was a UK-wide exercise to assess the quality of research conducted in publicly funded higher education institutions in England, Scotland, Wales and Northern Ireland. A total of 159 universities were assessed, including 18 South East Universities<sup>3</sup>.
- 4.3 For each of the six priority sectors the most relevant Units of Assessment (UOAs) as introduced in the RAE 2008 have been grouped to analyse the South East research strengths in comparison to the national average. A number of UOAs are important for more than one sector and have therefore been included in each relevant sector. A detailed breakdown of UOAs by priority sectors is provided in Annex A.
- 4.4 For this overview the RAE 2008 data has been used to assess funding, critical mass and international excellence of research. A more detailed analysis by sector is provided in the following chapter.
- 4.5 To compare the South East universities' position to the UK the following table illustrates the number of submissions in UOAs by sector, expressed as South East total and UK total as well as South East as percentage of UK total. This baseline comparison is useful to assess the overall competitive position of South East universities in the UK context by sector.

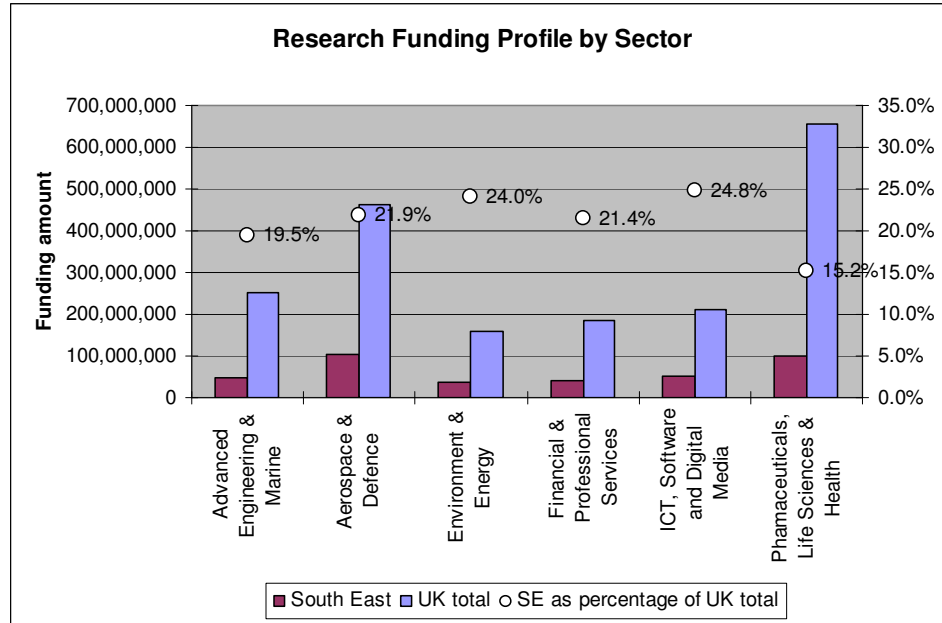


<sup>2</sup> <http://www.rae.ac.uk/>

<sup>3</sup> Brighton, Buckinghamshire New, Canterbury, Chichester, UCA, Kent, OU, Oxford, Oxford Brookes, Portsmouth, Reading, Royal Holloway - University of London, Southampton, Southampton Solent, Surrey, Sussex, Thames Valley, Winchester.

**RESEARCH FUNDING**

**4.6** Some £290m funding from public and private sector sources (Research Council, UK industry and HEFCE) is awarded to South East universities for research relevant to the six priority sectors.<sup>4</sup> The highest amount of funding is available for aerospace and defence (£102m) closely followed by pharmaceuticals, life sciences & health (£99m). With almost a quarter of the total (24.8%), ICT, software and digital media have the highest share of UK research funding coming into South East universities, followed by 24% in the environment and energy sector. The lowest percentage share of funding can be observed for pharmaceuticals, life sciences & health (15.2% of UK total). A more detailed analysis of the funding sources is provided in the following chapter.

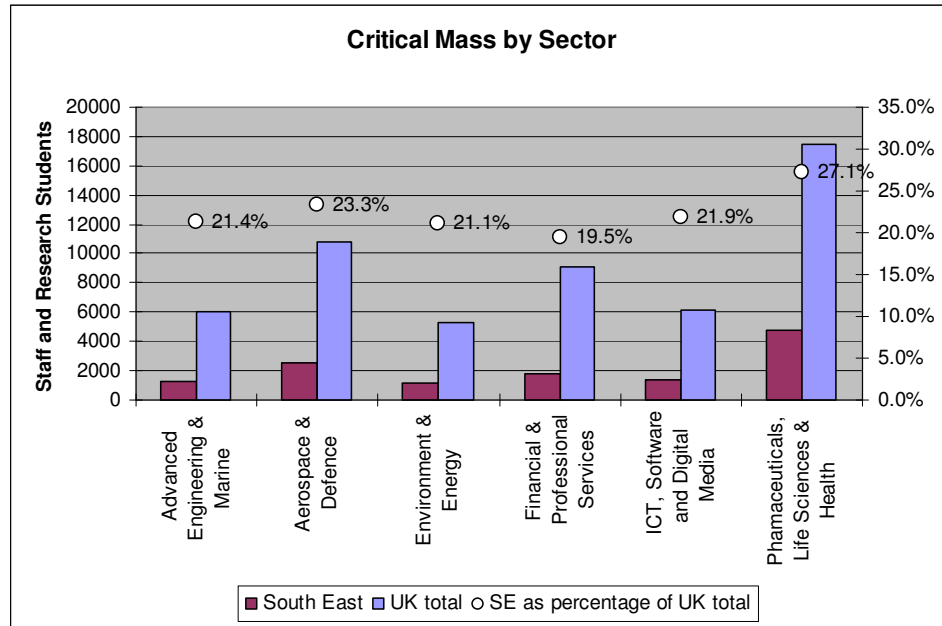


**CRITICAL MASS**

**4.7** A similar picture emerges for critical mass in each of the six priority sectors with the South East universities’ staff and number of research students included in the submissions ranging between 19.5-27.1% of the UK total. The lowest critical mass can be observed in Financial and Professional Services (19.5% of the UK total). With some 27% of the UK total the critical mass of staff and research students working on topics related to the pharmaceuticals, life sciences and health sector a significantly higher than average critical mass can be identified despite the below average funding (see paragraph 3.6).

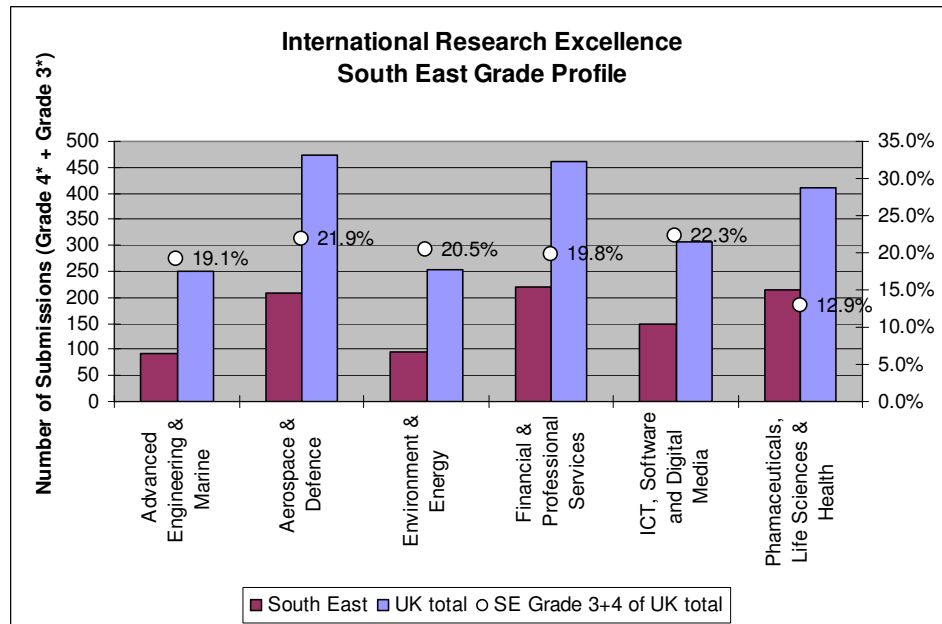
**4.8** In absolute figures critical mass of research submissions from South East universities ranges for the majority of key sectors between 1117 and 1775 individuals. Higher submission numbers can be observed in aerospace and defence (2509 individuals) and the pharmaceuticals, life sciences and health sector (4735 individuals). A more detailed analysis of critical mass by sector is provided in the following chapter.

<sup>4</sup> Some UOAs are relevant to more than one priority sector which has been factored in when calculating the total amount of funding received in South East universities.



**INTERNATIONAL RESEARCH EXCELLENCE**

4.9 Based on three overarching components of the RAE submissions – research outputs, research environment and indicators of esteem – the RAE assessment panels provided a graded profile for each UOA by HEI.<sup>5</sup> The two highest grades signify ‘world-leading research’ (grade 4\*)<sup>6</sup> and ‘internationally excellent research’ (grade 3\*)<sup>7</sup> and are therefore used in this analysis as an indicator of the international research excellence of South East universities in each of the six priority sectors.



<sup>5</sup> Details of the assessment method can be accessed at: [www.rae.co.uk](http://www.rae.co.uk)

<sup>6</sup> Definition: Quality that is world-leading in terms of originality, significance and rigour.

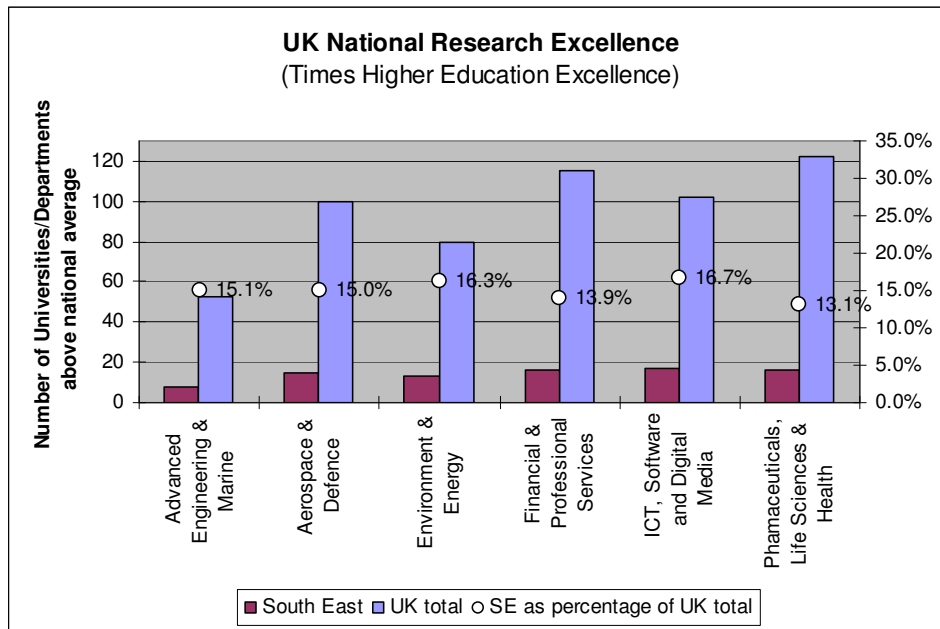
<sup>7</sup> Definition: Quality that is internationally excellent in terms of originality, significance and rigour but which nonetheless falls short of the highest standards of excellence.

4.10 The highest percentage of international research excellence is achieved in ICT, Software and Digital Media (22.3% of UK total), closely followed by Aerospace and Defence (21.9%). Environment and Energy (20.5%), Financial and Professional Services (19.8%) and Advanced Engineering and Marine (19.1%) also have strong grading profiles. With 12.9% the international research excellence in pharmaceuticals, life sciences and health is lower than expected with the critical mass (see paragraph 3.7/3.8) and number of South East HEIs with RAE submissions in this sector (see paragraph 3.5). A more detailed analysis of the grade profiles by sector is provided in the following chapter.

**UK NATIONAL COMPARISON**

4.11 Based on RAE 2008 data Times Higher<sup>8</sup> provided a comparative table setting out for each UOA subject rating the national grade-point average and the relative scoring of individual HEIs. This information is used here to provide a relative assessment of the South East universities' performance in each of the six priority sectors in comparison to their UK peer group.<sup>9</sup>

4.12 Within the national comparison of research excellence a more equal picture across all six priority sectors can be observed. Whilst the research excellence in pharmaceuticals, life sciences and health is still the lowest in comparison the difference is less marked than in the international research excellence analysis (see paragraph 3.10). A more detailed analysis of the UK national research excellence by sector is provided in the following chapter.



<sup>8</sup> [http://www.timeshighereducation.co.uk/Journals/THE/THE/18\\_December\\_2008/attachments/RAE\\_2008\\_THE\\_RESULTS.pdf](http://www.timeshighereducation.co.uk/Journals/THE/THE/18_December_2008/attachments/RAE_2008_THE_RESULTS.pdf)

<sup>9</sup> If a university/department performs above national average in more than one UOA within the sector it is counted each time. The same principle has been applied to the total number of UK HEIs assessed above national grade-point average to allow for comparison.

## 5 Research excellence – analysis by sector

### Advanced Engineering and Marine

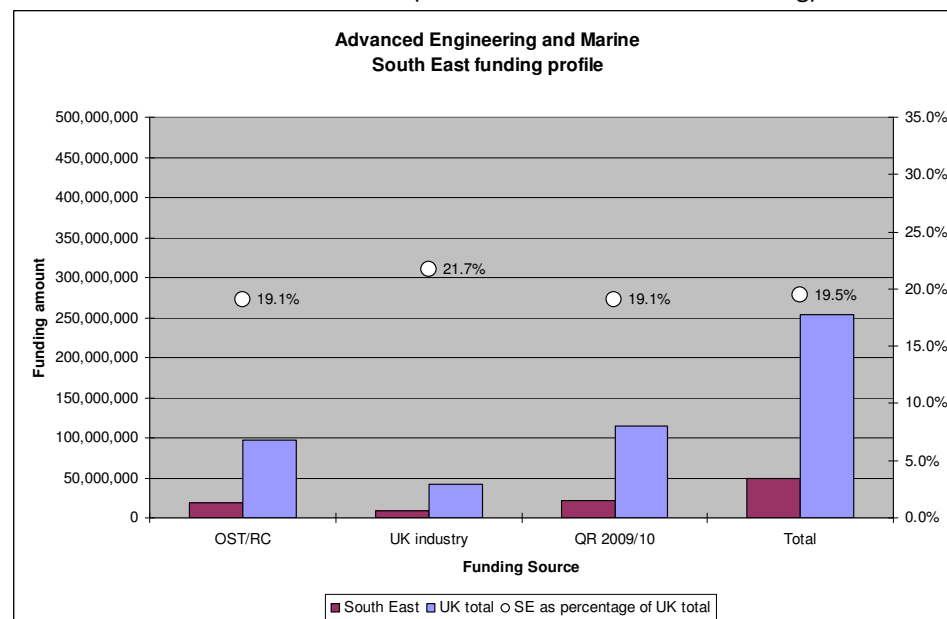
5.1 To assess research excellence in the advanced engineering and marine sector the following UOAs (RAE 2008) have been used:

- 25 General Engineering and Mineral & Mining Engineering
- 26 Chemical Engineering
- 27 Civil Engineering
- 28 Mechanical, Aeronautical and Manufacturing Engineering
- 29 Metallurgy and Materials

5.2 The following 13 South East universities submitted returns against these UOAs:

- University of Brighton
- Cranfield University
- University of Greenwich
- University of Kent
- Kingston University
- Open University
- University of Oxford
- Oxford Brookes University
- University of Portsmouth
- University of Southampton
- Southampton Solent University
- University of Surrey
- University of Sussex

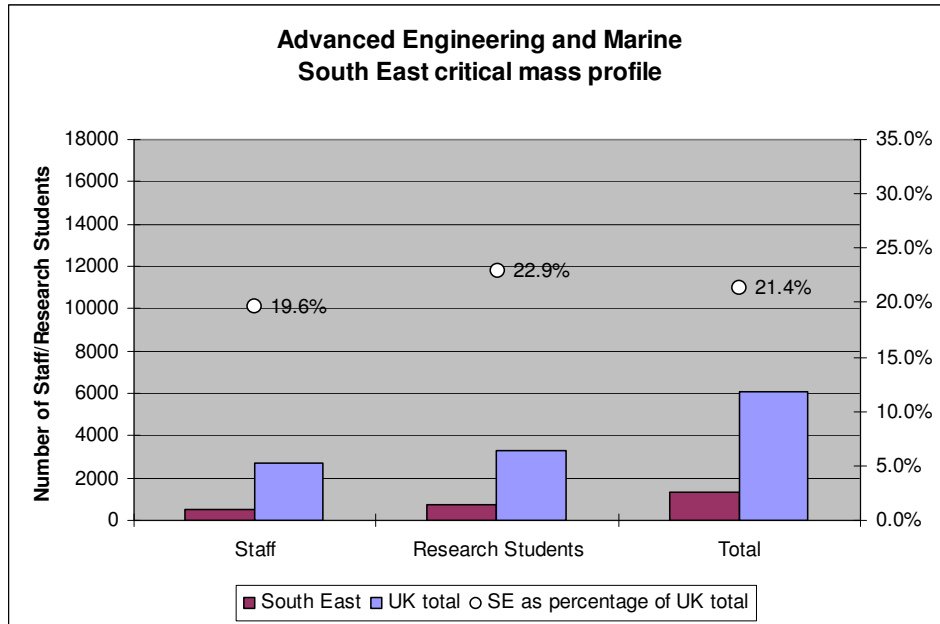
5.3 £21.8 QR funding (some 19% of the UK total QR) was awarded to South East universities in 2009/10, complemented by a yearly average £9.1m UK industry funding<sup>10</sup> and £18.5m yearly average OST/RC<sup>11</sup> funding, adding up to a total research investment of **£49.5m** in this sector (19.5% of UK total research funding).



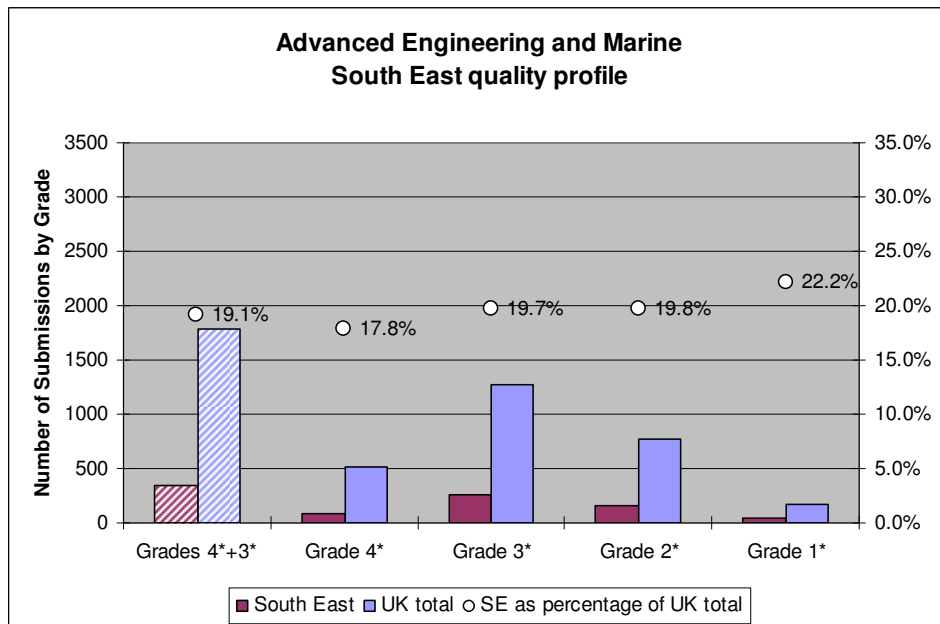
<sup>10</sup> The average yearly UK industry funding is based on actual UK industry funding to the listed universities in each UOA between 2000 and 2007.

<sup>11</sup> OST: Office of Science and Technology; RC: Research Councils; average based on actual 2000-2007.

5.4 Almost 1300 academic staff and research students from the South East were included in submissions relevant to the advanced engineering and marine sector. This compares to a total of just over 6000 academics and research students included in submissions UK-wide.



5.5 19.1% (342 submissions<sup>12</sup>) of the total UK research in the advance engineering and marine sector graded as world-leading (grade 4\*) or internationally excellent (grade 3\*) comes from South East universities. The highest number of grade 4\*/3\* submissions comes from the University of Oxford (30/71), closely followed by the University of Southampton (28/76). Other South East universities with international research excellence in this sector are Cranfield (19/43) and Surrey (7/27).



<sup>12</sup> The universities' whole submission to a particular UOA was given an overall 'quality profile' comprising percentages of grade 4\*, 3\*, 2\* and 1\*. For the purpose of this report these percentages were applied to the number of individuals' research contributions included in the universities' overall submission to the RAE to arrive at the number of submissions by grade (proxy measure).

- 5.6 Within the sector especial strengths of South East universities are in Mechanical, Aeronautical and Manufacturing Engineering (UOA28) as well as General Engineering and Mineral & Mining Engineering (UOA25).
- 5.7 Comparing South East universities to the national grade-point average in disciplines relevant to the advanced engineering and marine sector the following institutions were assessed above national average:

UOA No.	Subject	National average	South East universities above national average
25	General Engineering and Mineral & Mining Engineering	2.66	University of Oxford (3.10) University of Surrey (2.90)
26	Chemical Engineering	2.86	Nil
27	Civil Engineering	2.82	University of Southampton (3.05)
28	Mechanical, Aeronautical and Manufacturing Engineering	2.70	University of Greenwich (2.95) University of Southampton (2.70) University of Brighton (2.70)
29	Metallurgy and Materials	2.69	University of Kent (3.05) University of Oxford (3.00)

- 5.8 Within the South East there are areas of particular research excellence and specialised facilities at the following HEIs<sup>13</sup>:-

5.8.1 University of Brighton

- Centre for Automotive Research, an internationally recognised centre of excellence focused on the application of complementary experimental and modelling skills to IC engine combustion processes. In particular, laser diagnostic and modelling techniques are developed and used to improve the efficiency and reduce the pollution associated with the internal combustion engine (ICE).
- Sir Harry Ricardo Laboratories – facilities for ICE research + research group with strong industrial links. The group’s expertise is being applied to other areas of ‘clean’ and sustainable energy. This includes waste heat and kinetic energy recovery, alternative fuels, and life cycle analysis.

5.8.2 University of Greenwich

- Contaminated Land Remediation & Waste Management Group
- Centre for Numerical Modeling & Process Analysis
- Civil Engineering
- Computational Mechanics & Reliability Group
- Computational Science & Engineering Group
- Electronics Manufacturing Engineering Group
- Fire Safety Engineering Group
- Infrastructure Management Research Group
- Innovative Product Development Research Group
- Internet Security Research Laboratory
- Mobile & Wireless Communications Engineering
- Wolfson Centre for Bulk Solids Handling Technology

5.8.3 University of Kent

- Functional Materials Group

---

<sup>13</sup> This list is not exclusive and is based on submissions received from universities.

- Nanobiotechnology Group
- SEPnet (South East Physics Network) research themes: Condensed Matter and Astrophysics
- Durrell Institute of Conservation and Ecology: Balanced Seas project
- Specialised equipment including: X-ray diffractometers, X-ray fluorescence spectrometer, two DSCs, TGA, nitrogen adsorption, SEM, two SEC/GPC systems, multi-nucleus solution-state NMR, a particle sizer, Raman, FT-IR and polarising optical microscopes, ATR, UV-vis, ovens/furnaces up to 1800°C, substantial computing facilities, a 200kN temperature controlled (300°C) sample press, a Nano-Zetasizer and various centrifuges. Within the wider science faculty at Kent FMG/NBT have access to TEM (including cryo-TEM), AFM, and MALDI-TOF. The successful development and exploitation of national/international synchrotron X-ray and neutron scattering facilities adds world-class strengths to this portfolio.

#### 5.8.4 Open University

- Department of Physics and Astronomy
  - Science and applications of the ionized gases ('Technological Plasmas')
  - Plasma Physics - Collision Physics, Damage of DNA by UV light & low energy electrons, Biomolecular Clusters, Electron interactions with molecules
- Structural Integrity Research Group
  - Measurement of materials properties, materials modelling, fatigue and fracture, forensic engineering, stress analysis & residual stress measurement
  - World-leading in the application of neutron and synchrotron X-ray diffraction for the determination of internal residual stresses
  - State-of-the-art laboratory X-ray diffraction, incremental hole drilling, nano-indentation, servo-hydraulic and high temperature mechanical testing, and optical and electron microscopy facilities
  - Materials characterization, particularly the high-temperature behaviour of materials such as creep, micro-structural evolution and the effects of welding and weld residual stresses at elevated temperatures

#### 5.8.5 University of Oxford

- Engineering
  - Information, Control and Vision engineering
  - Turbomachinery
  - Micro-Fluid-Dynamics and Nano-Particle Flows
  - Electrical and Opto-electronic engineering
  - Chemical and Process engineering
  - Heat Exchangers
  - Instrumentation Use and Development
  - Continuous SPLITT Fractionation
  - Structural Integrity
  - Materials Modelling
  - Ocean and Coastal Engineering and Water Resources
  - Civil engineering
  - Pattern analysis
  - Machine learning
  - Mobile robotics
  - Control group
  - Active vision
  - Visual geometry
  - Communications



- Oxford Plasma Physics and Pulsed Power
- Liquid Crystal and Ordered Molecular Systems
- Microelectronic Circuits and Analogue Devices
- Optical Communications
- Scanning Optical Microscopy
- Cryogenic Engineering
- Systems Engineering
- Earth Sciences
  - Marine geophysics
  - Physical Oceanography
  - Ocean Biogeochemistry
  - Stratigraphy and sedimentology
- Begbroke Science Park
- Materials
  - High temperature superconductivity
  - Micromechanics
  - Photonic nanomaterials
  - Semiconductors
- Mathematics
  - Mathematical Geoscience
  - Fluid mechanics and materials

#### 5.8.6 University of Portsmouth

- Rapid Prototyping Lab
- Digital Material Stress Analysis Modelling
- Advanced Polymers and Composites Laboratory
- Institute of Industrial Research
- Training courses for employees of businesses in Marine and Aerospace industries (e.g. 'Advanced Polymers and Composites' and 'Non-Destructive Testing'), financed by the European Social Fund (ESF)

#### 5.8.7 University of Southampton

- Maritime Strategic Research Group
- Fluid Structure Interactions Research Group
- The Wolfson Unit for Marine Technology and Industrial Aerodynamics
- Transportation Research Group
- Institute of Maritime Law
- Lloyd's Register University Technology Centre (LR UTC)
- Royal National Lifeboat Institution Advanced Technology Partnership on Maritime Engineering and Safety (RNLI ATP)
- Ministry of Defence/Lloyd's Register Centre of Excellence for Marine Structures
- ECS (School of Electronics and Computer Science) and the Mountbatten Research Centre
- Southampton Nanofabrication Centre
- Optoelectronics Research Centre (ORC)
- Electronic Systems and Devices Group (ECS)
- Communications Research Group (ECS)
- Electrical Power Engineering Research Group (ECS)
- Institute of Sound and Vibration Research (ISVR)
- nCATS – National Centre of Advanced Tribology at Southampton
- National Crystallography Service

5.8.8 University of Surrey

- University wide research network on nano-technology & materials
- Advanced Materials Devices and Nanotechnology (Faculty of Engineering and Physical Sciences)
  - Advanced Technology Institute
  - Surrey Materials Institute
- Materials and Nanoscience (Faculty of Health and Medical Sciences)
- Nuclear and Radiation Physics (Faculty of Engineering and Physical Sciences)
  - Centre for Nuclear and Radiation Physics
  - Nuclear Physics Group
  - Radiation and Medical Physics Group

5.8.9 University of Sussex

- Mechanical Engineering Group
- Electrical and Electronic Engineering Group

**Aerospace and Defence**

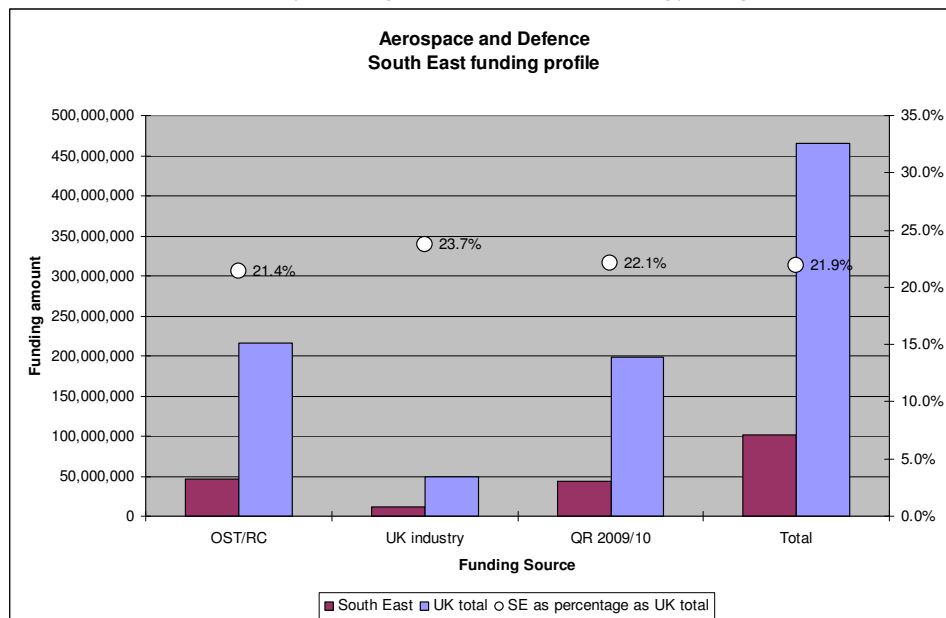
5.9 To assess research excellence in the aerospace and defence sector the following UOAs (RAE 2008) have been used:

- 19 Physics
- 23 Computer Science & Informatics
- 24 Electrical & Electronic Engineering
- 25 General Engineering and Mineral & Mining Engineering
- 28 Mechanical, Aeronautical and Manufacturing Engineering

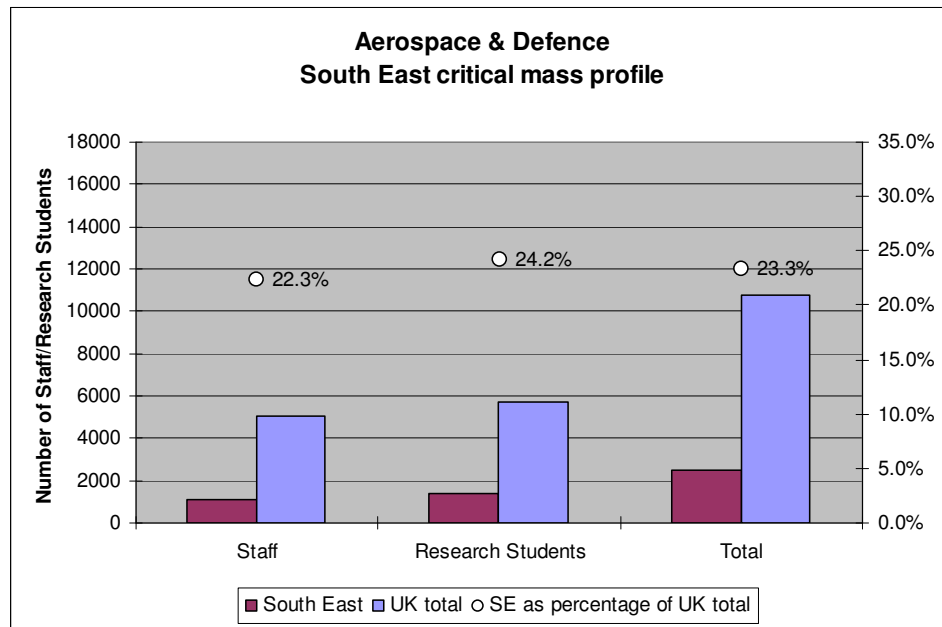
5.10 The following 16 South East universities submitted returns against these UOAs:

- University of Brighton
- Cranfield University
- University of Greenwich
- University of Kent
- Kingston University
- Open University
- University of Oxford
- Oxford Brookes University
- University of Portsmouth
- University of Reading
- Royal Holloway, University of London
- University of Southampton
- Southampton Solent University
- University of Surrey
- University of Sussex
- Thames Valley University

5.11 The **£102m** funding for aerospace and defence related research is broken down into £44m QR funding (22.1 % of the UK total QR), £46m yearly average OST/RC (21.4% of UK total) and £11.8m yearly average UK industry funding (23.7% of UK total). In absolute terms the UK industry funding attracted to South East universities in this sector is the highest of all six priority sectors and the second highest as a percentage of the UK total UK industry funding (environment and energy is higher at 33.5%).

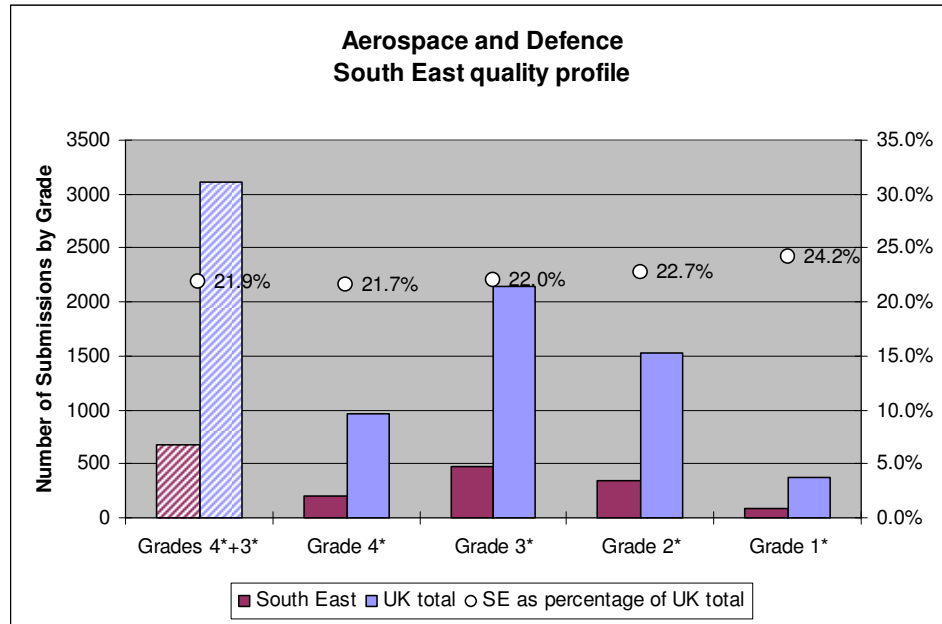


5.12 With some 2500 academic staff and research students South East universities have a significant body of research in relation to aerospace and defence (23.3% of UK total). This is the second highest critical mass profile of South East universities in the six priority sectors, both in absolute and relative terms.



5.13 South East universities account for 21.9% (681 submissions<sup>14</sup>) of grade 4\*/3\* research in aerospace and defence related disciplines. With 66/120 grade 4\*/3\* research submissions the University of Oxford has the highest number of internationally excellent research in the South East, followed by the University of Southampton (55/119), both demonstrating particular strengths in computer science & informatics (UOA 23). Other South East universities with significant international research excellence in this sector are Surrey (29/68), Cranfield (19/43) and Sussex (11/35).

<sup>14</sup> See footnote 13.



5.14 South East universities have very significant strengths in Computer Science & Informatics (UOA23). Particular strengths in relation to this sector also include Physics (UOA19), Mechanical, Aeronautical and Manufacturing Engineering (UOA28) and Electrical & Electronic Engineering (UOA24).

5.15 In comparing South East universities to the national grade-point average in disciplines relevant to the aerospace and defence sector the following institutions were assessed above national average:

UOA No.	Subject	National average	South East universities above national average
19	Physics	2.65	University of Oxford (2.65) University of Southampton (2.65)
23	Computer Science & Informatics	2.75	University of Southampton (3.20) University of Oxford (3.15) Open University (2.95) University of Sussex (2.85) Royal Holloway, University of London (2.80) University of Kent (2.75)
24	Electrical & Electronic Engineering	2.67	University of Surrey (2.95) University of Southampton (2.85)
25	General Engineering and Mineral & Mining Engineering	2.66	University of Oxford (3.10) University of Surrey (2.90)
28	Mechanical, Aeronautical and Manufacturing Engineering	2.70	University of Greenwich (2.95) University of Southampton (2.70) University of Brighton (2.70)

5.16 Within the South East there are areas of particular research excellence and specialised facilities at the following HEIs<sup>15</sup>:-

5.16.1 University of Kent

- Centre for Astrophysics and Planetary Science (CAPS)

5.16.2 University of Greenwich

- Centre for Computer and Computational Science
- Centre for Numerical Modeling & Process Analysis
- Computational Mechanics & Reliability Group
- Computational Science & Engineering Group
- Electronics Manufacturing Engineering Group
- Fire Safety Engineering Group
- Innovative Product Development Research Group
- Internet Security Research Laboratory
- Mobile & Wireless Communications Engineering
- Wolfson Centre for Bulk Solids Handling Technology

5.16.3 Open University

- Structural Integrity Research Group
- Planetary and Space Sciences Research Institute (PSSRI) – Part of CEPSAR, the OU Centre for Earth, Planetary, Space & Astronomical Research:
  - Solar System exploration missions
  - First class analytical and environmental simulation facilities for the investigation of extra-terrestrial materials and processes
  - Search for answers to basic questions about our Universe, studying all aspects of planetary and space sciences including the evolution of planets and moons in our Solar System, near-Earth objects such as asteroids, the early Solar System, interstellar dust particles, impacts on all scales and astrobiology
  - The group has involvement in missions like Stardust, Genesis, Rosetta, had three instruments on board the highly successful Cassini/Huygens spacecraft which landed on Titan, one of Saturn's moons in January 2005, and is now developing new instruments for the ESA ExoMars mission in 2013
  - Technology and expertise in PSSRI, developed for planetary science, is now being evolved and applied to a wide range of terrestrial applications such as biomedical, environmental and security monitoring.
  - The 'e2v Centre for Electronic Imaging' (CEI), a research centre within the PSSRI, is a collaboration between e2v technologies plc and the Open University. The CEI is dedicated to the research and development of advanced technologies for electronic image sensing and provides knowledge exchange between the UK technology industry and academia.
- Department of Physics and Astronomy:
  - A programme of observational, theoretical, laboratory based and mission based astronomy research, focusing on three of the nine themes endorsed by the STFC roadmap: Are we alone in the universe? How do galaxies, stars and planets form and evolve? What are the laws of physics in extreme conditions?
  - Member of the UK SALT Consortium, which owns a 5% share in the 10m Southern African Large Telescope

---

<sup>15</sup> This list is not exclusive and is based on submissions received from universities.

- Partner in the SuperWASP consortium which operates two robotic sky-patrol camera systems (one in La Palma, one at Sutherland Observatory)
- Members of the group serve on the science teams for the 2009 ESA GENIE and the 2015 DARWIN missions, and are members of the guaranteed time consortia of the 2006 Japanese Akari infrared survey mission and the 2009 Herschel SPIRE instrument
- Coordination of an EU Network in Astrobiology
- Coinvestigators in the future Japan/ESA SPICA mission and the forthcoming UK LOFAR Consortium.

#### 5.16.4 University of Oxford

- Heat Transfer and Aerodynamics (Engineering)
- Aerodynamics and Astronautics (Engineering)
- Internal Combustion Engine Group (Engineering)
- Systems security (Computing Laboratory)
- Sensor networks (Computing Laboratory)
- Armed conflict law (Law)

#### 5.16.5 University of Portsmouth

- Space Office: the University's European Space Agency School (ESA)
- Logistics and Management Mathematics: Research Group into Operational Research and Mathematical Programming, Multi-Objective Optimisation and Logistics and Supply Chain Management
- Materials & Structural Integrity Laboratory
- Institute of Industrial Research: Artificial Intelligence Algorithms to systems which improve their accuracy, efficiency and deliver a superior product.

#### 5.16.6 University of Reading

- Department of Meteorology
- National Centre for Earth Observation
- School of Systems Engineering: Computational Vision Group
- School of Politics and International Relations: Centre for Strategic Studies

#### 5.16.7 Royal Holloway, University of London

- Department of Physics
  - Bio-diagnostics
  - Experimental Particle Physics
  - John Adams Institute for Accelerator Science
  - Nanophysics and Nanotechnology
  - Quantum Technology

#### 5.16.8 University of Southampton

- Aerospace Industrial Sector Team
- School of Engineering Sciences
- Rolls Royce University Technology Centre (UTC) – Gas Turbine Noise
  - Fluid Dynamics and Acoustics Group
- Rolls Royce University Technology Centre (UTC) – Computational Engineering
  - Computation and Engineering Design Group
- Airbus Noise Technology Centre (ANTC)
- Materials Research Group (School of Engineering Science)
- Microsoft Institute for High Performance Computing

5.16.9 University of Surrey

- University Wide Research Network: Space
- Space, Aerodynamics and Mechanical Engineering (Faculty of Engineering and Physical Sciences)
  - Surrey Space Centre
  - Thermo-Fluid Systems Group
  - Surrey Advanced Vehicle Analysis Group



**Environment and Energy**

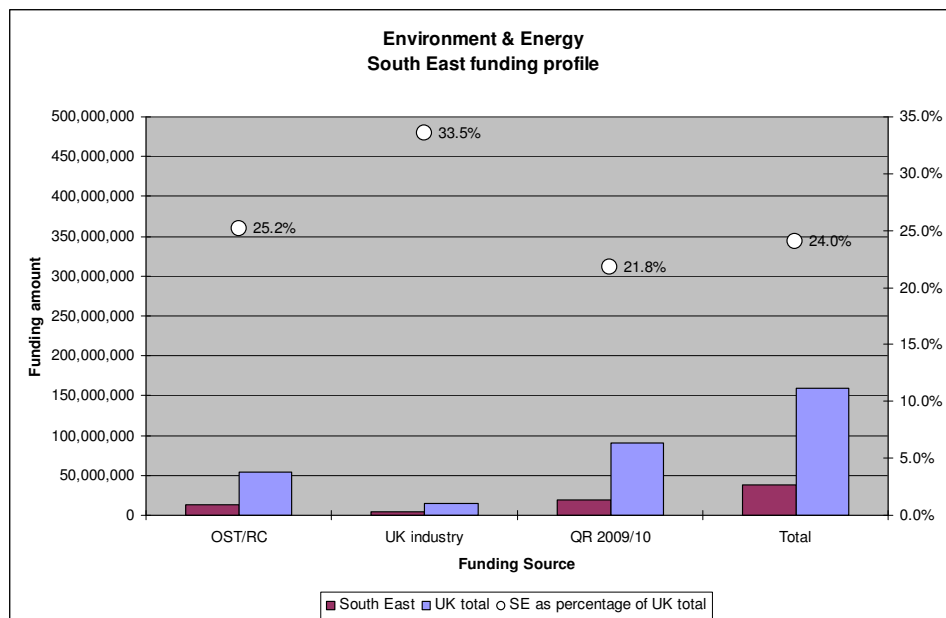
5.17 To assess research excellence in the environment and energy sector the following UOAs (RAE 2008) have been used:

- 16 Agriculture, Veterinary and Food Science
- 17 Earth Systems and Environmental Sciences
- 30 Architecture and the Built Environment
- 31 Town and Country Planning
- 32 Geography and Environmental Studies

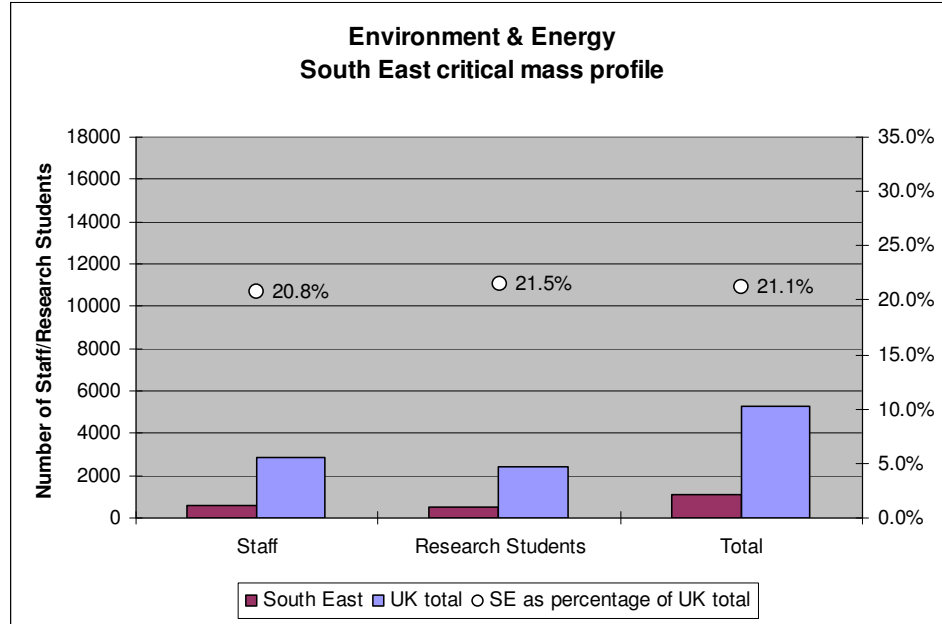
5.18 The following 13 South East universities submitted returns against these UOAs:

- University of Brighton
- Cranfield University
- University of Greenwich
- University of Kent
- Kingston University
- Open University
- University of Oxford
- Oxford Brookes University
- University of Portsmouth
- University of Reading
- Royal Holloway, University of London
- University of Southampton
- University of Sussex

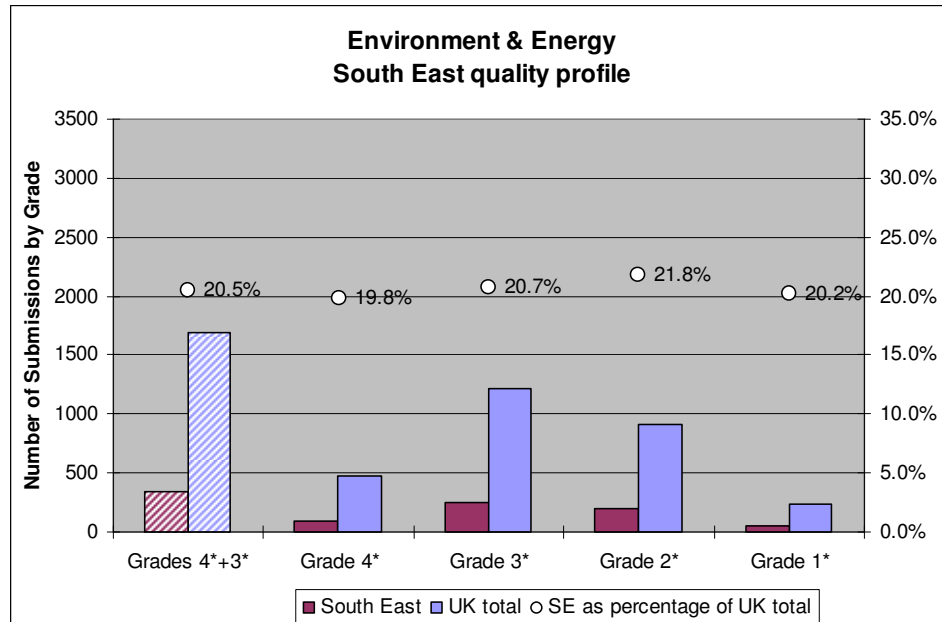
5.19 Whilst the overall funding of **£38.4m** in disciplines related to the environment and energy sector is the lowest amount compared to the other sectors it is noticeable that South East universities attract a third of the total UK industry research funding in this area. About a quarter (£13.6m) of the total UK OST/RC funding and 21.8% (£ 19.7m) of QR funding is awarded to South East universities in this sector.



5.20 596 academic staff and 521 research students (1117 in total) have submitted evidence of research to the RAE2008 in disciplines supporting the environment and energy sector. It is noteworthy that a lower average percentage of researchers (21.1% of UK total) managed to attract 24% of total UK funding with an exceptionally high proportion of UK industry funding (see paragraph 4.14).



5.21 A strong position of South East universities in research disciplines supporting the environment and energy sector is evidenced by 20.5% (347 submissions<sup>16</sup>) of the UK total grade 4\*/3\* submissions. The University of Reading accounts for 29 grade 4\* and 70 grade 3\* submissions, followed by Oxford (19/27) and Southampton (18/40). The Open University (11/34) and Royal Holloway, University of London (10/25) also display international research excellence relevant to the environment and energy sector.



<sup>16</sup> See footnote 13.

5.22 Within the energy and environment sector South East universities have strengths in Earth Systems and Environmental Sciences (UOA17) and Geography and Environmental Studies (UOA32). The University of Reading’s strengths in Food Bioscience is also noteworthy, although it may be more relevant to the land-based and wholesale/retail sectors.

5.23 Comparing South East universities to the national grade-point average in disciplines relevant to the environment and energy sector the following institutions were assessed above national average:

UOA No.	Subject	National average	South East universities above national average
16	Agriculture, Veterinary and Food Science	2.41	University of Reading (2.60)
17	Earth Systems and Environmental Sciences	2.73	University of Oxford (3.20) University of Reading (3.00) Royal Holloway, University of London (2.90) University of Southampton (2.85) Open University (2.80)
30	Architecture and the Built Environment	2.64	University of Reading (2.90)
31	Town and Country Planning	2.52	University of Reading (2.70)
32	Geography and Environmental Studies	2.64	University of Oxford (2.95) Royal Holloway, University of London (2.80) University of Sussex (2.75) Open University (2.70) University of Southampton (2.65)

5.24 Within the South East there are areas of particular research excellence and specialised facilities at the following HEIs<sup>17</sup>:-

5.24.1 University of Brighton

- Aquatic Research Centre
- Centre for Sustainability in the Built Environment
- Built Environment and Civil Engineering
- University-wide Research Network:
  - The Sustainability Network
- Faculty of Science and Engineering Research Themes:
  - Applied Geosciences
  - Environmental Management
  - Society, Space and Environment
- Faculty of Science and Engineering Research Groups:
  - Waste and Energy Research Group (WERG)
  - Environmental Nanotechnologies Group
  - Environment and Public Health Research Unit (EPHRU)
- Faculty of Arts Research Groups:
  - Inheritable Futures Lab
  - The Office for Spatial Research
  - Urban Performance
  - Continuous Productive Urban Landscapes (CPULS)

<sup>17</sup> This list is not exclusive and is based on submissions received from universities.

- The Centre for Tourism Policy Studies (CENTOPS)
- Sport and Leisure Cultures Research Group

#### 5.24.2 University of Greenwich

- Agricultural Biosecurity Group
- Biodiversity and Molecular Biology Group
- Chemical Ecology & Plant Biochemistry Group
- Fire Safety Engineering Group
- Bio-energy Research Group
- Contaminated Land Remediation & Waste Management Group
- Accelerated Carbonation Technology (ACT)
- Biomass conversion
- Plant and algal biochemistry
- Bio-remediation and soil quality
- Environmental geography
- Sustainability
- Environmental conservation
- Landscape assessment and forestry
- Groundwater contamination and remediation
- Environmental pollution
- Analytical chemistry, geochemistry and chemostratigraphy
- GIS and remote sensing
- Solar energy conversion, photocatalysis & renewable fuels.
- Solar hydrogen production
- Pest Behaviour Group
- Sustainable Built Environment Research Group
- Landscape and Environmental Design Research Group
- Design in the Built Environment Research Group
- Post-Harvest & Value Addition Research Group

#### 5.24.3 University of Kent

- Durrell Institute of Conservation and Ecology
- Environment research network
- Energy research network
- Instrumentation and Embedded Systems research group
- Future Computing group (including green computing and power-efficient memory technology)
- Kent Law School (environmental law)

#### 5.24.4 Open University

- Open University Business School
  - Low carbon workplaces
  - Corporate Social Responsibility
- Department of Earth and Environmental Sciences
  - Climate modelling and linked climate/economic models
  - Isotope geochemistry including applications to both ancient climate change and modern issues such as methane release and ocean deoxygenation
  - Natural hazards such as volcano eruptions
  - Biogeochemistry including issues such as waste management and methane release from peatlands
  - Geomicrobiology

- Department of Life Sciences
  - Ecology of floodplain meadows (The Floodplain Meadows Partnership)
- Faculty of Maths, Computing & Technology
  - Sustainability, Energy and Environment research theme
  - Integrated Waste Systems Research Group (IWS)
  - Sustainable Design Research Group
  - Transport Research
  - Open Systems Research Group
  - Environmental acoustics research

#### 5.24.5 University of Oxford

- Engineering
  - Energy Engineering
  - Electrical Power Group
  - Environmental Chemical Engineering
- Chemistry
  - Atmospheric chemistry
  - Energy and catalysis
- Earth Sciences
  - Environmental microbiology
  - Isotopes and climate
- Materials
  - Materials for fusion and fission power
  - Solar energy
- Geography
  - Biodiversity
  - Climate systems and policy
  - Landscape dynamics
  - Technological Natures: Materials, Cities, Politics
  - Transformations: Economy, Society and Place
- Law
  - Environmental Law (Law)
- Smith School
  - Environmental Sciences and Governance
  - Environmental Economics
  - Climate & Development
  - Low Carbon Mobility
  - Catastrophe Risk Financing
  - Private Sector Transformation
- ECI
  - UK climate impact
  - China environment and energy
  - Environmental change and food systems
  - Ecosystem dynamics
  - Forest governance
  - Biodiversity
  - African ecology
  - Buildings
  - Energy behaviour
  - Energy in developing countries
  - Fuel poverty
  - Lights and appliances

- Lower carbon economy
- Personal carbon trading
- Renewable energy use
- Water research and management

5.24.6 University of Portsmouth

- Sustainable Waste Water Management and Clear-up
- Carbon Footprint (performance assessment and evaluation)
- Centre for Urban Regeneration
- Transport Planning
- Aquatic Hydrology, Ecology and Toxicology
- Coastal Analysis

5.24.7 University of Reading

- Walker Institute for Climate Systems
- Advanced Climate Technology Urban Atmospheric Laboratory (ACTUAL)
- Technologies for Sustainable Built Environments (TSBE) Centre
- National Centre for Earth Observation

5.24.8 Royal Holloway, University of London

- Department of Earth Sciences
  - Fault Dynamics Research Group
  - Plant Palaeobiology Research Group
  - South East Asian Research Group
- Department of Geography
  - Centre for Developing Areas Research
  - Centre for Quaternary Research
  - Information and Communication Technologies for Development
  - Social and Cultural Geography

5.24.9 University of Southampton

- National Oceanography Centre
- Living with Environment Change Strategic Research Group
- nCATS – National Centre of Advanced Tribology at Southampton
- Energy USRG
- Ultrasonics and Underwater Acoustics (UAUA)
- Complexity Science Strategic Research Group – Institute for Complex Systems Simulation

5.24.10 University of Surrey

- University Wide Research Network: Energy
- University Wide Research Network: Water
- Sustainability, Energy and Environment (Faculty of Engineering and Physical Sciences)
  - Centre for Environmental Strategy
- Science, Environment and Technologies (Faculty of Arts and Human Sciences)
- Environmental Regulatory Research (Faculty of Management and Law)

5.24.11 University of Sussex

- SPRU – Science and Technology Policy Research
  - Sussex Energy Group

- Social, Technological and Environmental Pathways to Sustainability Centre (STEPS)
- School of Global Studies

### Financial and Professional Services

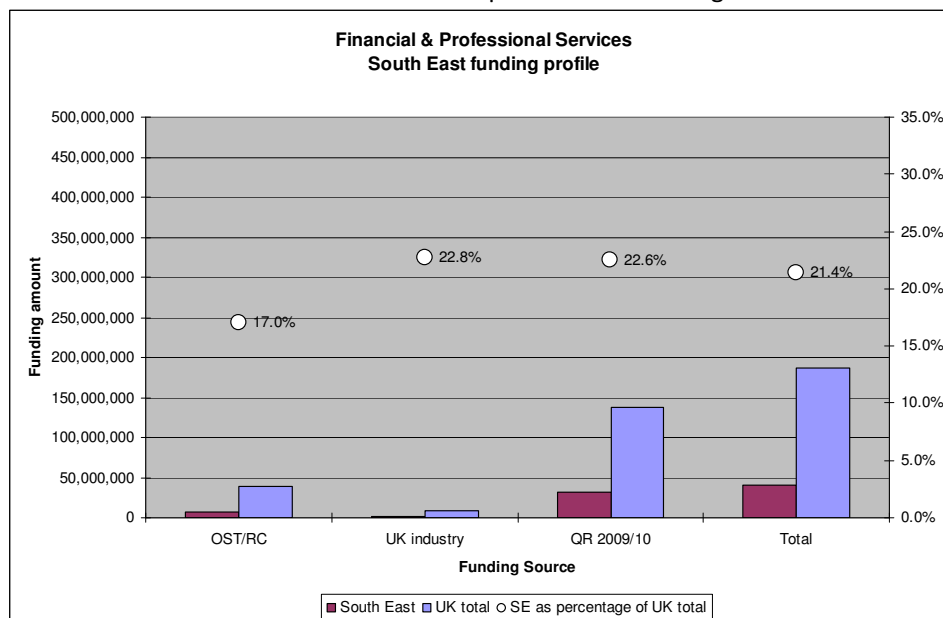
5.25 To assess research excellence in the financial and professional services sector the following UOAs (RAE 2008) have been used:

- 20 Pure Mathematics
- 21 Applied Mathematics
- 22 Statistics and Operational Research
- 34 Economics and Econometrics
- 35 Accounting and Finance
- 36 Business and Management Studies
- 38 Law

5.26 The following 15 South East universities submitted returns against these UOAs:

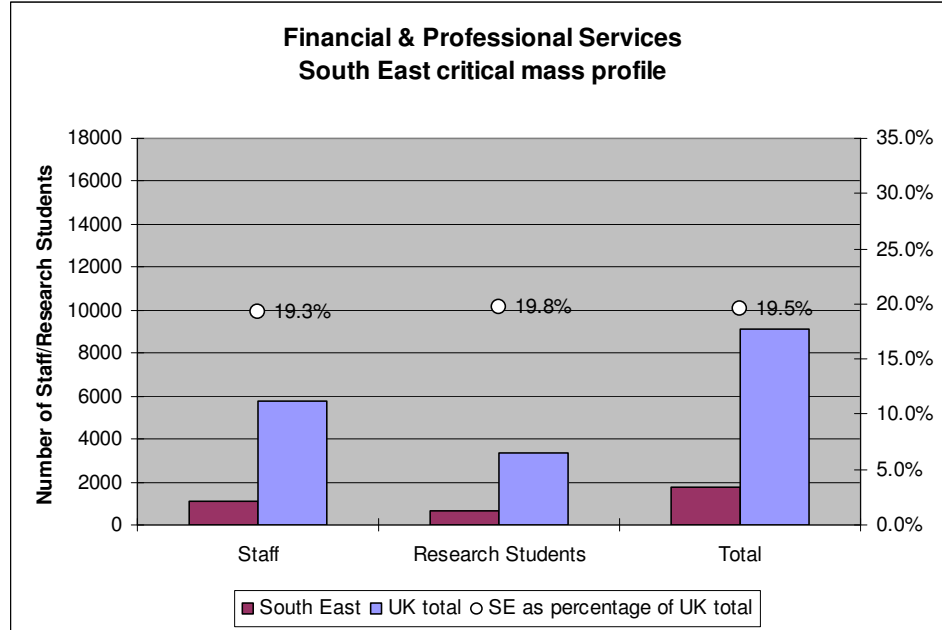
- Buckinghamshire New University
- University of Brighton
- Cranfield University
- University of Greenwich
- University of Kent
- Kingston University
- Open University
- University of Oxford
- Oxford Brookes University
- University of Portsmouth
- University of Reading
- Royal Holloway, University of London
- University of Southampton
- University of Surrey
- University of Sussex

5.27 The £31.1m QR funding (22.6% of UK total) provides the most significant funding stream for research related to financial and professional services. With £6.7m OST/RC and £2.1m UK industry funding the total amounts to just below **£40m**. This level of funding is similar to the amount available in the energy and environmental sector but with a much heavier reliance on public sector funding.

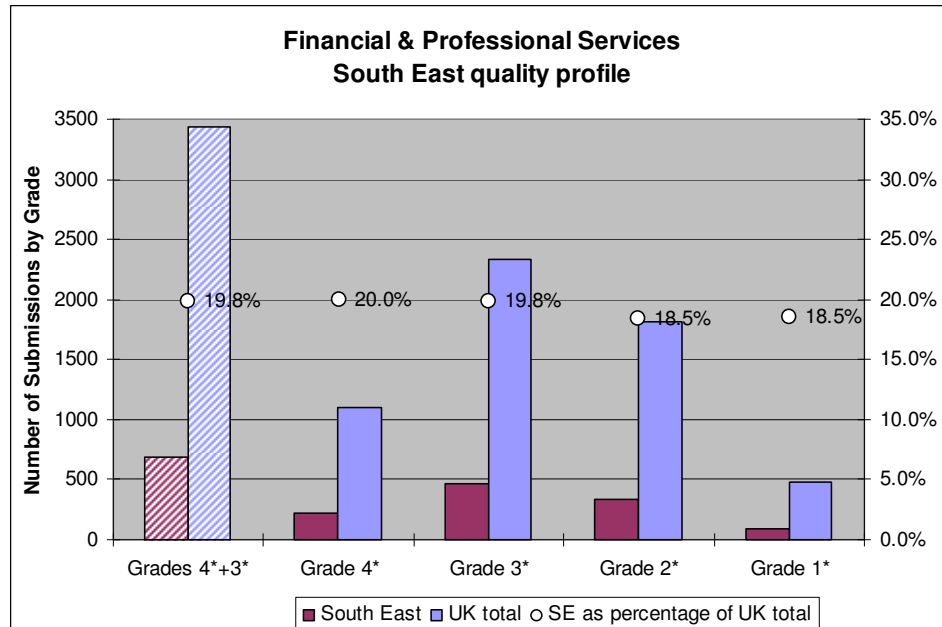




5.28 Despite the comparatively low total funding amount 1775 academic staff and research students seek to advance knowledge creation in areas relevant to financial and professional services. One reason for the funding levels associated with research into financial and professional services might be that Pure and Applied Mathematics (UOA 20+21) have been included in this analysis; both are disciplines which attract lower amounts of direct industry and/or OST/RC funding.



5.29 19.8% (682 submissions<sup>18</sup>) of the total UK research in the financial and professional services sector assessed at grades 4\*/3\* comes from South East universities. The University of Oxford (126/156) accounts by far for the highest number of grade 4\*/3\* submissions with a very significant strengths in Law (UOA38) and Economics & Econometrics (UOA 34), followed by Southampton (19/72) and Kent (18/43). Other South East universities with research excellence in this sector include Royal Holloway, University of London (11/34), Surrey (8/33) and Reading (8/30).



<sup>18</sup> See footnote 13.

- 5.30 Business and Management Studies (UOA36), Law (UOA38) and Economics & Econometrics (UOA34) are particular strengths of South East universities. Strong performance can also be observed in Applied Mathematics (UOA21) and Pure Mathematics (UOA20).
- 5.31 Comparing South East universities to the national grade-point average in disciplines relevant to the financial and professional services sector the following institutions were assessed above national average:

UOA No.	Subject	National average	South East universities above national average
20	Pure Mathematics	2.69	University of Oxford (3.10)
21	Applied Mathematics	2.70	University of Oxford (3.05) University of Portsmouth (2.90) University of Southampton (2.85) University of Surrey (2.80)
22	Statistics and Operational Research	2.69	University of Oxford (3.30) University of Southampton (2.75)
34	Economics and Econometrics	3.01	University of Oxford (3.35)
35	Accounting and Finance	2.34	Nil
36	Business and Management Studies	2.55	University of Oxford (2.95) Royal Holloway, University of London (2.65) University of Southampton (2.60)
38	Law	2.48	University of Oxford (3.00) University of Kent (2.85) University of Reading (2.70) University of Sussex (2.60) University of Southampton (2.50)

- 5.32 Within the South East there are areas of particular research excellence and specialised facilities at the following HEIs<sup>19</sup>:-

5.32.1 University of Brighton

- Brighton Business School
  - Economics and Econometrics including major research unit CENTRIM (Centre for Research in Innovation Management)
  - Accounting and Finance, focused on small business finance
  - Business and Management, including marketing, innovation, supply chain management, employment related studies as well as broader areas of research around employment patterns, employability and effects of gender.
  - A particular strand of applied research is in the area of learning support networks and small business with a major initiative around Profitnet supporting over 600 SMEs in the region and creating tools and services for developing inter-organisational learning and strategies to improve design capability in emerging technologies and creative industries.
  - Research expertise in manufacturing innovation where work has been completed in how new approaches to management and leadership can transform organisations and lead to new organisational linkages and development.

<sup>19</sup> This list is not exclusive and is based on submissions received from universities.

#### 5.32.2 University of Greenwich

- Centre for Business Network Analysis
- Centre for Governance, Risk and Accountability
- Property and Trusts Law
- Commercial Law
- Corporate and Employment Law
- Environmental Law
- Public Services International Research Unit
- Sociology Criminology and Cultural Studies
- Statistics & Operational Research Group
- Supply Chain Research Group
- Work & Employment Research Unit

#### 5.32.3 University of Kent

- Macroeconomics, money and finance research group
- Accounting and Finance research group
- Centre of Actuarial Science, Risk and Investment
- School of Law

#### 5.32.4 Open University

- Open University Business School
  - xDelia project (developing learning approaches to improve financial decision-making – EU framework 7 funded)
  - Financial Services Organisations and Consumers
  - Retail investors
  - Collaboration with BBC
  - Understanding Limited Liability Partnerships in the Small and Medium Sized Business Sector
  - Regional economic development (eEconomy, eGovernance and eEntrepreneurship)
  - Taxation
  - Economics, finance and management of the public sector
  - Centre for Financial Management
  - Institute of Social Marketing
- Digital Economy (Computing Department)
- Centre for Innovation, Knowledge and Development

#### 5.32.5 University of Oxford

- Mathematical and computational finance (Mathematics)
- Oxford-Man Institute of Quantitative Finance (Oxford-Man)
- Said Business School (Accounting, Finance, Management science, Marketing, Operations management, Organisational behaviour, Strategy, entrepreneurship and international business)
- Economics
  - Improving institutions for growth
  - Oxford Centre for the Analysis of Resource-Rich Economies
  - Development Economics
  - Econometrics
  - Financial Economics
  - Industrial Economics
  - Innovation, Productivity and Growth
  - International Trade

- Labour and applied microeconometrics
- Marcoeconomics
- Transition Economics
- Law
  - Commercial Law
  - Comparative Law
  - Competition Law
  - Corporate Law and Finance
  - Criminal Law and criminology
  - European Union Law
  - Family Law and human rights
  - Intellectual property
  - Judicial Process
  - Property
  - Tax

5.32.6 University of Portsmouth

- Centre for the Economics and Management of Aquatic Resources (CEMARE)
- Centre for Organisation Research and Development (CORD)
- Centre for Counter Fraud Studies (CCFS)

5.32.7 University of Reading

- Henley Business School
- ICMA (International Capital Market Association) Centre of Excellence

5.32.8 Royal Holloway, University of London

- Department of Mathematics
  - Discrete Mathematics and Algebra
  - Information Security Group
  - Statistics and Probability
- School of Management
  - Accounting, Finance and Economics
  - Centre for Public Services Organisations
  - Centre for Research into Sustainability
  - Enterprise Engineering Research Initiative
  - Marketing
  - Strategy and International Business
  - Technology and Information Management

5.32.9 University of Southampton

- Digital Economy Strategic Research Group
- Centre for Operational Research, Management Science and Information Systems (CORMSIS)
- Centre for Population Change (CPC)

5.32.10 University of Surrey

- University Wide Research Network: Digital Economy
- Economics (Faculty of Arts and Human Sciences)
  - Economic research
  - Applied Microeconomics
  - Health Economics
  - Radio Communications Group

- Surrey Centre for International Economic Studies
- Surrey Energy Economics Centre
- Accounting and Financial Management (Faculty of Management and Law)

5.32.11 University of Sussex

- School of Business, Management and Economics

**ICT, Software and Digital Media**

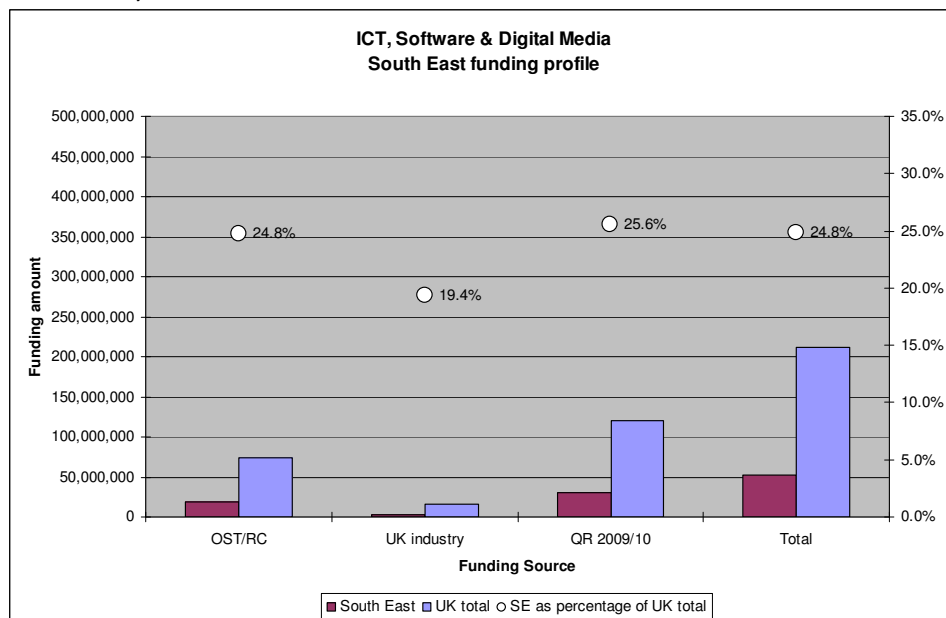
5.33 To assess research excellence in the ICT, Software and Digital Media sector the following UOAs (RAE 2008) have been used:

- 21 Applied Mathematics
- 22 Statistics and Operational Research
- 23 Computer Science and Informatics
- 24 Electrical & Electronic Engineering
- 66 Communication, Cultural and Media Studies

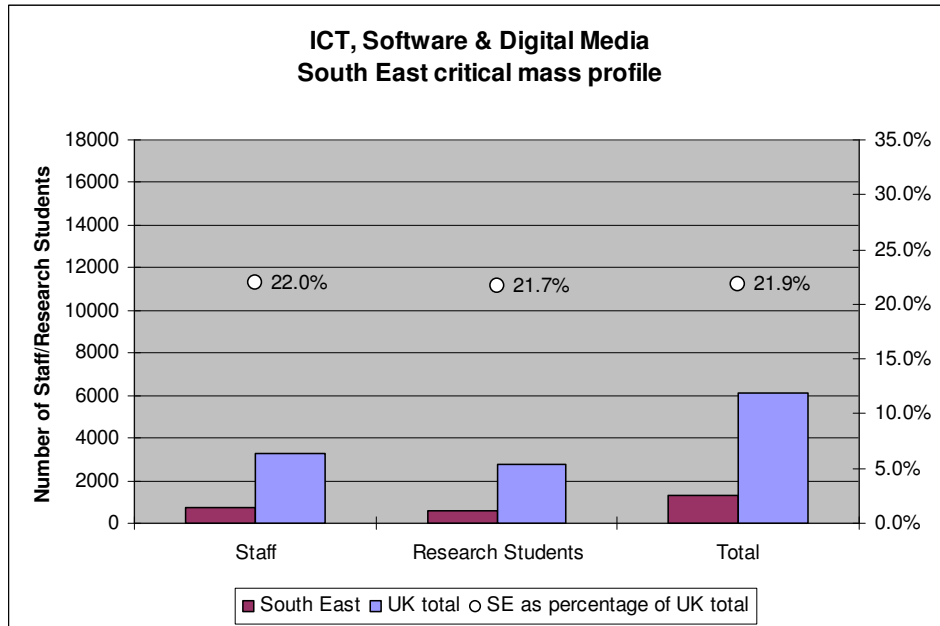
5.34 The following 15 South East universities submitted returns against these UOAs:

- University of Brighton
- University of Greenwich
- University of Kent
- Kingston University
- Open University
- University of Oxford
- Oxford Brookes University
- University of Portsmouth
- University of Reading
- Royal Holloway, University of London
- University of Southampton
- University of Surrey
- University of Sussex
- Thames Valley University
- University of Winchester

5.35 With almost a quarter of the total UK research funding attracted to South East universities ICT, Software and Digital Media is the strongest sector in relative terms. A total of **£52.4m** research funding is available, broken down into £30.9m (25.6% of UK total) QR, £18.3m (24.8% of UK total) OST/RC and £3.2m (19.4%) UK industry funding. Against the strong public sector funding UK industry funding in this sector is considerably lower, both in relative and absolute terms.

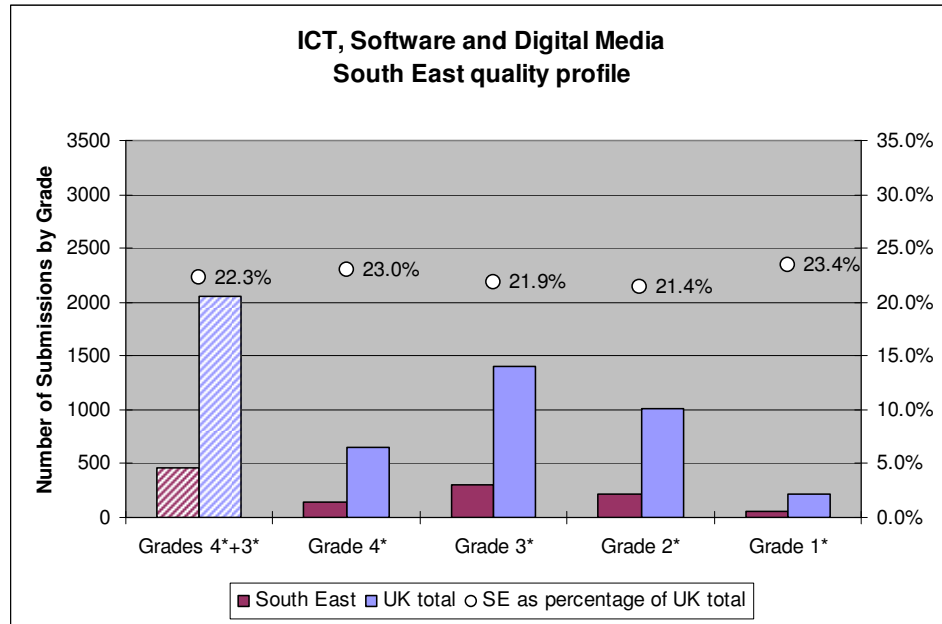


5.36 Working for South East universities 726 academic staff and 608 research students (1334 in total) have submitted evidence of research to the RAE2008 in disciplines supporting the ICT, Software and Digital Media sector. This equates to 21.9% of total UK critical mass.



5.37 In research related to the ICT, Software and Digital Media sector South East universities have a significant share of both grade 4\* (23% of UK total) and grade 3\* (21.9% of UK total) submissions<sup>20</sup>. These add up to 457 submissions or 22.3% of UK total output in international research excellence. With 47/65 grade 4\*/3\* research submissions the University of Oxford has the highest number of internationally excellent research in the South East, followed by the University of Southampton (36/68), both demonstrating particular strengths in computer science & informatics (UOA 23) and the latter also in Electrical & Electronic Engineering (UOA24). Other South East universities with significant international research excellence in this sector are Surrey (22/39, significant research excellence in electrical & electronic engineering), Sussex (10/31) and Kent (9/23).

<sup>20</sup> See footnote 13.



- 5.38 The South East universities’ strengths in Computer Science & Informatics (UOA23) and Electrical & Electronic Engineering (UOA24) are particularly relevant to this sector. Significant strengths in Applied Mathematics (UOA21) and Statistics & Operational Research (UOA22) further enhance the South East’s competitive position in the ICT, Software and Digital Media sector.
- 5.39 Comparing South East universities to the national grade-point average in disciplines relevant to the ICT, Software and Digital Media sector the following institutions were assessed above national average:

UOA No.	Subject	National average	South East universities above national average
21	Applied Mathematics	2.70	University of Oxford (3.05) University of Portsmouth (2.90) University of Southampton (2.85) University of Surrey (2.80)
22	Statistics and Operational Research	2.69	University of Oxford (3.30) University of Southampton (3.15)
23	Computer Science and Informatics	2.75	University of Southampton (3.20) University of Oxford (3.15) Open University (2.95) University of Sussex (2.85) Royal Holloway, University of London (2.80) University of Kent (2.75)
24	Electrical & Electronic Engineering	2.67	University of Surrey (2.95) University of Southampton (2.85)
66	Communication, Cultural and Media Studies	2.60	Royal Holloway, University of London (2.90) University of Sussex (2.90) University of Oxford (2.65)



5.40 Within the South East there are areas of particular research excellence and specialised facilities at the following HEIs<sup>21</sup>:-

5.40.1 University of Brighton

- Visual Modelling Research Group
- Natural Language Technology Research Group
- Interactive Technologies Research Group
- Cultural Informatics Research Group
- CUBIST (Cultural Business: Impact, Strategy and Technology) Research Group

5.40.2 University of Greenwich

- Centre for Computer and Computational Science
- Centre for Numerical Modeling & Process Analysis
- Computational Mechanics & Reliability Group
- Computational Science & Engineering Group
- Media and Communications Research Group
- Fire Safety Engineering Group
- Institute for the Converging Arts & Sciences
- Mobile & Wireless Communications Engineering
- Statistics & Operational Research Group

5.40.3 University of Kent

- Computational Intelligence Group
- Security Group
- Programming Languages and Systems Group
- Future Computing group
- Broadband and Wireless Communications research group
- Digital media research group
- Instrumentation, Control and Embedded Systems
- Image and Information Engineering research group

5.40.4 Open University

- Centre for Research in Education and Educational Technology
- Childhood and Youth Studies
  - Digital literacies and multi modal approaches to learning languages
- Institute of Educational Technology
  - Technology Enhanced Learning
  - Learning in an Open World Research Group
  - Next Generation Distance Learning Group
  - Digital Scholarship
  - Jennie Lee Labs
- Knowledge Media Institute (KMi)
  - Future internet
  - New media systems
  - Semantic services and sense making
  - Information retrieval
- Open University Business School
  - World Wide Web
  - Employee surveillance techniques
  - E-commerce

---

<sup>21</sup> This list is not exclusive and is based on submissions received from universities.

- Information and Communication Technologies
  - Human-centred computing
  - Language, Multimedia and Knowledge Technologies
  - Software engineering
- Shareable interfaces: mobile, tangible and ubiquitous computing
  - Pervasive Computing Research Group
- Digital Media Research Group
- Digital security
  - Security and Privacy Research Group
- NeXt Generation Multimedia and Network Technologies Research Group
- Technology Management Research Group
- ESRC Centre for Research on Socio-Cultural Change (broadcasting and new media, digital cultures and the creative industries, and advertising)
- OpenSpace Research Centre

#### 5.40.5 University of Oxford

- Computing Laboratory
  - Databases
  - Knowledge Representation and Reasoning
  - e-Science and the Semantic Web
  - Computational Linguistics
  - Spatial Reasoning
  - Programming languages
  - Information modelling
  - Requirements engineering
  - Model-based development)
  - Research informatics
  - Verification
- Statistics
  - Bioinformatics
  - Computer-intensive statistics
  - Applied probability
  - Discrete Mathematics and Operational Research
- Oxford Internet Institute
  - Future Internet and Web 2.0
  - e-security
  - Cybertrust
  - Global networks and societies
  - Government on the web
  - Internet governance
  - Social networks

#### 5.40.6 University of Portsmouth

- Advanced Games Research Group
- State of the art facilities include:
  - Virtual Reality Suite
  - Motion Capture Suite
  - Video Broadcasting
  - Music and Sound Studios

#### 5.40.7 University of Reading

- The School of Systems Engineering
- Department of Mathematics
  - Mathematical Modeling for the Digital Economy;
  - Social network analysis
  - Communication networks with evolving networks
  - Digital teleconnections
  - Behavioural inferencing
  - Customer lifetime value
- The Cybernetic Group
- Department of Typography - Simplification Centre
- School of Construction Management – Innovation Research Centre
  - Research at the socio-technical interface to develop new tools and processes for the design of buildings and infrastructure in the digital economy

#### 5.40.8 Royal Holloway, University of London

- Department of Computer Science
  - Bioinformatics
  - Centre for Systems and Synthetic Biology
  - Computer Learning Research Centre
  - Theory of Computing
- Department of Media Studies
  - Migrant and Diasporic Cinema in Contemporary Europe

#### 5.40.9 University of Southampton

- Digital Economy Strategic Research Group
- Centre for Operational Research, Management Science and Information Systems (CORMSIS)
- Intelligence, Agents, Multimedia Group (ECS)
- Autonomous Learning Agents for Decentralised Data and Information Networks (ALADDIN) research programme
- Web Science Trust (WST)
- Archaeological Computing Research Group (School of Humanities)

#### 5.40.10 University of Surrey

- Information and Communication Technologies (Faculty of Engineering and Physical Sciences)
  - Information and Communication Technologies Research
  - Centre for Communication Systems Research
  - Centre for Vision, Speech and Signal Processing
  - Digital Ecosystems Group
  - Formal Methods and Security Group
- Digital World Research Centre (Faculty of Arts and Human Sciences)

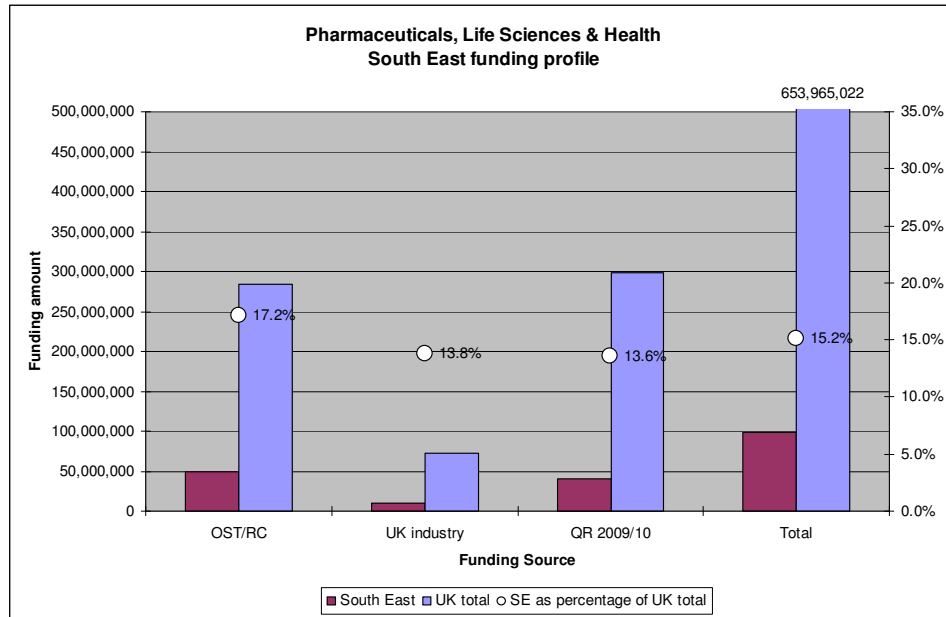
#### 5.40.11 University of Sussex

- School of Informatics
  - Patient Records Enhancement Project (PREP)
  - Foundations of Software Systems
  - Networking and Distributed Systems
  - Pervasive Computing Systems
  - Foundations of Computation

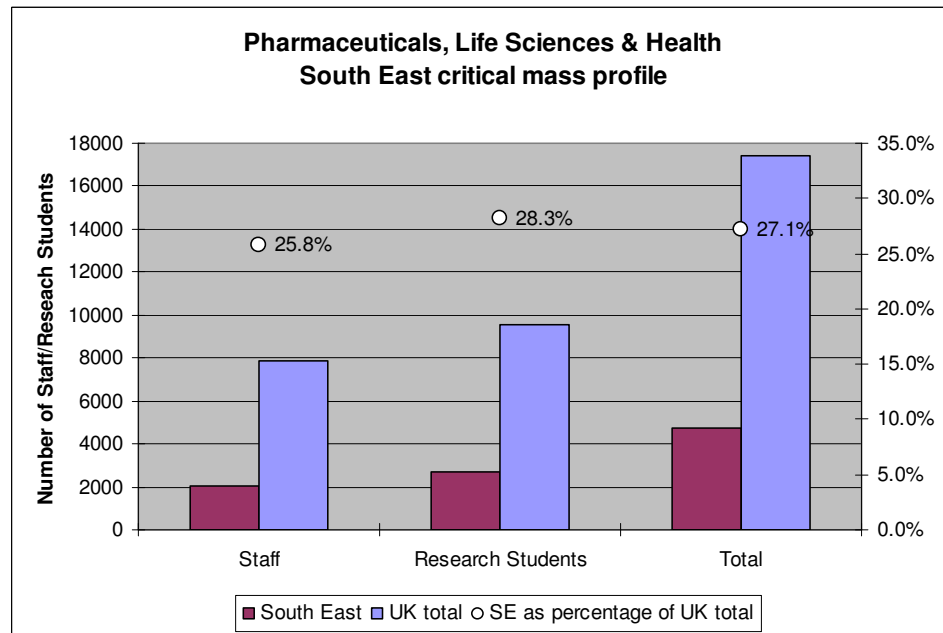
- Compiler Design and Programming Language Implementation
- Interactive Systems
- Centre for VLSI and Computer Graphics
- Sackler Centre for Consciousness Science
- Interoceptive Awareness
- Explanatory Correlates
- Synaesthesia

### **Pharmaceuticals, Life Sciences and Health**

- 5.41 To assess research excellence in the pharmaceuticals, life sciences and health sector the following UOAs (RAE 2008) have been used:
- 1 Cardiovascular Medicine
  - 2 Cancer Studies
  - 3 Infection and Immunology
  - 4 Other Hospital Based Clinical Subjects
  - 5 Other Laboratory Based Clinical Subjects
  - 6 Epidemiology and Public Health
  - 7 Health Services Research
  - 8 Primary Care and Other Community Based Clinical Subjects
  - 9 Psychiatry, Neuroscience and Clinical Psychology
  - 10 Dentistry
  - 13 Pharmacy
  - 14 Biological Sciences
  - 15 Pre-clinical and Human Biological Sciences
  - 18 Chemistry
- 5.42 The following 12 South East universities submitted returns against these UOAs:
- University of Brighton
  - Cranfield University
  - University of Greenwich
  - University of Kent
  - Open University
  - University of Oxford
  - Oxford Brookes University
  - University of Reading
  - Royal Holloway, University of London
  - University of Southampton
  - University of Surrey
  - University of Sussex
- 5.43 Whilst the **£99m** overall funding available in disciplines relating to pharmaceuticals, life sciences & health is the second highest in absolute terms of all six priority sectors South East universities only attract 15.2% of the total UK funding in this field. £49m OST/RC funding (17.2% of UK total) is the largest contributor, closely followed by £40.5m QR funding (13.6% of UK total). Only about 10% of the South East funding portfolio (£9.9m; 13.8% of UK total) comes from UK industry.



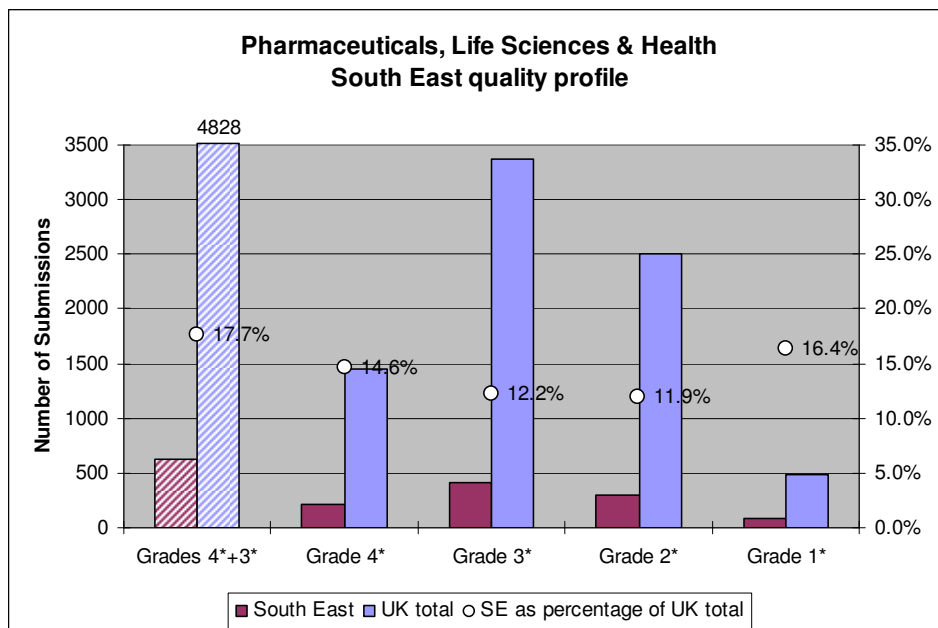
5.44 With more than 2000 academic staff and 2700 research students South East universities have a very significant critical mass in pharmaceuticals, life sciences & health (27.1% of UK total). This is the highest critical mass profile of South East universities in the six priority sectors, almost twice as high as aerospace & defence which is the second highest.



5.45 However, looking at the grade profile it is noteworthy that South East universities only account for 12.9% of all UK grade 4\*/3\* submissions<sup>22</sup>. With 171 grade 4\* and 231 grade 3\* submissions the University of Oxford dominates in this area. All other South East universities have far lower grade profiles: Southampton (22/101), Sussex

<sup>22</sup> See footnote 13.

(11/33), Reading (3/20), Royal Holloway, University of London (3/11), Kent (1/5), OU (1/3), Cranfield (1/2), Greenwich (0/1), Oxford Brookes (0/1) and Surrey (0/1).



- 5.46 South East universities demonstrate particular strengths in Infection & Immunology (UOA3), Biological Sciences (UOA14) and Other Hospital Based Clinical Subjects (UOA4). Other areas of strengths include Chemistry (UOA18) and Pre-clinical and Human Biological Sciences (UOA15).
- 5.47 Comparing South East universities to the national grade-point average in disciplines relevant to the ICT, Software and Digital Media sector the following institutions were assessed above national average:

UOA No.	Subject	National average	South East universities above national average
1	Cardiovascular Medicine	2.70	University of Oxford (3.30)
2	Cancer Studies	2.88	University of Oxford (2.95)
3	Infection and Immunology	2.79	University of Oxford (3.25)
4	Other Hospital Based Clinical Subjects	2.81	University of Oxford (3.00)
5	Other Laboratory Based Clinical Subjects	2.62	University of Oxford (3.05)
6	Epidemiology and Public Health	2.72	University of Oxford (2.95)
7	Health Services Research	2.55	University of Oxford (2.80)
8	Primary Care and Other Community Based Clinical Subjects	2.66	University of Oxford (3.25) University of Southampton (3.10)
9	Psychiatry, Neuroscience and Clinical Psychology	2.60	University of Oxford (2.65)
10	Dentistry	2.76	Nil
13	Pharmacy	2.56	Nil
14	Biological Sciences	2.55	University of Oxford: - Biochemistry (3.00) - Plant Sciences (2.85) Royal Holloway, University of

			London (2.80) University of Oxford: - Zoology (2.70)
15	Pre-clinical and Human Biological Sciences	2.57	University of Oxford (3.00)
18	Chemistry	2.79	University of Oxford (3.05)

5.48 Within the South East there are areas of particular research excellence and specialised facilities at the following HEIs<sup>23</sup>:-

5.48.1 University of Brighton

- Centre for Nursing and Midwifery Research
- International Health Development Research Unit
- Social Science Policy and Research Centre (SSPARC)
- Clinical Research Centre for Health Professions
- Wellbeing, Health and Occupation Research Group
- Healthy Ageing Group
- Brighton and Sussex Medical School
  - Division of Medicine conduct research in a number of different domains including Cancer Medicine, Immunology and Inflammation, Elderly Care, Infectious Diseases and Neuropsychiatry
  - Division of Primary Care the main research foci are in asthma, diagnostic methods in sexually-transmitted diseases, and medical informatics
- Centre for Biomedical & Health Science Research
- Epidemiology and Public Health

5.48.2 University of Greenwich

- Applied Psychology Research Group
- Research Centre for Children, School & Families
- Experimental Thermodynamics
- Bio-medical and Drug Discovery Group
- Food & Nutrition Group
- Formulation & Pre-formulation Sciences Group
- Bio-energy Research Group
- Centre for Nursing & Healthcare Research
- Sexual Health Group
- Diabetes Group
- Offenders Health Group

5.48.3 University of Kent

- Protein science research group
- The Biomedicine research group
- Cell and developmental biology research group
- Pharmacy at Medway
  - New approaches to drug formulation and drug delivery
  - Novel therapeutic agents in neuronal disorders (pain, sleep disorders, addictive behaviour)
  - Cancer Infection and Immunity
- The Clinical and Professional Practice group
- Health care and Health Services

---

<sup>23</sup> This list is not exclusive and is based on submissions received from universities.



- Kent Law School (medical law)

#### 5.48.4 Open University

- Open University Business School
  - Failings of governance mechanisms, particularly in the NHS
  - Characteristics of the physical and financial value chain within which SME bio-pharma firms are located
- Biomedical Research Network (BRN)
  - Biomolecular damage
  - Biopsychology
  - Cell biology
  - Disease and diagnostics
  - Neuroscience
- Ageing and later life
- Children, young people, parenthood and families
- Death, dying and bereavement
- Living with disability and long term conditions
- Reproductive and sexual health
- Pharmacoepidemiology – Medical Statistics Research Group
- Infectious disease modelling and surveillance

#### 5.48.5 University of Oxford

- Engineering
  - Biomedical Image Analysis
  - Biomedical Instrumentation
  - Biomedical Signal Processing & e-health
  - Biomedical Ultrasonics & Biotherapy
  - Drug and Vaccine Delivery (DVD)
  - Fluidics and Biocomplexity
  - Ophthalmic Engineering
  - Orthopaedic Biomedical Engineering – Mechanobiology and Biomechanics
  - Physiological Understanding through Modelling, Monitoring and Analysis
  - Tissue Engineering and Bioprocessing
- Life Sciences Interface (many departments)
- Systems Biology (many departments)
- Computing Laboratory
  - Fluid mechanics for heart failure
  - Medical imaging
  - Circulation modelling
  - Molecular modelling
- MSD
  - Cancer biology
  - Infection and Immunology
  - Vaccines
  - Gene therapy
  - Epidemiology
  - Clinical Trials (Clinical Trials Unit)
  - Cardiovascular Science
  - Diabetes, Endocrinology and Metabolism (OCDEM)
  - Musculo-skeletal science
  - Neuroscience
  - Genetics

- Reproduction and development
- Ethics of bioscience (Ethics)
- Drug discovery (Chemistry, Pharmacology)
- Synthetic biology (Chemistry)
- Dosage (Pharmacology)
- Centre for Mathematical Biology (Mathematics)
- Particle therapy cancer research (Physics)
- Biological physics (Physics)
- Biochemistry and physiology (Plant sciences)
- Cell and developmental biology (Plant sciences)
- Mathematical and statistical genetics (Statistics)
- Bioinformatics (Statistics)
- Medical Law and ethics (Law)

5.48.6 University of Portsmouth

- Digital Wellbeing – Smart Home Research
- Improving the performance of artificial implants (Synthetic Joints)
- Identifying future needs of an ageing population
- Telecare and Healthy Computing
- Institute of Biomedical and Biomolecular Science
- Brain Tumour Treatment
- Expert Centre for health professional training
- Geographical Wellbeing
- Dental Academy

5.48.7 University of Reading

- Research centres in the Life Sciences
  - Institute for Cardiovascular & Metabolic Research (ICMR)
  - Centre for Integrated Neuroscience and Neurodynamics (CINN)
- Lead on South East Universities' Biopharma Consortium
- Department of agri-food science
- Centre for Food Security

5.48.8 University of Southampton

- School of Medicine and the Southampton University Hospitals Trust (SUHT)
  - Centre of Excellence for blood cancer research (leukaemia, lymphoma and myeloma)
  - Human Genetics
  - Centre for Human Development, Stem Cells and Regeneration (CHDSCR)
  - Respiratory Diseases
  - DOHaD (Developmental Origins of Health and Disease)
- Institute for Life Science Strategic Research
- DePuy International University Technology Partnership (UTP) in Bioengineering Science
- ICE-T Showcase – TeleCare for Health, Work, and Wellbeing
- Health Technologies Strategic Research Group
- Human Sciences Research Group (ISVR)
  - Human Factors Research Unit
  - Hearing and Balance Centre
- Fluid Dynamics and Acoustics Group (ISVR)
- Signal Processing and Control Group (ISVR)

- nCATS – National Centre of Advanced Tribology at Southampton

#### 5.48.9 University of Surrey

- University Wide Research Network: Health & Medical
- Centre for Biomedical Engineering (Faculty of Engineering and Physical Sciences)
- Public Health (Faculty of Health and Medical Sciences)
- Diabetes, Obesity and Metabolism Group (Faculty of Health and Medical Sciences)
- Food Consumer behaviour and Health Research Centre (Faculty of Arts and Human Sciences)
- Health Psychology (Faculty of Arts and Human Sciences)
- Age, Generation and Everyday Life (Faculty of Arts and Human Sciences)
  - Age, Generation and Gender Research Group
  - Centre for Research on Ageing and Gender
- Sleep Centre (Faculty of Arts and Human Sciences, Faculty of Health and Medical Sciences)

#### 5.48.10 University of Sussex

- Biomedical Engineering Group (School of Engineering and Design)
- Sussex Centre for Genome Damage and Stability
- Brighton and Sussex Medical School
  - Oncology and Genetics
- School of Psychology
  - Behavioural and Clinical Neuroscience
  - Cognitive Psychology
  - Developmental and Clinical Psychology
  - Social and Applied Psychology
  - Behaviour change: intervention, design and evaluation
  - Pro-social and Moral Engagement
  - Intergroup Relations and Collective Behaviour
  - Health Psychology
  - Identity, Culture and Well-being
  - Laboratory of Apiculture and Social Insects (LASI)

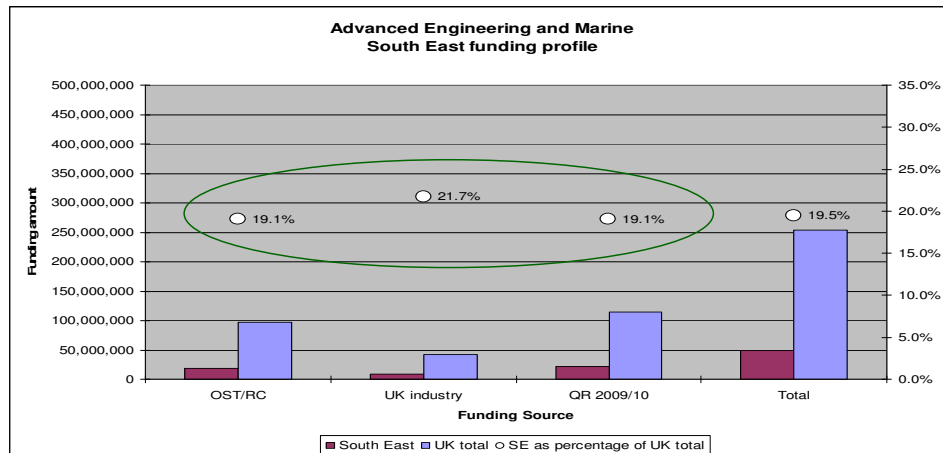
## 6 Observations

6.1 This analysis of South East universities' research strengths in relation to six priority sectors demonstrates the sound and broad base of international excellence that the academic sector can bring to sustain and advance the UK's competitive advantage. In applying world leading research to further economic development in partnership with industry the South East is well positioned in the global market both to attract foreign direct investment and to grow indigenous businesses.

6.2 In summary the following observations can be made in relation to the six priority sectors:

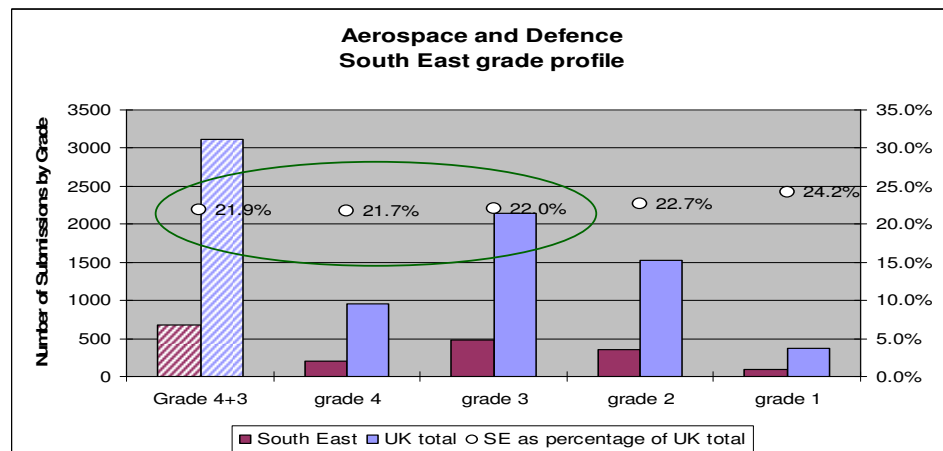
### 6.2.1 Advanced Engineering and Marine

- Particular strengths in Mechanical, Aeronautical and Manufacturing Engineering (UOA28)
- Balanced funding profile: £18.5m OST/RC + £9.1m UK industry + £21.8m QR
- Strong dominance of University of Oxford and University of Southampton (international research excellence)



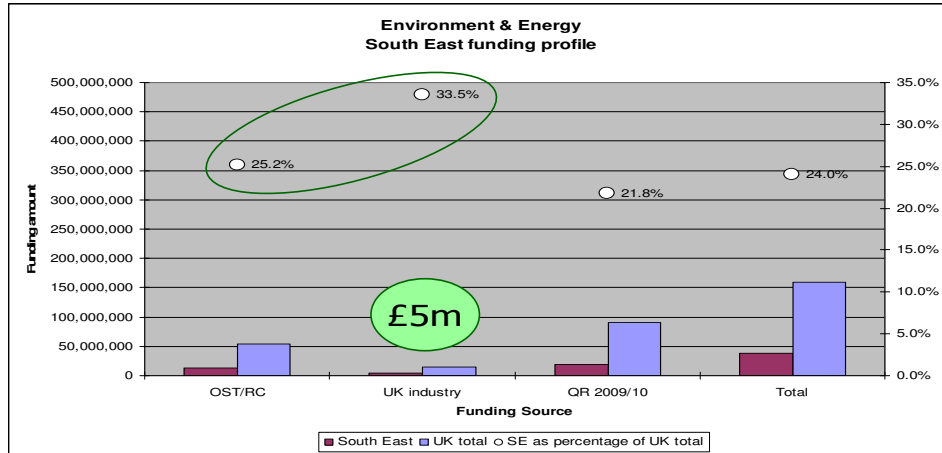
### 6.2.2 Aerospace and Defence

- Highest funding amount in absolute terms
- Highest UK industry funding in absolute terms
- Consistently high grade profile



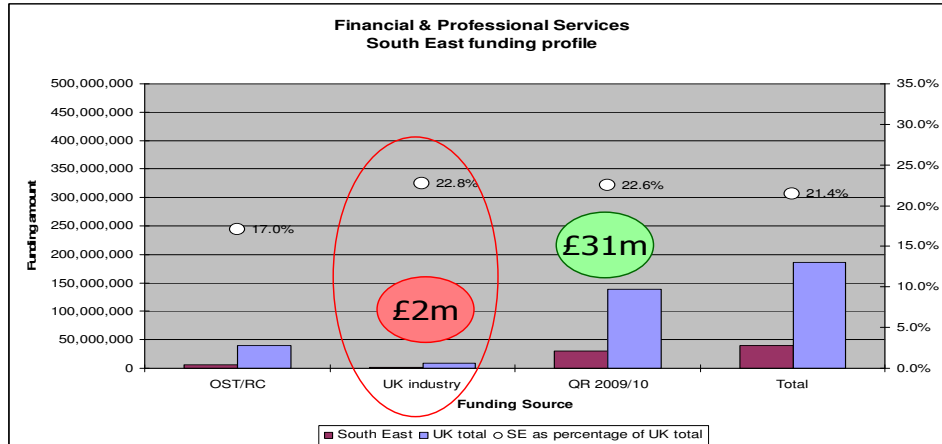
### 6.2.3 Environmental and Energy Technologies

- Lowest absolute amount of funding; but
- One third of total UK industry funding to South East HEIs; and
- One quarter of UK total OST/RC funding



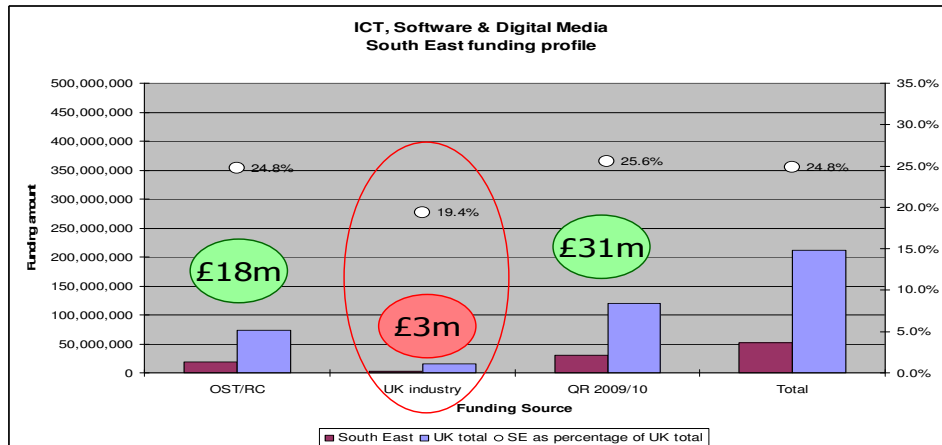
### 6.2.4 Financial and Professional Services

- High dependency on QR funding
- Very low private sector funding (UK and SE)



### 6.2.5 ICT, Software and Digital Media

- Strong public sector funding
- Low level of industry funding (absolute and relative)



- 6.2.6 Pharmaceuticals, Life Sciences & Healthcare
- Lowest relative funding profile (15.2% of UK total)
  - High absolute funding amount (£99m)
  - High relative critical mass (27.1% of UK total)
  - Low international excellence (12.9% of UK total)
- 6.3 The analysis also identified some other significant areas of strengths which are relevant to the international competitiveness of the region's businesses:
- 6.3.1 South East HEIs are particularly strong in mathematics and computing (statistics & operational research and applied mathematics) which is fundamental to many industry sectors.
- 6.3.2 Collectively there are significant strengths across the universities in languages, cultural and area studies which is a significant enabler for doing international business.
- 6.4 Finally, there are some areas which have not been fully explored in this report and might stimulate further analysis:
- 6.4.1 Private sector income streams for the universities in the aerospace & defence sector as well as the financial & professional services sector might be subject to confidentiality agreements and may therefore not have been included in the RAE submissions.
- 6.4.2 A mapping exercise of international research groups/partnerships which South East universities lead or participate in could be used to enhance this analysis by adding the dimension of understanding global networks within the priority sectors.
- 6.4.3 To identify opportunities for greater collaboration (between universities/research groups and with industry) this report would also benefit from a more detailed analysis into whether sectoral strengths are based on cumulative research excellence or on a smaller number of key industry partnerships.

## A. Annex A – RAE 2008 Units of Assessment (UOAs) by priority sector

The following grouping of UOAs against the six priority sectors has been applied to analyse the research strengths, critical mass and funding. It is recognised that other topics may also be relevant to the priority sectors; however, the table below is based on an assessment of which UOAs are most relevant to each of the six priority sectors in order to arrive at a comparative data set interpretation.

Priority sector		Units of Assessment (UOAs)
<b>(1) Advanced engineering and marine</b>	25 26 27 28 29	General Engineering and Mineral & Mining Engineering Chemical Engineering Civil Engineering Mechanical, Aeronautical and Manufacturing Engineering Metallurgy and Materials
<b>(2) Aerospace and Defence</b>	19 23 24 25 28	Physics Computer Science & Informatics Electrical & Electronic Engineering General Engineering and Mineral & Mining Engineering Mechanical, Aeronautical and Manufacturing Engineering
<b>(3) Environment and Energy</b>	16 17 30 31 32	Agriculture, Veterinary and Food Science Earth Systems and Environmental Sciences Architecture and the Built Environment Town and Country Planning Geography and Environmental Studies
<b>(4) Financial and Professional Services</b>	20 21 22 34 35 36 38	Pure Mathematics Applied Mathematics Statistics and Operational Research Economics and Econometrics Accounting and Finance Business and Management Studies Law
<b>(5) ICT, Software and Digital Media</b>	21 22 23 24 66	Applied Mathematics Statistics and Operational Research Computer Science and Informatics Electrical & Electronic Engineering Communication, Cultural and Media Studies
<b>(6) Pharmaceuticals, Life Sciences and Health</b>	1 2 3 4 5 6 7 8 9 10 13 14 15 18	Cardiovascular Medicine Cancer Studies Infection and Immunology Other Hospital Based Clinical Subjects Other Laboratory Based Clinical Subjects Epidemiology and Public Health Health Services Research Primary Care and Other Community Based Clinical Subjects Psychiatry, Neuroscience and Clinical Psychology Dentistry Pharmacy Biological Sciences Pre-clinical and Human Biological Sciences Chemistry

A full list of all UOAs and more detailed descriptions of each UOA can be accessed online (<http://www.rae.ac.uk/aboutus/uoasp>).